



BRIDGE DIVISION GUIDELINES



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Introduction

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1.1 Overview

This document provides general guidance for engineers when designing structures and preparing construction plans and specifications for Arkansas Department of Transportation (ARDOT) projects. Its objectives include providing design and detailing criteria and preferences to improve the quality, uniformity, completeness, and efficiency of all phases and products, and documenting Bridge Division practices from the initiation of a project through archival.

Guidelines presented in this document are in no way intended to override, replace, or eliminate the application of sound engineering principles and judgment in the design and detailing process.

The mission of the ARDOT Bridge Division is to:

- Provide plans and specifications for safe, efficient, cost effective, and aesthetically pleasing structures
- Evaluate existing structures for safety and function

1.2 Organization

See [Appendix A1.1](#) for Bridge Division's Organizational Chart.

References to information located on the Bridge Division's internal website within this document may be available to consultant engineers on the Department's FTP website. When available, the information can be accessed following a similar naming convention.

1.3 Governing Specifications

- Applicable edition of the AASHTO LRFD Bridge Design Specifications as determined by the design criteria established for the project. This document uses *AASHTO LRFD Bridge Design Specifications, Seventh Edition, with 2015 Interim Revisions* [9] for article reference (LRFD).
- *Arkansas State Highway and Transportation Department Standard Specifications for Highway Construction, 2014 Edition* (AHTD) [12]

1.4 Quality Control and Assurance

The quality control and assurance processes defined below are for the internal development of ARDOT projects.

1.4.1 Quality Control

The quality control (QC) process used by Bridge Division to meet mission goals and to produce a quality set of plans and specifications suitable for bidding and construction is defined as follows:

- The Design Engineer is responsible for ensuring that appropriate design specifications are used, that specification interpretation is in accordance with Departmental and Bridge Division practices, that design assumptions are appropriate for the structure or structural component, and that design calculations are accurate and complete. In addition, the Design Engineer is responsible for reviewing drafted plans to ensure they correctly depict the design intent.
- The Detailer is responsible for the quality and consistency of the plan details. The Detailer shall ensure that the plan drawings are in accordance with Bridge Division practices, contain accurate

and adequate information for structure construction, and are legible, orderly, and concise. When projects contain multiple structures, the plan details shall be consistent between structure sets.

- The design and details shall be evaluated by an engineer, designated as the “Checker”, with relative experience in the work being checked. Different engineers may act as design or detail checkers for the same structure/project. For the design of a structure, the Checker shall evaluate the layout (geometry, hydraulics, scour, clearances, notes, etc.), deck, railing, superstructure, substructure, including seismic, and any other miscellaneous designs required such as deck drainage, cast-in-place walls, etc. For the plan details, the Checker shall ensure that they accurately depict the design intent, that all information necessary for fabrication and construction is provided, that they are orderly, clear and legible, and that all details, dimensions, and quantities are accurate. Collaboration between the Checker and the Design Engineer/Detailer is used to resolve any discrepancies found during the evaluation.
- Design calculations shall be initialed by the Design Engineer and design Checker. Plan drawings shall be initialed by the Detailer, Design Engineer, and plan Checker in the title box of each drawing. All plan drawings shall also include the seal and signature of the Bridge Engineer.

1.4.2 Quality Assurance

The quality assurance (QA) process consists of a review of the completed structure plans and job specifications by the Design Section Supervisor and Bridge Administration. The Design Section Supervisor will address any revisions required prior to submittal to the Bridge Administration, and additionally any comments from the Bridge Administration prior to preparation of final plans for signature by the Bridge Engineer.

1.5 Revision History

Version	Publication Date	Summary of Changes
1	July 2, 2020	New Document

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2.1 Decks

2.1.1 Bridge Width

Clear bridge width for structures without sidewalks or shared use paths is defined as the distance from face to face of parapet railing and is typically based on the criteria in [Table 2.1](#).

Table 2.1: General Guidelines for Bridge Width

Roadway Type	Bridge Width
Interstate	Full Shoulder
Principal Arterial	Full Shoulder
Minor Arterial	Full Shoulder
Major/Minor Collector	Full Shoulder [Future ADT of 2000 or greater] Pavement + 8' [Future ADT less than 2000]
Local Highways	Pavement + 8'
City Streets	Pavement + 8' or AASHTO Standard Width, if approved
Gravel Roads	Pavement + 4'
County Roads	Pavement + 4'

Bridge width should be coordinated with the Roadway Design or State-Aid Division as applicable. Site specific constraints such as sight distance ([Subsection 2.1.4](#)), farm equipment access, or context-sensitive design may override the criteria for bridge width shown in [Table 2.1](#).

Clear and out-to-out bridge widths shall be shown on the layout. Out-to-out bridge width shall be measured from edge to edge of deck overhangs. Typically, deck overhangs shall be extended a minimum of 2 inches past the outside face of the parapet railing to aid in the rail forming, however consideration should be given to the minimum development length required for the cantilever deck reinforcing when setting this dimension. Use of architectural enhancements on the parapet railing may reduce the slab extension to a minimum of 1 inch beyond the outside railing face.

2.1.2 Sidewalks, Bike Lanes, and Shared Use Paths

In accordance with the Department's "Bicycle and Pedestrian Accommodation Policy" implemented in August 2005 and included in [Appendix A2.1](#), the following guidelines are for bridges carrying vehicular traffic in combination with sidewalks, bike lanes, or shared use paths. Full compliance with the *Americans with Disabilities Act Accessibility Guidelines* [14] is expected unless it is determined that the accommodation is "technically infeasible" or an "undue burden". Refer to [Appendix A2.2](#) for Administrative Order No. 2011-02 which defines the above exceptions and review process. For information on pedestrian bridges (no vehicular traffic), see [Subsection 9.6](#).

A 1% cross-slope shall be used for sidewalks in normal crown bridges. Sidewalk cross-slopes as well as bridge deck slopes under the sidewalk may require adjustment when bridge decks are in superelevation to provide a minimum sidewalk thickness or to minimize excess sidewalk thickness at the deck overhangs. Cross-slopes for sidewalks, bike lanes, and shared use paths shall not exceed 2%. Clear roadway width on bridges with raised sidewalks, raised median, bike lanes, or shared use paths shall be measured from face to face of curb or to barrier as appropriate.

Sidewalks, bike lanes, and shared use paths may have a profile grade that exceeds 5%, but it shall not be greater than the vertical profile of the bridge. Special circumstances including sight distance requirements, exceptionally long bridges, retaining walls along edge of sidewalks, etc. should be evaluated, and any variations from these guidelines shall be approved by the Bridge Engineer.

2.1.2.1 Sidewalks

In order to provide a consistent transition between the roadway approach section and the bridge, the following requirements shall be met:

- When the design speed of the facility is 45 mph or less, sidewalk width shall be a minimum of 6'-6" as measured from face of curb to face of parapet railing. This provides for a 6'-0" usable raised sidewalk behind the back of the 6 inch curb. Transitional approach railing shall be used at the end of bridge wingwall railing or parapet railing adjacent to retaining walls as shown in [Figure 2.1](#) to transition from sidewalks abutting traffic lanes to sidewalks separated from traffic by a berm. Refer to [Standard Dwg. No. 55013](#) for details of transitional approach railing.
- When the design speed of the facility is 50 mph or greater, the sidewalk shall be separated from highway traffic by a barrier located in compliance with LRFD.

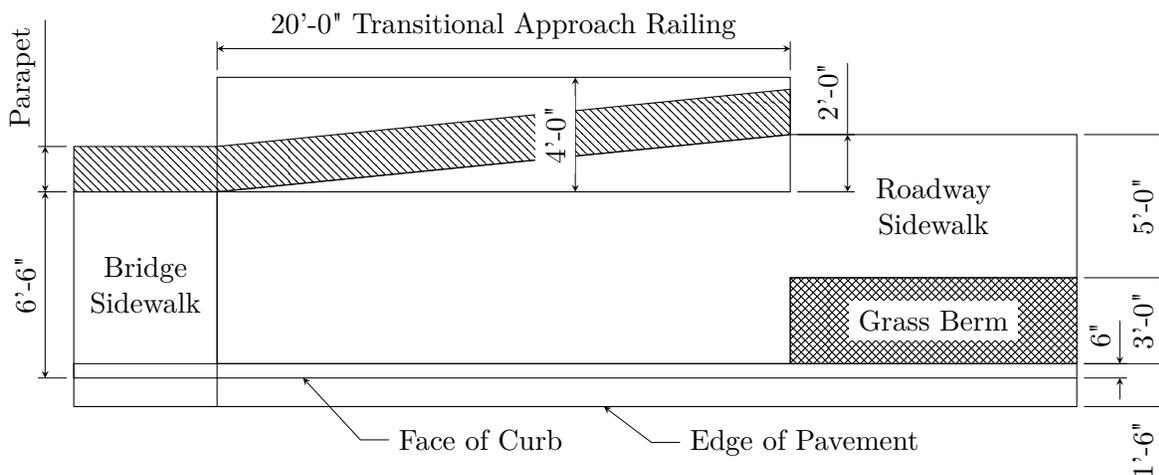


Figure 2.1: Sidewalk Approach Transition Sketch

2.1.2.2 Bike Lanes

- When bicycle accommodations are provided on routes with a curb and gutter section, the bike lane width shall be 4 feet measured from travel lane to gutter (5 feet to face of curb).
- When bicycle accommodations are to be made on routes with an open shoulder, the paved shoulder shall be used to accommodate bicycles.

2.1.2.3 Shared Use Paths

Shared use paths are joint use facilities for pedestrian and bicycle traffic that are typically separated from vehicular traffic by a barrier. Barriers between vehicular traffic and shared use paths shall be terminated in a manner that provides safety for pedestrians and bicyclists and is appropriate for resisting vehicle collision considering the design speed of the route. Unless otherwise approved by the Bridge Engineer, the minimum width of shared use paths separated by a barrier shall be 10 feet.

2.1.3 Cross-Slope and Superelevation

Bridge decks in normal crown are defined as shown in [Figure 2.2](#) and layout elevations shall be based on the working point at the centerline of the bridge deck. Rounding is not applied when a longitudinal joint is placed at the centerline for stage construction or when median barriers are used.

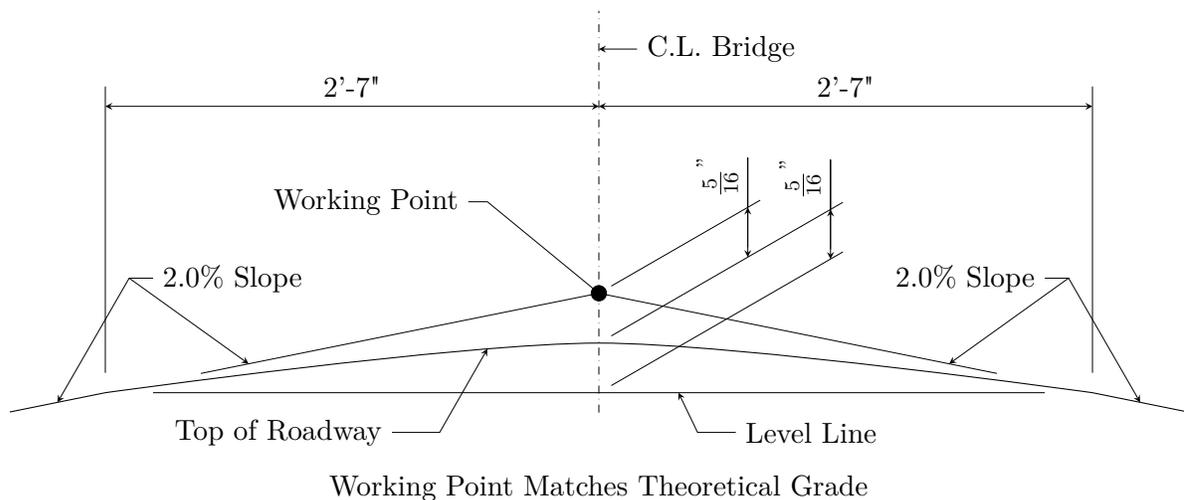


Figure 2.2: Rounding Detail For Normal Crown Decks

The need for superelevation or superelevation transition on bridges due to curvature in the alignment shall be determined by the Roadway Design or State-Aid Division. In order to simplify detailing and construction, it is preferable to avoid superelevation transitions on bridges and the appropriate Division should be contacted to determine if any adjustments can be made to simplify bridge details. If a superelevation transition cannot be avoided, the next preference is to avoid any break over in cross-slope on the bridge deck.

Superelevation may revolve around centerline or inside pavement edge. The appropriate Division will establish the rotation point location.

At the beginning and end of superelevation transitions (at end/beginning of normal crown), there is often an abrupt change in longitudinal slope. A vertical correction curve shall be provided at the deck gutterline(s) when the tangent to curve transition exceeds the maximum relative gradient for the design speed specified in the latest Department approved edition of *AASHTO's Policy on Geometric Design of Highways and Streets* (Green Book) [4].

2.1.4 Sight Distance

For bridges in curvature or with curved approaches, stopping sight distance shall be checked to ensure that the bridge geometry in conjunction with vertical obstructions such as the parapet rails, wingwalls, and sidewalks meet the minimum requirements of the Green Book. If Green Book requirements are not initially satisfied, the Roadway Design or State-Aid Division should be contacted to determine what changes could be made to the vertical or horizontal alignment that will result in compliance with the Green Book. If after coordination with the Roadway Design or State-Aid Division, and Green Book requirements cannot be met, shoulder or sidewalk widths shall be increased in 6 inch increments until minimum stopping sight distances are provided or until a maximum 12 foot shoulder or sidewalk width is obtained. A Design Exception will be required for bridges that do not meet stopping sight distances with a 12 foot shoulder or sidewalk width.

2.1.5 Bridge Railing

Generally, all bridge railing shall meet the Test Level Four (TL-4) selection criteria specified in the design specifications. See [Subsection 4.8.1](#) for exemption criteria and for additional information. Concrete parapet railing shall be one of the following types unless otherwise approved by the Bridge Engineer:

- 2'-9" tall New Jersey railing (TL-4 design)

- 3'-6" tall single slope railing (TL-4 design)

For bridges with sidewalks, Type H metal handrail is typically mounted to the top of New Jersey railing to meet the minimum pedestrian rail height specified in LRFD. When requested by local authorities for aesthetic reasons and approved by the Bridge Engineer, a 3'-6" tall decorative railing can be provided to serve as a combination rail for pedestrian and vehicular traffic.

For bridges with shared use paths, a minimum rail height of 54 inches is required. A New Jersey parapet with modified handrail is typically used to separate pedestrian/bicycle and vehicular traffic. The outer railing shall be suitable for pedestrian/bicycle loads and aesthetics should be considered when applicable.

2.2 Spans

2.2.1 Span Type

1. Steel W-Beams or Plate Girders Composite with Concrete Deck
 - (a) Wide range of span length options
 - (b) Weathering steel is preferred for hydraulic structures. Low clearance (10' or less) between low steel and ordinary high water for hydraulic structures may exclude use of weathering steel.
 - (c) The use of unpainted weathering steel on spans over highways shall be determined on a case by case basis. Coordination with local authorities on paint color may be required for painted beams/girders. Refer to [Section 10](#) for information on aesthetics.
2. Precast Prestressed Concrete Girders or Bulb-Tee Sections Composite with Concrete Deck
 - (a) Not preferred for use on grade separation structures due to difficulty repairing girders damaged by vehicle impacts. If used on overpass structures, see minimum vertical clearance requirements in [Subsection 2.2.2.2](#).
 - (b) Not preferred for use in spans with skew or curvature
 - (c) Preference should be given to the use of equal span lengths for greater economy in detailing and fabrication
 - (d) Approximate span length ranges for standard AASHTO precast prestressed girders and bulb-tees (V and VI) are shown in [Table 2.2](#).

Table 2.2: Typical Span Ranges for Prestressed Girders

Girder Type	I	II	III	IV	V	VI
Span Range, ft.	30-45	40-60	55-80	70-100	90-120	110-140

3. Reinforced Concrete Deck Girders (Simple Spans Only)
 - (a) Use 5' span increments up to a maximum 40' span length
 - (b) Span lengths shall be detailed so that the same forms can be used for both end and intermediate spans
 - (c) Not to be used in spans with curvature
4. Precast Concrete Spans (Simple Spans Only)
 - (a) May be used on county and city projects with low traffic and truck volumes (future ADT < 400 and ADTT ≤ 50)

(b) Division standards are available with the following limitations:

- 24'-6" and 28'-0" Clear Bridge Width
- 19', 25', and 31' Span Length
- 0° Skew (15° and 30° skew pending)
- Seismic Performance Zone 1

(c) May be used for Seismic Performance Zones 2, 3, and 4 with custom design of connection and foundation elements

5. Reinforced Concrete Slab Spans (Continuous Units Only)

- (a) Preliminary approval of Assistant Chief Engineer-Design is required for use
- (b) 30', 35', or 40' Span Lengths
- (c) Consider for use when necessary to eliminate or reduce a grade raise

2.2.2 Span Length

Continuous units are preferred for multi-span bridges. General criteria for selecting span and unit lengths include, but are not limited to the following:

- Type of superstructure
- Bent skew
- Range of thermal movement and joint size
- Fitting the bridge to the site topography
- Foundation type
- Bent heights (Span to exposed bent height proportion)
- Necessity for minimizing grade increase
- Avoidance of existing foundations
- Avoidance of utilities
- Bent alignment relative to companion bridges or adjacent bridges to remain in place
- Avoidance of drainage ditches/channels
- Bridge end embankment height limitations in high seismic regions
- End span vs. intermediate span proportion (For economy of design and uplift considerations)
- Seismic response of structure proportions
- Provision for trails and public use areas (boat launch/parking, etc.)

Criteria for setting span lengths are also dependent on the crossing type the structure is spanning. Additional considerations and requirements related to hydraulic, grade separation, and railroad crossings are as follows:

2.2.2.1 Hydraulic Structures

Span length selection criteria include:

- Fitting the bridge to the channel location within the floodplain
- Bridge length required to meet Department hydraulic guidelines
- Bridge length required to meet floodplain criteria
- Scour (location of bents in channel and length of bridge)
- Drift potential
- Environmental constraints for bents located within channel
- Minimum clearance requirements for navigable waterways

The Department's Hydraulic Section in the Roadway Design Division develops hydraulic models for the unconstricted (natural) and constricted (with existing bridge) channel and determines the site floodplain restrictions. Bridge Division models the new bridge and requests hydraulic certification in accordance with [Subsection 3.6](#). For Division hydraulic guidelines and for the hydraulic table and details to be shown on the bridge layout, refer to [Section 3](#).

Bridge Division will determine the bridge deck elevation required to meet hydraulic requirements. The Roadway Design or State-Aid Division will determine the bridge deck elevation required to fit the site topography and meet Green Book requirements. Typically the final bridge deck elevation shall be the higher of these determinations.

Proposed bridge lengths shall typically be equal to or greater than the existing bridge. The proposed low chord elevation shall not be lower than the low chord elevation of the existing bridge without approval of the Bridge Engineer. Adjacent existing bridges to remain in place or future bridges to be constructed shall be considered when selecting span arrangements and assessing hydraulic impacts.

Additional coordination is required with the United States Coast Guard (USCG) for bridges over navigable waterways and with levee boards or districts for any proposed construction within or adjacent to an existing levee. Refer to [Subsection 2.6](#) for additional information. Additional coordination may be required with the US Army Corps of Engineers (USACE) or other agencies as necessary.

2.2.2.2 Grade Separation Structures

Bent columns or walls without pier protection devices or guardrail shall be located in conformance with the clear-zone concept identified in Chapter 3, of the latest edition of the *AASHTO Roadside Design Guide* [5]. The Roadway Design or State-Aid Division will provide the required clear-zone distances for the facility. The horizontal clear zone is measured from the edge of travel lane.

For curbed sections, the minimum distance from the face of curb to the face of columns or walls shall be 10 feet unless otherwise approved by the Bridge Engineer. A distance of 14 feet is preferred.

The following policy shall be used to determine the vertical clearance:

1. Vertical clearance on interstate and arterial highways shall be at least 16 feet over the entire roadway width plus an allowance for future overlays of not less than 6 inches.
2. Vertical clearance on collector and local highways shall be at least 15 feet over the entire roadway width plus an allowance for future overlays of not less than 6 inches except:
 - If future overlays are not practical due to site restrictions, the allowance for future overlays may be omitted.

- In some cases, vertical clearance between 14 and 15 feet, when provided on a local highway at an existing bridge, may be satisfactory.
 - At existing bridge sites where there is a history of collision damage due to vertical clearance being less than 16 feet, the vertical clearance shall be at least 16 feet.
 - If the roadway is part of an interchange, then vertical clearance shall be 16 feet over the entire roadway width plus an allowance for future overlays of not less than 6 inches.
3. Vertical clearance for concrete girders shall be increased 1 foot over the above requirements. Protective plates shall also be installed on the portions of concrete girders spanning the roadway.
 4. Vertical clearance for overhead sign supports and pedestrian overpasses shall be increased 1 foot over the above requirements in accordance with LRFD Article 2.3.3.2.

For the purpose of determining vertical clearance, the extent of the roadway width shall include shoulders for open shoulder routes and shall be curb-to-curb for curb and gutter routes.

Bridge Division shall coordinate with the Roadway Design or State-Aid Division on establishing a vertical profile for grade separation structures that will provide the minimum vertical clearance for the anticipated superstructure depth and will meet geometric and drainage requirements. Open drains in parapet rails or decks will not be allowed over roadways.

2.2.2.3 Railroad Structures

Major railroad companies typically have their own grade separation guidelines that need to be met and these guidelines are available on [ARDOT's network](#). Short-line railroad companies may need to be contacted individually to determine their grade separation requirements and ownership or approving authority. The Railroad Coordinator in the Transportation Planning & Policy Division will assist in providing this information and in coordinating with the railroad companies.

In addition to the development of a bridge layout, an "Exhibit A" is typically required for the final plans and railroad coordination. For the Union Pacific Railroad (UPRR), an example "Exhibit A" is shown in [Appendix A2.3](#). The Department is currently developing a UPRR Project Development Manual to aid in the coordination and plan review/approval process. For other railroad companies, the plan details required may vary and their individual guidelines shall be considered.

If no components of the overpass are encroaching on railroad right of way, prepare and submit Exhibit A to the railroad company. If the preferred alternative does encroach on the railroad right of way, prepare preliminary schematic alternatives with cost estimates and submit to the railroad for preliminary approval. One of the alternatives should include completely spanning railroad right of way. This is to reduce time and effort in preparing a bridge layout and detailed Exhibit A which may not meet railroad requirements. UPRR prefers electronic submissions and an example email submission is included in [Appendix A2.4](#). All emails to UPRR shall include the following information in the "Subject" line:

Project Type, %Plans, City, State, Street, RR Milepost, Subdivision, DOT#, Lat/Long

The Department's minimum vertical clearance above top of rail is 23'-6". For UPRR & BNSF, this minimum vertical clearance shall be maintained for 29'-0" from centerline existing track(s) when future tracks are feasible/warranted as shown in [Figure 2.3](#) to provide adequate clearance for potential future tracks. Other railroad companies may have different requirements and their individual guidelines shall be considered.

2.2.3 Bent Skew

Skew angle is measured from a line perpendicular to the longitudinal centerline of the bridge or, when the bridge is in a horizontal curve, from a radial line. Bent skew is typically defined at C.L. Bent for

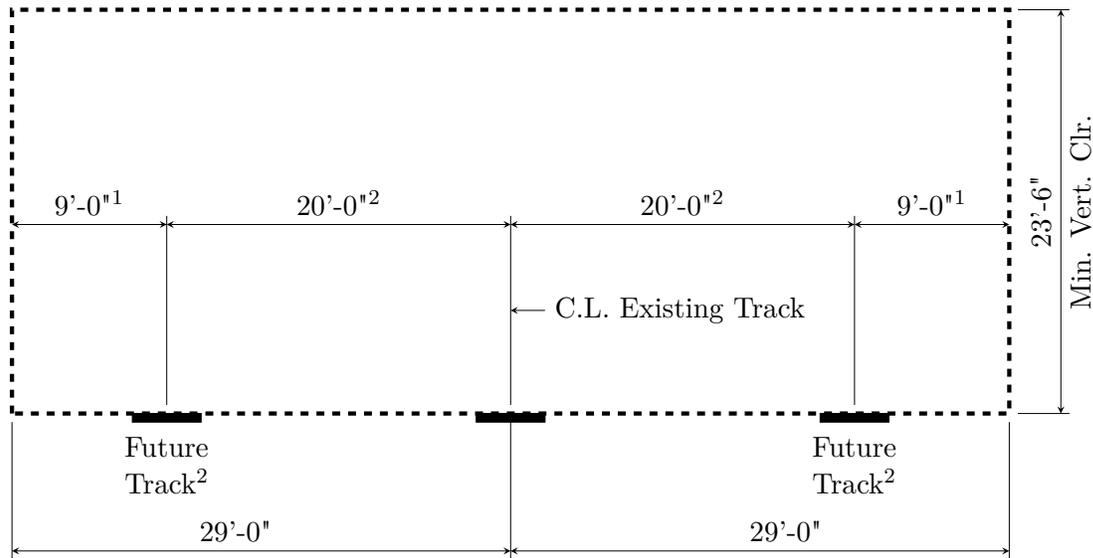


Figure 2.3: Minimum Permanent UPRR & BNSF Vertical Track Clearance

intermediate bents and at C.L. Joint for end bents. Skew angles for hydraulic structures should be no less than 15° , and shall be rounded to a 5° increment. Skew angles for grade separation and railroad structures should match the intersection angle rounded to the nearest 30 minutes. A more refined skew angle may be necessary when warranted by the width of the structure, geometry, site conditions, or to align bents with adjacent existing structures.

2.2.4 Joints

Thermal movement ranges at joints are affected by the continuous unit or simple span length(s), superstructure element material, and bent fixity and stiffness. These movement ranges need to be accommodated by the proper selection of joint type and size.

Bridge joints shall be designed in accordance with the LRFD. The number of joints should be minimized when possible. For Units with lengths ≤ 250 feet and skew angles $\leq 25^\circ$, the use of integral bents may be considered. Common joint types include the following and the simplest, most economical type should generally be chosen for the thermal movement range required. Refer to [Subsection 4.4.5](#) for additional information on joints.

With the exception of finger joints, joint width shall be measured perpendicular from face to face of joint armor at 60°F .

1. Poured Silicone Joint

- Use Manufacturer's recommendations for longitudinal and racking movement ranges
- Use $1/2$ inch increments for joint width and a maximum width of $2\frac{1}{2}$ inches at 60°F measured perpendicular to joint
- May be advantageous for use on curved, skewed bridges to accommodate the potential for non-uniform joint width
- Often used to retrofit existing joints, if joint width is acceptable
- Not recommended for unpaved approaches

¹See Section 5.2.1.a of the UPRR-BNSF Railway Guidelines for curved track adjustments

²When future track is feasible/warranted

2. Armored Joint with Neoprene Strip Seal

- Use Manufacturer's recommendations for longitudinal and racking movement ranges
- Wingwall lengths greater than the minimum 10 foot transition length are required to maintain the same parapet face shape across the joint allowing for unrestrained movement of the parapet slider plates

3. Preformed Silicone Joint

- Use Manufacturer's recommendations for movement range
- Relatively new type of joint to be used sparingly until performance can be evaluated
- A special provision is required when specifying this joint type

4. Preformed Compression Joint Seal

- Typically not used on new bridges, but may be used to replace joints on existing bridges to be rehabilitated or widened
- A size selection chart is included in [Appendix A2.5](#)

5. Finger Joint

- Use when larger movement ranges required
- Use only on joints without skew unless otherwise approved by the Bridge Engineer

6. Inverted Tee Cap with Poured Silicone Joint or Strip Seal

- Use when larger movement ranges required
- Approval of the Bridge Engineer is required

Joints are prone to failures and long term maintenance issues. In order to mitigate beam corrosion when using ASTM A709, Gr. 50W steel, all structural steel, except galvanized members, surfaces in contact with concrete, and the expansion device, shall be painted within the following limits in accordance with AHTD Subsection 807.75:

- For W-beams, paint shall be applied to structural steel within 5' of the bridge joint.
- For plate girders, paint shall be applied to structural steel within $2 * D$ (web depth) of the bridge joint up to 10' maximum.

The color of paint shall be Brown equal or close to Federal Std. 595B, Color Chip No. 30070 and as approved by the Engineer.

2.3 Substructure Considerations

Common substructure types include multi-columns on spread or pile footings, hammerhead columns on spread or pile footings, columns on drilled shafts, pier walls on spread or pile footings, and pile bents. Common pile types include prestressed concrete, concrete filled steel shell, and steel HP shapes.

The choice of substructure type depends on a variety of factors including, but not limited to:

- Type, quality, uniformity, and depth of soil or rock
- Span lengths and bent heights
- Element proportions/Slenderness requirements

- Constructability issues such as proximity to railroads, utilities and structures, dewatering of excavations (cofferdams), and site access
- Aesthetics
- Seismic Performance Zone

2.3.1 Subsurface Investigations

Generally, a subsurface soil investigation shall be requested from the Materials Division as soon as a preliminary layout has been developed and the bent locations have been determined. Example requests to the Materials Division are shown in the appendix as follows:

- Appendix A2.6: Subsurface Investigation: Rock
- Appendix A2.7: Subsurface Investigation: Questionable Rock Depth and Tall Embankments
- Appendix A2.8: Subsurface Investigation: Seismic Performance Zone 2
- Appendix A2.9: Subsurface Investigation: Seismic Performance Zone 3 or 4
- Appendix A2.10: Subsurface Investigation: Shafts

For atypical site conditions, and to confirm seismic zone and limiting embankment heights and slopes, early coordination with the Materials Division may be beneficial. Partial, preliminary borings may be requested to determine foundation conditions that could significantly affect the choices made when developing the layout.

A minimum of one boring is typically requested at each bent. The ultimate locations will be determined by the Materials Division based on equipment access and site conditions. Additional borings per bent may be required for drilled shafts (typically request a boring at each shaft location), wide bridges, highly variable terrain, or in areas of suspected karstic conditions. Borings shall also be requested at suitable intervals along proposed retaining walls.

For bridge end embankments in excessive fills (approximately 30' or greater) and for those in Seismic Performance Zones 2 thru 4, an embankment analysis shall also be requested from the Materials Division. They will determine if any undercut or embankment stability measures are required which may affect the bridge layout. Embankment height is determined by taking the difference in elevations between the top of the deck at the bridge end and the natural ground at the toe of fill slope.

For large, significant, and costly structures, especially in high seismic zones, consideration should be given to requesting advanced soil sampling and testing methods such as cone penetration testing (CPT) and shear wave velocity to more accurately characterize the soil and its liquefaction potential.

2.3.2 Seismic Considerations

Potential seismic constraints should be considered when developing the bridge layout. Refer to [Section 7](#) for additional information. Seismic considerations include, but are not limited to:

- Embankment height and slope limitations
- Undercut and embankment stability
- Liquefaction potential
- Type of superstructure
- Joint Fixity
- Type and shape of substructure elements (e.g. round columns with spiral reinforcing)
- Use of approach slabs

2.4 Miscellaneous Considerations

2.4.1 Stage Construction

Stage construction of a bridge may be required as determined by the Roadway Design or State-Aid Division when establishing the horizontal alignment. Coordination between Divisions is required to ensure that the location of the longitudinal construction joint is acceptable. Items to consider during development of the stage construction details include, but are not limited to:

- The preferred location for a longitudinal construction joint is at a lane line or the center of a painted median or continuous left turn lane. If this is impractical, place joint as near as possible to the center of the lane. Longitudinal joints placed in wheel paths should be avoided.
- Location of longitudinal joint relative to beam line and substructure elements
- Need for partial removal of existing bridge elements
- Anticipated development lengths of reinforcing or need for mechanical splices
- Potential conflict between subsequent stage pile driving and previous stage reinforcing
- Minimizing need for anchoring temporary barriers to new bridge decks
- Constructability and need for shoring
- Need for closure pours due to large dead load deflections

The location of longitudinal construction joints and stage construction widths shall be shown on the bridge layout and a stage construction drawing or detail included in the plans. Naming or numbering of stages shall be coordinated with the Roadway Design or State-Aid Division and their maintenance of traffic details.

When using temporary precast barriers for maintenance of traffic on bridge decks, the following criteria shall apply for doweling barriers to the bridge deck:

- Connect barrier to deck when the clear distance from barrier to stage construction joint (or cut line) is less than 4 feet.
- Connect barrier located on the outside of a horizontal curve to bridge deck when the clear distance from barrier to stage construction joint (or cut line) is less than 6 feet.
- Consider connecting barrier to bridge deck for site conditions (high drop-off, high ADT, etc.) where rollover or penetration beyond the railing could result in severe consequences.

When connecting temporary barrier to the bridge deck is required, threaded inserts shall be cast into the bridge deck as shown on [Standard Drawing TC-4](#). The stage construction details shall indicate that the barrier is to be connected to the deck and that threaded inserts are required. When the temporary barrier is not to be connected to the deck, this shall also be noted on the stage construction details.

2.4.2 Temporary Bridges

Refer to [Subsection 9.4](#) for information and guidelines on determining temporary (detour) bridge length, width, deck elevation, and element types and notes.

When temporary bridges are required, show at a minimum the following in the “Plan View” of the layout:

- Centerline of temporary (detour) bridge
- Box outline of bridge (length x width)

- Toe of fill slope for 1V:1.5H slope

When special (non-standard) design and details are required for temporary bridges, a separate temporary bridge layout may need to be developed.

2.4.3 Shoring

Shoring or bracing for routine construction activities such as excavation and form work is typically included in the basis of payment for the various pay items in the AHTD. When the need for shoring in the form of sheet piling or other bracing system is anticipated to retain existing or proposed embankments, to maintain traffic, to protect workers, or for constructability, a job special provision for “Shoring” shall be included and the general location and intent of the shoring shown on the layout.

The “Shoring” special provision used will depend on the estimated likelihood and significance of the shoring required. If the anticipated need for shoring is extensive, the special provision with “Shoring” as a pay item shall be used. Otherwise, the special provision with "Shoring" being subsidiary to the other items in the contract shall be used.

2.4.4 Channel Relocation/Excavation

Channel relocation may be considered for purposes such as smoothing the channel approach through the bridge, correcting for longitudinal encroachments, and accommodating bent placement over skewed channels, especially for wide or twin structures. A significant advantage should be anticipated before channel relocation is used due to the environmental processes and mitigation which may be required and the tendency of channels to revert back to their original alignment. The Environmental Division should be contacted in advance to determine the potential environmental impact of any channel relocation.

Channel excavation may be warranted to remove existing approach embankments that restrict the channel or floodplain opening of the new bridge. Channel excavation to improve hydraulics and possibly reduce bridge length (excavating a pond just under the bridge) is discouraged for the same reason as channel relocation.

Whenever channel relocation or excavation is proposed, the limits of the work shall be defined on the layout plan and elevation or with a separate detail or drawing.

2.4.5 Riprap

Bridge end slopes are typically protected by Dumped Riprap ([Standard Drawing No. 55001](#)) or Concrete Riprap ([Standard Drawing No. 55002](#)). Typically, Dumped Riprap with Filter Blanket is used for hydraulic structures and Concrete Riprap is used for grade separation structures. Occasionally due to embankment heights or seismic considerations, Concrete Riprap or Rock Fill may be used at hydraulic structures.

When channel velocities are high and/or scour potential is significant, Dumped Riprap may need to be sized or Foundation Protection Riprap used. Refer to [Subsection 3.8](#) for additional information. If aesthetics is a concern, special requirements for type or color of stone may be specified.

Grouted Dumped Riprap, unlike loose riprap, acts as a rigid structure and will not conform to bank settlement or toe undermining making it susceptible to mass failure. It is seldom used, but may be considered when particle erosion is a concern, or when it is the most practical choice as a scour countermeasure. Special provisions may be required for its effective use.

2.4.6 Approach Slabs & Gutters

Approach gutters shall be used on all bridges without sidewalks or shared use paths. Approach slabs shall be used for all interstate and arterial bridges, including ramps, for bridges in Seismic Performance Zones 2, 3, and 4, and for bridges with integral end bents ([Subsection 6.3](#)). Approach slabs shall be used for bridges with high truck volumes. For this determination, high truck volumes shall be defined as ADTT > 50. When approach slabs are used with sidewalks, approach slab details may include construction of the curb as part of the slab. The ends (opposite to bridge end) of all approach gutters and approach slabs shall be square to allow for better compaction of the approach pavement, but they need not align with each other. When approach slabs are used, the effects of live load surcharge may be neglected in the design of the end bent backwalls.

Standard drawings and their limitations for use are shown in [Tables 2.3](#) and [2.4](#). Special details may be required for approach gutters and slabs when shoulder widths, roadway widths, wingwall lengths, stage construction, skews, etc. cannot be accommodated by the standard details.

2.4.7 Bridge End Terminals

Bridge End Terminals may be required at bridge ends where there is inadequate length for guardrail between the bridge rail and a driveway or cross-street. Coordinate with the Roadway Design or State-Aid Division to determine if bridge end terminals are required, and if so, provide the following details on the layout:

- In the plan view, show a rectangular box at the end of the wingwall rail and label “Bridge End Terminal (See Rdwy. Plans)”.
- Modify the note identifying the approach gutters used to include “Eliminate or modify Type ___ Approach Gutter curb section to fit bridge end terminal. No additional payment will be made for this work.”

2.4.8 Temporary Construction and Easements

Channel work, temporary detour bridges, or contractor work roads may require temporary construction easements when they extend outside the limits of the existing or proposed right of way. Stations and offsets defining the temporary easement shall be coordinated with the Roadway Design or State-Aid Division so they can advise the Right of Way Division of all right of way needs. When temporary construction easements are required, include the following note on the bridge layout:

For R/W data and Temporary Construction Easements, see Rdwy. Plans.

2.4.9 Historic Bridges

Existing bridges determined to have historical significance will be evaluated by the Department’s Historic Bridge Action Committee (HBAC). Viable alternatives for the preservation of the historic bridge through retention, rehabilitation or relocation will be evaluated. The plan of action chosen for the historic bridge needs to be decided early in the design process as its disposition may affect the layout development of proposed structures regarding alignments, bent placement, and hydraulic modeling.

A special provision shall be included in the contract specifications for historic bridges that are marketed to the public and accepted for relocation and/or reuse by another agency or party. The Environmental Division will need assistance developing this special provision to address the construction requirements, transportation and handling of the historic bridge salvage. Pay items and requirements regarding the historic bridge salvage/removal shall be included in the contract documents, as applicable.

Table 2.3: Standard Approach Gutters

Type	Std Dwg. No.	Use with Slab Type	Limitations for Use
A	55030A	A	Use on Collectors with ADTT \leq 50 and Local, County, & City Roads 10' thru 13' Wingwall Lengths
B	55030B	B	Use on Collectors with ADTT \leq 50 and Local, County, & City Roads > 13' thru 16' Wingwall Lengths
C	55030C	C1 or C2	Use on Interstates, Arterials, & Collectors with ADTT > 50 10' thru 21' Wingwall Lengths
D	55030D	D	Use with Precast Concrete Spans
E	55030E	E	Use with R.C. Slab Spans
PT	55035	Std. Dwg. 55045	For Existing Bridge Retrofits with New Jersey Parapet Rails only
AT	55036	Std. Dwg. 55045	For Existing Bridge Retrofits with 6" Curbs & Type A Railing

Table 2.4: Standard Approach Slabs

Type	Std Dwg. No.	Use with Gutter Type	Limitations for Use
A	55040A	A	Use on Collectors with ADTT \leq 50 and Local, County, & City Roads Seismic Performance Zones 2, 3, & 4 Limited Skew Angles for Slab Widths
B	55040B	B	Use on Collectors with ADTT \leq 50 and Local, County, & City Roads Seismic Performance Zones 2, 3, & 4 Limited Skew Angles for Slab Widths
C1	55040C1	C	Use on Interstates, Arterials, & Collectors with ADTT > 50 Seismic Performance Zone 1
C2	55040C2	C	Use on Interstates, Arterials, & Collectors with ADTT > 50 Seismic Performance Zones 2, 3, & 4
D	55040D	D	Use with Precast Spans Seismic Performance Zones 2, 3, & 4
E	55040E	E	Use with R.C. Slab Spans Seismic Performance Zones 2, 3, & 4
	55045	PT or AT	For Existing Bridge Retrofits

2.4.10 Retaining Walls

When retaining walls are required adjacent to bridges, mechanically stabilized earth (MSE) walls or cast in place (CIP) walls are generally used. CIP walls tend to be used when excavation for the reinforcement required behind MSE walls is not practical or economical. The intent and location of retaining walls should be shown on the bridge layout, but separate retaining wall layouts and details are also required. An example is shown in [Appendix A2.11](#). Refer to [Subsection 9.3](#) for additional information.

For MSE walls, it is preferred that the entire parapet railing be positioned behind the back face of the wall and designed using a moment slab so that the retaining wall is not subject to vehicular impact. However, the parapet railing may be positioned on top of the coping and designed using a moment slab for a TL-4 or less design criteria. The bridge end behind an MSE wall shall be supported by a pile cap and not on a spread footing, unless approved by the Bridge Engineer.

If aesthetics are a concern for the bridge site and retaining walls are used, they may require special surface finishes. Refer to [Section 10](#).

2.4.11 Accelerated Bridge Construction

Accelerated Bridge Construction (ABC) has been promoted by the Federal Highway Administration as part of its Every Day Counts 2012 initiative. The Department has developed procedures for determining when the use of ABC may be appropriate over conventional construction as shown in [Appendix A2.12](#). The potential use of ABC should be considered during the layout development phase.

2.4.12 Aesthetics

State of Arkansas form inserts shall be used on all grade separation structures over interstate highways and may also be required on retaining walls and other roadways as determined by the Bridge Engineer. Inserts shall typically be placed on all four corners of the bridge end wingwalls.

Other aesthetic treatments may be considered for use on bridges and retaining walls on high profile projects and when requested by local authorities, if approved by Department Administration and funding can be secured. Refer to [Section 10](#) for additional information.

2.4.13 Lighting

Bridge surface lighting may be required to provide illumination for pedestrians or for historic or aesthetic requirements. See [Subsection 10.4](#) for additional information and considerations. Under bridge lighting is required for railroad overpass structures with out to out bridge widths of 80 feet or greater. Under bridge lighting may also be required when there is frequent nighttime pedestrian traffic or where unusual or critical roadway geometry occurs adjacent to or underneath the bridge.

For additional information on navigational lighting, see [Subsection 2.6.1](#).

2.5 Environmental Coordination

2.5.1 Bridge Information

The Environmental Division requires bridge information in order to comply with all environmental regulations and to obtain permits for the project. The information to be submitted to the Environmental Division is shown on the sample form in [Appendix A2.13](#). For atypical details, this form can be edited to provide a more precise description of the proposed work.

Environmental forms are required for both hydraulic and grade separation structures, although generally only one “Final” submission is adequate for grade separation structures. No information needs to be

submitted for box culverts; however the Environmental Division may request information on the existing bridge structure to be removed, if applicable.

As soon as the layout concept has been developed, a “Preliminary” Bridge Information form shall be submitted to the Environmental Division. This will provide the scope of work and allow them to initiate environmental coordination and processing. After the layout has been approved, the substructure designed, and the conceptual work plan developed (hydraulic bridges only), applicable quantities should be determined and a “Final” Bridge Information form and “Conceptual Work Plan for Temporary Fill” sketch submitted to the Environmental Division. If any revisions occur later in plan development that would alter previously submitted “Final” information, the Environmental Division should be notified.

2.5.2 Conceptual Work Plans

Contractor work roads are typically necessary to provide access in the floodplain or across the channel for construction activities. A work road may be required to remove an existing bridge and/or construct a new bridge. Any temporary fill, excavation, or permanent materials placed below and within the ordinary high water (OHW) contours requires a USACE Section 404 Permit. The OHW elevation can be defined as the normal water surface elevation of a body of water without the influence of major flood events and extended periods of drought.

The Environmental Division will determine the OHW when requested by the Bridge Division (email is sufficient). A copy of the preliminary bridge layout or site topography (contours) should be attached to the request to aid in this determination.

A Conceptual Work Plan (CWP) sketch shall be developed by the Bridge Division to permit temporary fill quantities for all anticipated work roads. The CWP sketch with applicable quantities shall be submitted to the Environmental Division as indicated in [Subsection 2.5.1](#). In addition, the CWP sketch shall also be included in the Special Provision “Construction in Special Flood Hazard Areas” for all bridges located within permit types I, III, or V due to the presence of insurable buildings. An example CWP is shown in [Appendix A2.14](#). Permit types and requirements for hydraulic evaluation and detailing of work roads are described in [Section 3](#).

2.6 Navigable Waterways and Levees

2.6.1 Section 9 USCG Navigable Waterways

Construction of a new bridge, or reconstruction, modification, or removal of an existing bridge across navigable waters of the United States requires a Section 9 United States Coast Guard (USCG) Bridge Permit. This includes any temporary bridges used for construction access or detours. Bridge layout development over navigable waterways shall be coordinated with the USCG and a Bridge Permit obtained. A list of navigable waterways and additional guidance on the USCG approval process is provided in [Appendix A2.15](#). If it is uncertain whether the bridge is spanning a navigable portion of the waterway, the Environmental Division may be contacted to provide assistance and/or the USCG contacted by letter from the Bridge Engineer to obtain written confirmation.

Minimum horizontal (pier placement) and vertical clearances are determined by the USCG and will require preliminary coordination. Vertical clearances are typically set from a two-percent flow line. The two-percent flow line is defined by the USCG as “The statistical water surface elevation not expected to be exceeded more than two percent of the time at a particular location.”

Applications for a Bridge Permit should be submitted in accordance with the USCG’s *Application for Coast Guard Bridge Permits* using letter size paper. At a minimum, the following items shall be included in the request:

1. Application letter which typically includes: description of project and location, legal authority and funding for the project, environmental, business, residential, and navigational impacts, temporary and permanent fill quantities, and estimated cost.
2. Vicinity Map with Engineer's Seal
3. Proposed Bridge Plans with Engineer's Seal
4. Authorization from the Department for permit application
5. Environmental Findings (Tier 3 Categorical Exclusion or Environmental Assessment, for example)
6. USACE Section 404 Permit
7. Water Quality Certification issued by the Arkansas Department of Environmental Quality (ADEQ) when the work is within a waterway classified as "Extraordinary Resource, Ecologically Sensitive, or Natural and Scenic". When the work is not within these waterway types, a copy of the general permit (letter) between the ADEQ and the appropriate District Corp of Engineers should be furnished by Environmental for submittal to the USCG.
8. List of Adjacent Property Owners with Right of Way Plans

Additional items may be required by the USCG depending on the significance of the waterway and the scope of the project. The Environmental Division will provide Bridge Division the environmental documents, USACE Section 404 permit, and water quality certification. The Right of Way Division will provide Bridge Division the list of affected property owners and utilities.

Additional coordination with the USCG will be required to determine the need for navigational lighting and/or clearance gauges. The Bridge Division shall coordinate with the Maintenance Division in the development of the lighting details. Bridge Division shall provide the structural design and details and the Maintenance Division shall provide the electrical design, details, and special provision. The Bridge Division typically develops the details and specifications required for the clearance gauges.

2.6.2 Section 10 USACE Navigable Waterways

The USACE has jurisdiction over Section 10 navigable waters in Arkansas which includes any construction or demolition over, under, or in the waterway. A list of Section 10 waterways is provided in [Appendix A2.16](#). Typically, a special provision is required for stream traffic safety which is developed by the Environmental Division. Restrictions in the placement of Contractor work roads can also be affected by USACE requirements.

In addition to the above, some waterways in Arkansas are not Section 10 navigable waterways, but have recreational users that may require a similar special provision and Contractor work road restrictions. The Environmental Division should be consulted when recreational use is anticipated.

2.6.3 Levees

Any proposed construction within or adjacent to an existing levee (including at toe of slope) shall be coordinated with the levee owner and approval obtained. Levees may be owned by levee districts, boards, counties, or other authorities and are often maintained in conformance with the USACE levee constraints and requirements. Determining the levee owner or approving authority is often not obvious and may require investigation.

Application for approval shall be made directly to the levee owner and typically includes the following:

- Cover letter describing proposed work and impacts
- Proposed bridge layout with soil boring information

- Any additional documentation requested by the USACE (if part of the approval process) such as USACE 408 Permit Request Information form
- Material specifications for any proposed fill within the levee
- Details and limits of any proposed excavation or fill within the levee
- Any additional documentation requested by the levee owner

If the USACE is part of the review process, they have indicated they prefer an electronic submittal. The email submittal shall be sent directly to the levee owner for their forwarding to the appropriate USACE contact. A letter of approval must be obtained from the levee owner.

2.7 Layout Details

Details to be included on the bridge layout are described on the Layout Checklist in [Appendix A2.17](#). The list is not comprehensive, but includes most items that may be required on the bridge layout or supporting drawings. The Staff Engineer shall initial, date, and sign the checklist and include it as part of the preliminary layout submittal to the Bridge Division Administration. This list shall be stored in the job file and included with the final plans and specifications submitted for final review.

The title of the layout drawing shall be written in terms of the "Route" over the "CROSSING FEATURE". For example, the layout title for a bridge on Highway 278 over the Union Pacific Railroad would be as follows:

LAYOUT OF BRIDGE
HIGHWAY 278 OVER UNION PACIFIC RAILROAD
JOB TITLE
COUNTY

2.8 General Notes

General Notes for bridge layouts are used to give the broad, overall information needed to construct the bridge. Example notes are included in [Appendix A2.18](#). These notes are not intended to be comprehensive, but include variations of commonly used notes for layouts. Select the appropriate notes, modify as needed, and include them on the layout drawing in the order indicated. Provide additional notes as needed for unique items.

2.9 Layout Approval and Distribution

Layout approval is required from the Assistant Chief Engineer-Design (ACE-D) for all projects and from the Federal Highway Administration for all Federal Oversight (F) projects. When the layout(s) is sent to the ACE-D for review and approval, the layout(s) shall be distributed for information to the following Divisions/Sections, as applicable, via email:

- Roadway Design
- Hydraulics Section (Hydraulic structures only)
- State-Aid
- Environmental
- Right of Way
- Materials (When needed, i.e., embankment height issues)

- Heavy Bridge (When they may be interested in salvage items)
- Association of Arkansas Counties (In compliance with our Salvaged Steel Program)

Layouts shall also be sent for review and comments to the District Engineer and to the County Judge, Mayor, or approving authority for non-state owned bridges. Refer to [Appendix A2.19](#) for example memorandums and letters requesting layout review and/or approval.

Section 3

Bridge Hydraulics

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3.1 General

Hydraulic design of bridge structures over Arkansas waterways is necessary to determine the geometric requirements of the structure so that serviceability to the travelling public, protection of the structure, and meeting backwater criteria during flood events is ensured.

3.2 Hydraulic Design Criteria

3.2.1 Flood Events

Flood events are characterized as increases in channel flow due to storm events and the effects of their runoff on any given body of water. The following flood events shall be considered when determining bridge lengths and elevations:

3.2.1.1 Design Flood

The design flood for bridges on interstates and state highways, excluding major and minor collectors, is the Q_{50} event, also known as a 2% flood (2% chance of occurring in any given year). The design flood for bridges on major and minor collectors is the Q_{25} event, also known as a 4% flood (4% chance of occurring in any given year). Unless site conditions warrant otherwise, the design flood for bridges on county roads and city streets is the Q_{25} event. The design flood shall not overtop the roadway surface.

On certain projects it may not be feasible to set a deck/roadway elevation or size a bridge for the above minimum design floods. For these situations, the two alternates shown below are viable, with Alternate 1 preferred. Examples of site conditions which may require design exceptions include the following:

- Environmentally context-sensitive areas
- Limitations on raising the grade due to:
 - Adjacent development
 - Wide floodplains where raising the grade for the entire floodplain would exceed the bridge and approach project limits
 - County and City bridge and approach projects where the as-built approach embankment is not raised to meet a Q_{25} flood event
 - Adjacent railroad structures

Alternate 1:

Size the bridge with a future embankment elevation that meets the design flood requirements.

Size the bridge to meet the backwater criteria with a theoretical (future) embankment elevation that does not permit overtopping at the design flood. If the State or local agency raises the approach grade in the future, this will provide a structure that will meet the design flood requirements. Coordination with the Bridge Engineer is required prior to using this alternate on State highway bridges. Use [Table 3.2](#) for reporting the hydraulic data for both the as-built and future embankment conditions on the layout.

Alternate 2:

Size the bridge for a design exception.

For bridges owned by the City or County, use of this alternate requires prior approval by the Bridge Engineer. Written acceptance of the design exception is also required from the affected local agency when applicable. For State-owned bridges, use of this alternate requires prior approval of a design exception by the Assistant Chief Engineer-Design.

The design flood event will be based on the overtopping event for the site limitations leading to the design exception. Accordingly, the bridge length shall be set for this design flood event and the low chord of the bridge set to meet the vertical clearance requirements of [Subsection 3.2.2](#) with the effects of backwater. Use [Table 3.1](#) to report the hydraulic data and include the following note on the layout:

If the approach grade is raised above the design stage elevation, additional waterway opening will be required.

3.2.1.2 Base Flood

The base flood is the Q_{100} event, also known as a 1 % flood (1 % chance of occurring in any given year).

3.2.1.3 Extreme Flood

The extreme flood is the Q_{500} event, also known as a 0.2 % flood (0.2 % chance of occurring in any given year). Due to the rare occurrence of this flood, it is designated as an extreme event. The extreme flood is allowed to encroach on the bridge superstructure and is typically not a factor in determining vertical clearance, but should be considered when design forces due to this flood are excessive.

3.2.1.4 Overtopping Flood

The overtopping flood event shall be determined and reported if it is below a Q_{500} flood. No further investigation is required if the overtopping flood is above a Q_{500} flood.

3.2.2 Stream Vertical Clearances

Generally, a minimum vertical clearance of 1 foot shall be provided between the low bridge chord and the design flood water surface elevation with backwater at the immediate upstream toe of slope. If other bodies of water, such as large rivers, influence the water surface elevation at a bridge site, the design flood water surface elevation shall be determined to be the body of water that causes the highest water surface elevation. This water surface elevation and the resulting freeboard shall be shown in the “Elevation” view on the Layout.

The low bridge chord should also be set to permit passage of the base flood without pressure flow, inclusive of influences from other bodies of water. Stream forces are permitted to engage the superstructure at flood events greater than the base flood. When stream forces are permitted to engage the superstructure as well as substructure elements, the resulting forces shall be included in the design of the bridge structure.

Deviation from the above requirements may be necessary for unusual conditions or to accommodate the following concerns and should be coordinated with the Section Supervisor:

- Historical high water
- Maintain existing low chord elevation unless approved by the Bridge Engineer or Staff Hydraulics Engineer
- Grade raise restrictions
- Backwater permit requirements
- Debris or scour-related issues
- Backwater effects from downstream influences
- Navigable waterways

In all cases the vertical clearances for major river crossings will be decided on an individual basis. When requesting layout approval from the Bridge Administration, documentation should be provided explaining any necessary deviations in vertical clearance.

3.2.3 Existing Bridges

In general the proposed bridge shall not be shorter, have less waterway area, or have a low chord elevation lower than the existing bridge. With the approval of the Bridge Engineer, possible exceptions to the above include:

- Change in hydraulic characteristics since construction of the existing bridge
- Grade raise restrictions
- Alignment relocation

3.2.4 Backwater Criteria

The Hydraulics Section of the Roadway Design Division provides the permit requirements for backwater set by the National Flood Insurance Program. Currently there are six permit types with individual backwater requirements for regulatory floodways, regulatory floodplains, and special flood hazard areas.

A full description of each permit can be accessed at: \\CSD3\Hydraulics\SFHA SP's. All permit types require a Special Provision "Construction in Special Flood Hazard Areas" to be included in the project specifications. The design engineer is responsible for developing the Special Provision. Permit Types I and II are Zone AE studied streams with a floodway. Permit Types III and IV are Zone AE studied streams without a floodway. Permit Types V and VI are Zone A streams. Permit Types I, III, and V have an upstream insurable building and would require the inclusion of a Conceptual Work Plan for temporary construction in the Special Provision. See [Subsection 3.9](#). Permit Types II, IV, and VI do not have an upstream insurable building.

A brief description of each permit type is as follows:

Type I Permit (Regulatory Floodway with Insurable Building)

No increase in the estimated 100-year flood water surface elevations is allowed due to any temporary or permanent construction items within the regulatory floodway. A detailed analysis and floodplain permit are required for temporary fill and temporary drainage structures within the floodway.

Type II Permit (Regulatory Floodway without Insurable Building)

No increase in the estimated 100-year flood water surface elevations is allowed due to any permanent construction items within the regulatory floodway. No detailed analysis is required for temporary fill and temporary drainage structures within the floodway.

Type III Permit (Regulatory Floodplain with Insurable Building)

A maximum increase of one foot over the existing estimated 100-year flood water surface elevations is allowed for the temporary and permanent construction items if it will not cause any additional flooding of existing buildings. A detailed analysis and floodplain permit are required for temporary fill and temporary drainage structures within the floodplain.

Type IV Permit (Regulatory Floodplain without Insurable Building)

A maximum increase of one foot over the existing estimated 100-year flood water surface elevations is allowed for the permanent construction items. No detailed analysis is required for temporary fill and temporary drainage structures within the floodplain.

Type V Permit (Special Flood Hazard Area, No Detailed Study, with Insurable Building)

A maximum increase of one foot over the existing estimated 100-year flood water surface elevations is allowed for the temporary and permanent construction items if it will not cause any additional flooding of existing buildings. A detailed analysis and floodplain permit are required for temporary fill and temporary drainage structures within the floodplain.

Type VI Permit (Special Flood Hazard Area, No Detailed Study, without Insurable Building)

A maximum increase of one foot over the existing estimated 100-year flood water surface elevations is allowed for the permanent construction items if it will not cause any additional flooding of existing buildings. No detailed analysis is required for temporary fill and temporary drainage structures within the floodplain.

When determining if the backwater criteria is met, the backwater increase is defined as the difference in water surface elevations between the existing structure or condition (new location) and the proposed structure at the same river station.

Backwater criteria shall be met at the immediate upstream toe of slope and at all river stations within a bridge length upstream. A hydraulic jump or drawdown of the water surface often occurs at the upstream face of the bridge. Therefore, the immediate upstream section is not always a good indicator of the maximum backwater caused by the proposed bridge.

Where no permit is required, a maximum increase of one foot over the existing estimated Q_{100} backwater is preferred.

3.2.5 Historical High water

In very rare cases the historical high water (if available) may be used in lieu of the design flood or base flood to set minimum vertical clearances discussed in [Subsection 3.2.2](#). The historical high water shall never be considered as justification to lower a bridge. The reliability and source of the reported historical high water should be considered.

3.2.6 Navigable Waterways

Minimum horizontal and vertical clearances for bridges over navigable waterways are set by the United States Coast Guard (USCG). See [Subsection 2.6.1](#) for additional information.

3.3 Hydraulic Modeling

A detailed hydraulic analysis typically involves a one dimensional model of a floodway, floodplain, or special flood hazard area in conjunction with the roadway and bridge geometric data. Hydraulic Engineering Center River Analysis System (HEC-RAS), developed by the USACE, is the software used by the Department to model hydraulic structures.

The Hydraulics Section of the Roadway Design Division develops models of the unconstricted floodplain and the existing constricted conditions, if not on new location. The model files are stored on [ARDOT's network](#). It is the Design Engineer's responsibility to develop a model for the proposed bridge using input that accurately represents the proposed and/or future bridge and roadway geometry. Modeling the proposed bridge and roadway in HEC-RAS is typically an iterative process for selecting a bridge length and elevation that will provide an economical design while meeting hydraulic requirements.

3.3.1 Cross Section

HEC-RAS has the ability to import geometry data based on a Geographic Information System (GIS) format. New cross sections, if required, shall be input using data provided by a three dimensional surface

design file. Moving existing cross sections and interpolating new cross sections will not be allowed unless dictated by special circumstances. Refer to [Appendix A3.1](#) for guidance in creating new cross sections to be imported into HEC-RAS from Microstation Inroads.

3.3.2 Ineffective Flow Areas

Ineffective flow areas are defined as portions of the waterway that contain water but have no conveyance (velocity assumed to be zero). This remains true until the water surface reaches a trigger elevation set by the designer. Once the water surface reaches this elevation, the entire area becomes effective and water begins to move in the areas once defined as ineffective. The upstream left and right elevations are typically set to match the lowest roadway elevation on the left and right respectively. The downstream left and right elevations are set to the lower of the lowest roadway elevation or the low bridge chord on the left and right, respectively.

The designer must also set the stations of the ineffective flow areas based on upstream contraction rates and downstream expansion rates. If the proposed bridge is replacing an existing bridge, it is common practice to match the upstream contraction and downstream expansion rates used by the Hydraulics Section in their model of the existing constricted section. If the proposed bridge is on new location, the designer shall reference the user help documentation incorporated into the HEC-RAS computer program or contact the Hydraulics Section for guidance on determining appropriate upstream contraction and downstream expansion rates for the new bridge.

3.3.3 High Flow Methods

HEC-RAS has a feature to switch the high flow analysis method from energy equations to pressure and/or weir equations. This option can be found by clicking the “Bridge Modeling Approach” button found in the bridge input data. The “energy only” method is sufficient to use on projects where the water surface elevation is significantly lower than the approach roadway elevations and/or the low chord of the bridge structure. The “pressure and/or weir” method is appropriate on projects where the water surface elevation is nearing the approach roadway elevations and/or the low chord of the bridge structure. It is good practice for the Design Engineer to always use the “pressure and/or weir” method since HEC-RAS will still default to the appropriate “energy only” equations for low flow flood events and switch to “pressure and/or weir” equations as the water surface rises.

3.4 Scour Analysis

Scour analysis is a significant part of the hydraulic design process and can influence the overall bridge length, pier shape and placement, and type and depth of foundations. Once a preliminary bridge concept is determined, a scour analysis shall be conducted to determine if any adjustments are required. The scour analysis should consist of both a qualitative evaluation and quantitative computations.

A qualitative evaluation can provide the Design Engineer with contextual information such as past scour performance of the existing bridge, overbank vegetation, debris issues, tendency for lateral migration, and watershed characteristics that can aid in judging the correctness of the quantitative computations. Despite having quantitative scour depths, it is still dependent on the Design Engineer to use judgment when determining if the scour computations are reasonable. Scour is typically evaluated for the 100-year flood or the overtopping flood, if it occurs at less than the 100-year event, and for the 500-year or the overtopping flood, if it occurs between the 100-year and 500-year events.

For evaluating scour at bridges, the Bridge Division uses FHWA Hydraulic Engineering Circular No. 18 *Evaluating Scour at Bridges* [13]. Contraction scour is the lowering of the stream bed due to the contraction of the flow by the bridge. Local scour is the removal of the stream bed material from

around piers and abutments due to the increased flow velocity and resulting vortices induced by these obstructions.

Contraction scour can either be clear-water or live-bed. The maximum local scour at piers shall be calculated as $2.4 \times$ pier diameter (or width) in the direction of flow. At a minimum, the total scour depth equals the summation of the contraction and local scour, but long-term aggradation and degradation of the river bed, lateral migration, and other general scour conditions should also be evaluated as applicable.

The HEC-RAS program is capable of performing a scour analysis for models with single bridge openings only. A flow distribution needs to be run as an option under the “Steady Flow Analysis” to generate velocity windows for the calculation of local scour. This can be accessed via Run/Steady Flow Analysis/Options/Flow Distribution Locations. Flow subsections for velocity windows should be maximized and selected for both bridge and approach sections.

3.5 Hydraulic Data for Bridge Layouts

3.5.1 Single Bridge Openings

For single bridge openings meeting design flood requirements as built, [Table 3.1](#) shall be provided on the Bridge Layout with corresponding notes. Water surface elevations are typically reported to $1/10$ of a foot.

Table 3.1: Hydraulic Data

FLOOD DESCRIPTION	FREQUENCY	DISCHARGE	NATURAL ¹ WATER SURFACE ELEVATION	WATER SURFACE ELEVATION WITH BACKWATER
	YEARS	CFS	FEET	FEET
Design			“A”	“B”
Base	100		“A”	“B”
Extreme	500		“A”	“B”
Overtopping			“A”	“B”

¹ Unconstricted water surface elevation without structure or roadway approaches.

Q100 backwater elevation for existing structure = “C” feet

Proposed Low Bridge Chord Elev. = __ feet (include station if applicable)

Drainage Area = __ square miles

Historical H.W. Elevation = __ feet

“A” = Report the unconstricted water surface elevation that corresponds to the same stream station where the water surface elevation with backwater (“B”) is reported.

“B” = Report the constricted water surface elevation for the proposed bridge that produces the maximum backwater occurring within one bridge length upstream.

“C” = Report the constricted water surface elevation for the existing bridge that corresponds to the same stream station where the water surface elevation with backwater (“B”) is reported for the proposed bridge.

For single bridge openings not meeting design flood requirements as built and sized in accordance with Alternate 1 of [Subsection 3.2.1.1](#), [Table 3.2](#) shall be provided on the Bridge Layout with corresponding

notes. Water surface elevations with backwater are shown for both the as-built (plan) and future embankments. The future embankment elevation shall not allow overtopping at the design flood. Water surface elevations are typically reported to 1/10 of a foot.

Table 3.2: Hydraulic Data with Future Embankment

FLOOD DESCRIPTION	FREQUENCY	DISCHARGE	NATURAL ¹ WATER SURFACE ELEVATION	WATER SURFACE ELEVATION WITH BACKWATER	
				PLAN EMBANKMENT	FUTURE EMBANKMENT ²
	YEARS	CFS	FEET	FEET	FEET
Design			“A”	“B”	“B”
Base	100		“A”	“B”	“B”
Extreme	500		“A”	“B”	“B”
Overtopping			“A”	“B”	N/A

¹ Unconstricted water surface elevation without structure or roadway approaches.

² Future embankment elevation is assumed to be XXX.X and overtops at flows greater than the QXX. If the embankment is raised above this assumed elevation, additional waterway opening may be required.

Q100 backwater elevation for existing structure = “C” feet

Proposed Low Bridge Chord Elev. = __ feet (include station if applicable)

Drainage Area = __ square miles

Historical H.W. Elevation = __ feet

For single bridge openings sized for a design exception in accordance with Alternate 2 of [Subsection 3.2.1.1](#), a table similar to [Table 3.1](#) shall be provided on the Bridge Layout. Modifications to the notes may be required to address unique site conditions. The design flood shall be based on the overtopping event.

3.5.2 Multiple Bridge Openings

For a watershed with multiple bridge openings, [Table 3.3](#) shall be provided on the Bridge Layout with corresponding notes.

3.5.3 Influences From Other Bodies of Water

Some bridge sites have water surface elevations that are influenced by other bodies of water. The Hydraulics Section typically determines if there are any water surface elevation influences and includes this information in their memorandum submitting the project hydraulic information. An additional column of data shall be added to the hydraulic data table titled “FLOOD ELEVATION ON XXXXXX” that represents the water surface elevations at the bridge site due to the influence.

3.6 Hydraulic Certification

All bridges over waterways require certification that the hydraulic design complies with Department design criteria. The certification request should be submitted to the Hydraulics Section of the Roadway Design Division after the hydraulic design and bridge geometry is finalized, and the layout has been

Table 3.3: Hydraulic Data with Multiple Bridge Openings

FLOOD DESCRIPTION	FREQUENCY	TOTAL ² DISCHARGE	DISCHARGE THIS SITE	NATURAL ¹ WATER SURFACE ELEVATION	WATER SURFACE ELEVATION WITH BACKWATER
	YEARS	CFS	CFS	FEET	FEET
Design Base	100			“A”	“B”
Extreme	500			“A”	“B”
Overtopping				“A”	“B”

¹ Unconstricted water surface elevation without structures or roadway approaches.

² The total discharge includes flow at this site and __.

Q100 backwater elevation for existing structure = “C” feet
 Proposed Low Bridge Chord Elev. = __ feet (include station if applicable)

Drainage Area = __ square miles
 Historical H.W. Elevation = __ feet

approved by the Assistant Chief Engineer-Design. Once the Hydraulics Section is satisfied with the hydraulic design, a Hydraulic Certification will be issued.

An example request is shown in [Appendix A3.2](#). Certification requests should be emailed to the Section Head of Hydraulics and the Roadway Division Head and Staff Roadway Engineer copied. A copy of the layout(s) shall be included with the request and layout details should coincide with the geometry used in the hydraulic modeling (HEC-RAS).

3.7 Hydrographs

Hydrographs shall be included in the plans when cofferdam and/or drilled shaft construction is necessary for major river crossings and when gaging station records are available at the United States Geological Survey (USGS) or others. If a gaging station is not located at the bridge site, data may be interpolated from upstream or downstream gaging stations. Hydrographs provide a database of past water surface elevations occurring throughout the year. This information can aid the Design Engineer in establishing work road and top of shaft elevations, and the Contractor in designing cofferdams and scheduling their work. Hydrographs shall include river stage data for at least the three (preferably five) preceding sequential years.

3.8 Riprap

Dumped riprap is the standard method of erosion protection for bridge end slopes at waterway crossings and is typically used at all bridge sites regardless of flow velocity. Foundation protection riprap is used when flow velocities become excessive and smaller riprap may be transported downstream. When maximum stream/river velocities approach 10 ^{feet/sec} or greater, foundation protection riprap should be considered.

Riprap may be used as a scour countermeasure for existing bridges and for new bridges when a longer bridge, change in bent location, or other countermeasures are not judged to be practical or effective.

Raising foundations and using riprap is not an acceptable scour countermeasure. When riprap is used as a scour countermeasure, it shall be properly designed and sized. Guidance for sizing riprap can be found in FHWA Hydraulic Engineering Circular No. 23, *Bridge Scour and Stream Instability Countermeasures* [16] [17].

When riprap is used at bridge ends, the top elevation of the riprap shall not be set below the design flood water surface elevation with backwater at the upstream toe of slope. Higher elevations may be desirable due to other factors, such as backwater controlled by downstream influences, and should be coordinated with the Section Supervisor. Do not use elevations less than 0.5 foot increments.

3.9 Conceptual Work Plans

The Bridge Division shall develop a conceptual work plan (CWP) for every bridge constructed or demolished over a waterway when it is anticipated that a work road, work pad or platform, cofferdam, or temporary work bridge may be necessary for Contractor construction operations. The CWP is a “best” estimate to provide for Contractor accessibility. The District Construction Engineer may be contacted for assistance in determining work road needs or for feedback on a preliminary concept. Guidelines for developing Contractor work roads include, but are not limited to, the following:

Backwater Criteria

The CWP shall meet the backwater restrictions for temporary conditions defined for each permit type. The Hydraulics Section will analyze work roads in Permit Types I and III and size the temporary pipes. For work roads in Permit Type V, Bridge Division will typically analyze the temporary fill to ensure that the backwater criteria is met. For work roads in Permit Types I and III, and at large river crossings, work roads are typically extended to bents from each side of the bank and not across the entire channel. Depending on the bridge geometry and backwater restrictions for the site, both work roads may not be able to be in place simultaneously.

Elevation of Work Road

The top of work road elevation shall be set a minimum of 1 foot above the ordinary high water elevation (OHW) provided by the Environmental Division. See [Subsection 2.5.2](#) for additional information. Higher work road elevations are often required to provide clearance for temporary pipes or to allow the Contractor greater accessibility, especially for larger crossings. When a higher work road elevation is considered necessary, the backwater created by the work road may need to be checked to ensure the backwater criteria is not exceeded.

Environmental Coordination

See [Subsection 2.5](#) for information on environmental coordination. The Environmental Division may need to be consulted on the location of work roads in context-sensitive areas.

Existing Bridge Removal

Depending on the relative proximity of existing and proposed bridges, a separate work road may be required to remove the existing structure.

Notes

The following notes shall be included on the CWP sketch for all permit types:

The temporary fill to construct the work road(s) shown has been permitted to facilitate construction of the project. The Contractor shall determine and provide temporary culverts of a size and number that will be sufficient to maintain low stream flows and assist passage of aquatic wildlife.

The Contractor may submit an alternative work road plan for approval by the Engineer showing details of and describing the proposed modifications. A primary objective of any

proposed modifications should be to minimize the reduction of waterway opening in the floodplain. The top of the alternative work road(s) shall not exceed the elevation shown. A determination will be made by the Engineer within ten (10) business days concerning the necessity or practicability of the request. A modification of the Section 404 Permit and additional review time by the Corps of Engineers may be required if the alternative work road(s) increases the volume of temporary fill that has been permitted for the project. The contract time will not be extended for the time required to consider or approve any alternate work road(s) submittals.

Any additional work or expenses incurred preparing, submitting, or completing the alternate work road plan shall be at no additional cost to the Department. See SP Job XXXXX "Construction in Special Flood Hazard Areas" and Section 110.05(c) in the Standard Specifications for additional information. The Contractor is responsible for maintenance of the work road(s) during the contract period.

When the bridge is in a county that does not participate in the National Flood Insurance Program, references to the special provision "Construction in Special Flood Hazard Areas" shall be omitted from the above note.

When required for hydraulic requirements, the following note shall be included on the CWP sketch when multiple work roads are needed:

Work roads shall not be in place simultaneously. Work Road "A" must be completely removed and the natural terrain restored to its original condition prior to construction of Work Road "B".

Quantities

See [Subsection 2.5.2](#) for the quantities to be provided.

Special Provisions

A Special Provision, "Construction in Special Flood Hazard Areas," is required for all bridges requiring permits. A CWP shall be included in the above Special Provision for Permit Types I, III, and V.

Temporary Construction Easements

It is preferred for work roads to be located within existing or proposed right of way. When this is not possible, a temporary construction easement may be required and should be coordinated with the Roadway Design or State-Aid Division.

Temporary Work Bridge

A temporary work bridge may be considered for major river crossings or when backwater constraints are restrictive.

Width of Work Road

The minimum work road width is 20 feet. Widths of 25 feet and 30 feet should be specified for longer bridges and projects with heavier and larger construction materials (large concrete piles, drilled shafts, concrete beams, plate girders, etc.) which will require larger cranes with greater footprints. The wider work roads also allow safer passage of employees and small equipment around the larger cranes and are less likely to require maintenance.

3.10 Bridge Deck Drainage

Proper bridge deck drainage is necessary to ensure an acceptable level of safety to the traveling public during a rainfall event. As the rainfall intensity increases, so does the rate at which the water needs

to be removed from the bridge deck. Inadequate deck drainage can cause flooding of the bridge deck increasing the potential for hydroplaning.

3.10.1 Design Intensity

Except for bridges on interstates and connecting ramps, all bridge deck drainage systems shall be designed for a 10-year flood event with a 5 minute time of concentration and rainfall intensity. All interstate bridge deck drainage systems shall be designed for a 50-year flood event with a 5 minute time of concentration and rainfall intensity. Rainfall intensity may be obtained from the NOAA ATLAS 14 website: <http://hdsc.nws.noaa.gov/hdsc/pfds/>.

3.10.2 Lateral Spreading

Lateral spreading is defined as the width of the roadway perpendicular to the bridge centerline allowed to pond runoff during a given intensity of rainfall. The maximum allowable lateral spreading for bridge decks is shown in [Table 3.4](#).

Table 3.4: Allowable Ponding Widths

Highway Description	Single or Multi-Lane in Direction of Travel	Allowable Width of Lateral Spreading
Interstates/Ramps	Single or Multi-Lane	Shoulder Only
Highways w/Shoulders	Single	Shoulder Only
Highways w/Shoulders	Multi-Lane	Shoulder + 1/2 Outside Lane
Highways w/Sidewalks	Single or Multi-Lane	1/2 Outside Lane
Highways w/Bike Lanes	Single or Multi-Lane	Bike Lane + 1/2 Outside Lane

When permitted, open drains in parapet rails are typically used to drain bridge decks. See [Subsection 4.8.2](#) for additional information on open parapet rails. When site constraints do not permit the use of open parapet rails, and/or the bridge geometry results in exceedance of the allowable ponding widths, a drainage system shall be designed and detailed to meet the above criteria. The design shall consist of sizing and spacing inlets, and sizing of trunk line and outfall. *FHWA Hydraulic Engineering Circular No. 21 (HEC-21)* [20] can provide guidance with spacing inlets. Special grate types are required for areas with bicycle traffic.

[Equation 3.1](#) from Woo(1988) [19] shall be used to calculate the lateral spread of gutter flow.

$$T = \sqrt[2.67]{\frac{LCniW}{24400S_x^{1.67}S^{0.5}}} \quad (3.1)$$

where:

T = lateral spread of gutter flow (*ft*)

L = portion of bridge length being drained (*ft*)

C = coefficient of imperviousness in Rational Formula (usually 0.9)

n = Manning's roughness coefficient (usually 0.016)

i = design storm intensity (*in./hr*)

W = width of bridge deck drainage area (*ft*)

S_x = cross slope of bridge deck surface (*ft/ft*)

S = longitudinal slope of bridge deck surface (*ft/ft*)

or solving for L :

$$L = \frac{24400S_x^{1.67}S^{0.5}T^{2.67}}{CniW} \quad (3.2)$$

Section 4

Superstructure

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4.1 Design Specifications

For the design of new bridges, use the edition of the *AASHTO LRFD Bridge Design Specifications* established by the project's design criteria. For the widening or rehabilitation of existing bridges, the superstructure may be designed in accordance with the following:

- Use the *AASHTO Standard Specifications for Highway Bridges, 17th Edition, 2002* [7] for all existing bridges with original designs that did not use load resistance factor design.
- Use the applicable edition of the original design specifications or the latest edition of the *AASHTO LRFD Bridge Design Specifications* for all existing bridges designed using load resistance factor design.

4.2 Design Loads

4.2.1 Load Modifiers

Bridges shall be designed for conventional levels of ductility, redundancy, and operational importance; therefore, load modifiers of 1.0 shall be used. For bridges classified as critical or essential, increasing the operational importance shall be considered on a case by case basis.

4.2.2 Dead Loads

4.2.2.1 Non-Composite Loads

Non-Composite loads typically considered in design are the self-weight of the beam/girder and slab, diaphragms or cross-frames, connections, permanent steel deck forms, lateral bracing, and any utilities/drainage attached to the beam/girder. For the design of beams/girders, include a non-composite load from [Table 4.1](#) to account for the additional concrete and form weight due to the permanent steel deck forms. Non-matching forms are likely on bridges with large girder spacing, flared girders, unusual reinforcing spacing, or higher degree of curvature.

Table 4.1: Non-Composite Load for Permanent Steel Deck Forms

	Simple Steel Spans and all Prestressed AASHTO girders	Continuous Steel Spans
Matching Forms Likely	12 psf	15 psf
Non-Matching Forms Likely	15 psf	18 psf

4.2.2.2 Composite Loads

Composite loads typically considered in design are the railings, future wearing surface, sidewalks, median barrier, fencing, and lighting. The future wearing surface of 24 psf shall be applied to the clear roadway width. This is based on a 2 inch thick asphalt overlay with a unit weight of 144 pcf.

4.2.3 Live Loads

Live loads shall be applied to the bridge deck in accordance with the design specifications and shall include vehicular and pedestrian loads, dynamic load allowance, and centrifugal forces, when applicable.

For the possibility of future widening, vehicular live loads shall be applied to sidewalks and shared use paths in lieu of pedestrian loading as an additional load case.

The average daily truck traffic (ADTT) should be calculated using the design year average daily traffic (ADT), directional distribution, and truck percentage provided by the Roadway Design or State-Aid Division. The design year ADT and truck percentage may also be found on the Project Design Criteria.

4.3 Material Properties

Typical materials and design strengths used for bridge superstructures are listed in [Table 4.2](#). Structural steel is typically Grade 50W. If structural steel is to be painted, Grade 50 steel should be used. Structural steel completely embedded in concrete may be Grade 36, unless otherwise noted. Grade HPS 70W steel may be considered for girder flanges with advance approval of the Bridge Engineer.

Table 4.2: Materials and Design Strengths

Materials	Strengths
Class S(AE) Concrete (superstructure)	$f'_c = 4,000$ psi
Class S Concrete (superstructure)	$f'_c = 6,000$ psi
Reinforcing Steel (AASHTO M 31 or M 322, Type A)	$f_y = 60,000$ psi
Wire Fabric (AASHTO M 55 or M 221)	$f_y = 65,000$ psi
Prestressing Strands (AASHTO M 203, Gr. 270)	$f_{pu} = 270,000$ psi
- Low Relaxation Strands	
- Minimum Concrete Strength at Release	$f'_c = 4,500$ psi
Structural Steel (ASTM A709, Gr. 36)	$F_y = 36,000$ psi
Structural Steel (ASTM A709, Gr. 50 or 50W)	$F_y = 50,000$ psi
Structural Steel (ASTM A709, Gr. HPS 70W)	$F_y = 70,000$ psi

4.4 Deck Slabs on Beams and Girders

4.4.1 Beam/Girder Spacing

The beam/girder spacing should provide economy of design by balancing moments between the interior and exterior beams/girders. Generally, the moments are reasonably balanced when the overhang width is 30% to 35% of the beam/girder spacing. No less than 4 beam/girder lines shall be used. Additional items to consider when selecting the beam/girder spacing include, but are not limited to:

- Location of stage construction joints and closure pours
- Vertical clearance
- Live load deflection
- Clearance between beam/girder flange and deck gutterline
- Span curvature
- Constructability and site constraints

- Need for accelerated bridge construction (ABC)
- Needs of anticipated future widening

Unless controlled by other considerations, the Bridge Division typically uses the beam/girder spacing shown in [Table 4.3](#) for standard clear bridge widths with New Jersey railing and without sidewalks, bike lanes, or shared use paths.

Table 4.3: Beam/Girder Spacing for Standard Bridge Widths

Clear Bridge Width	Beam/Girder Spacing
24'-0"	3 sp. at 7'-6"
28'-0"	3 sp. at 8'-6"
30'-0"	3 sp. at 9'-0"
32'-0"	3 sp. at 9'-8" / 4 sp. at 7'-6"
34'-0"	4 sp. at 8'-0"
38'-0"	4 sp. at 8'-10"
40'-0"	4 sp. at 9'-3"
52'-0"	6 sp. at 8'-3"
75'-0"	8 sp. at 9'-0" / 9 sp. at 8'-0"

4.4.2 Concrete Deck Slabs

4.4.2.1 Design

Reinforcing steel shall be epoxy coated. The following should be considered when determining an acceptable design for concrete deck slabs:

Deck Thickness

The depth of a concrete deck shall not be less than 7¹/₂ inches including provision for a 1/2 inch sacrificial wearing surface.

Effective Slab Depth

The effective slab depth for design purposes (i.e. slab design and composite properties) shall be 1/2 inch less than the detailed thickness. This accounts for any poor-quality surface concrete and for abrasion of the concrete that will occur over the service life of the deck.

Method of Design

Concrete deck slabs shall be designed using the Traditional Design method. The Empirical Design method shall not be allowed.

Internal bridge slab designs have been developed for typical roadway widths and can be found on [ARDOT's network](#).

4.4.2.2 Detailing

Plan details for concrete decks typically include the following:

- Typical roadway section(s)
- Section near joint showing joint and expansion device
- Adjustment for slab thickness tolerance (when different from standard)
- Reinforcing plan and bar list
- Railing as applicable

- Pouring sequence
- Slab joint detail (when different from standard)
- Sidewalk and curb details (if required)

Concrete Cover

Provide a concrete cover of 2¹/₂ inch and 1 inch for top and bottom transverse reinforcement in the deck, respectively. Longitudinal bars for temperature and distribution are typically placed above each layer of transverse reinforcement.

Concrete Placement Procedure

A detail for the concrete placement procedure shall be required for skewed bridges.

Slab Joints

Slab Joints used for crack control are required at the centerline of all intermediate bents of continuous units and at all pouring sequence construction joints. Additional crack control joints are required if the dead load inflection point is more than 20 feet from centerline bent. Slab joints shall typically align with parapet open joints except when used at small closure pours at ends of units. Pouring sequence construction joints shall preferably be placed near the dead load inflection points of a span at the Service Limit State.

Deck Pouring Sequence

The design engineer shall be responsible for the “Pouring Sequence Diagram”. Typically, the pouring sequence will show Pours (1) in all positive moment regions and Pours (2) in all negative moment regions. For this type of pouring sequence, the following notes shall be included:

Pours with the same number may be placed simultaneously or separately. All Pour(s) 1 must be placed before Pour(s) 2 can be placed. 48 hours shall elapse between the end of a pour and the start of the next pour. 72 hours shall elapse between adjacent pours.

Concrete in bridge superstructure shall be placed, consolidated and screeded off for the entire pour before any concrete has taken its initial set. This may require the use of a retarding agent.

A minimum of 72 hours shall elapse between completion of the slab and the pouring of the bridge railing. Any railing pours made before the entire slab unit has been placed must be approved by the Engineer. The Contractor must obtain approval from the Engineer for any deviations from the pouring sequence(s) shown.

For continuous units with 120 cubic yards or less of concrete in the entire deck, alternate pouring sequence diagrams shall be provided as shown in [Appendix A4.1](#). Modification to the above notes will be required for any alternate pouring sequences or for project details such as sidewalk, median barrier, and stage construction. In addition, factors such as uplift, deflection, or camber may warrant further consideration of the pouring sequence and less conventional details.

Contractors requesting to pour bridge decks in a sequence other than that shown on the project plans may request this in writing to the Resident Engineer unless otherwise noted in the plans. This request will be forwarded through the Construction Division to the Bridge Division and will be addressed on a case by case basis.

Protective Surface Treatment

All bridges shall have a protective surface treatment applied to the roadway surface and top and front face of concrete parapet rails and sidewalks, if applicable. All State-owned bridges in Districts 4, 5, and 9 shall receive a Class 2 protective surface treatment. All others shall receive a Class 1 protective surface treatment. See AHTD Section 803 for additional details.

Class 1 or Class 2 protective surface treatment shall not be used on surfaces where textured coating finish is specified.

Rounding Detail

A rounding detail is required for bridge slabs in normal crown and should be modified for bridges in superelevation transition. Rounding is not used on bridge slabs with median barriers or with a longitudinal construction joint at the roadway centerline.

Stage Construction

A longitudinal construction joint detail shall be included in the plans when stage construction of the deck is required.

Surface Finish

The bridge deck shall be given a fine finish as specified for final finishing in AHTD Subsection 802.19 for Class 5 Tined Bridge Roadway Surface Finish unless a Class 7 Grooved Bridge Roadway Surface Finish is specified on the plans.

Sidewalks shall receive a broomed finish as specified for final finishing in AHTD Subsection 802.19, for Class 6 Broomed Finish.

4.4.3 Steel Beams and Plate Girders Composite with Concrete Deck

4.4.3.1 General

Rolled W-Beam shapes are preferred, but plate girders should be considered when the W-Beam weight required for design becomes uneconomical.

4.4.3.1.1 Design

Bolted Field Splices

For bridge lengths where fabricating, handling, shipping, or erecting the entire length of a beam/girder in one piece is not possible, provisions shall be made for bolted field splices. Generally, piece lengths of 90 feet or less meet fabrication and handling constraints unless site characteristics, sequence of construction or girder proportion, weight, or curvature are concerns. Piece lengths up to 120 feet can often be specified, but the Design Engineer should verify acceptability with a Fabricator prior to their use. When long piece lengths are used, the design engineer should consider providing details for an optional bolted field splice.

Field splice minimums are as follows:

- Minimum flange splice plate thickness is 1/2 inch
- Minimum web splice plate thickness is 3/8 inch
- For 2 rows of bolts in flange, a minimum of 8 bolts each side of splice is required
- For 4 rows of bolts in flange, a minimum of 12 bolts each side of splice is required
- Web splice plates shall have a minimum of 3 vertical rows of bolts each side of splice

Web splice plates should be as deep as practicable but shall maintain adequate tightening clearances between the bolts in the web and the bolts in the flanges. The minimum distance between center of bolt holes and from center of bolt holes to edges shall be in accordance with AHTD Subsection 807.42(a) and LRFD.

Bolted splices shall be designed considering Strength I and Service II Limit States using factored loads in accordance with the design specifications acting on a non-composite section.

Elastic/Plastic Design

Elastic design shall be implemented if the bridge is on one of the following routes:

- Interstate or Arterial
- Collector or local route with high truck traffic (ADTT > 50)
- Route near industrial area
- Area with a high chance of overweight permit vehicles

Plastic design may be implemented if the requirements of the design specifications are met and the bridge is not on one of the routes mentioned above. Bridges closely spaced along a corridor should have similar load-carrying capacities.

Haunch Thickness

A minimum haunch thickness of $\frac{3}{4}$ inch, inclusive of flange thickness, shall be used. Flange thickness, superelevation rate, and maintaining adequate overhang thickness shall be considered when selecting a haunch thickness. The selected haunch thickness shall allow for a minimum adjustment of plus or minus 1 inch. The flange shall not engage the bottom transverse reinforcing bars at the detailed haunch thickness.

Live Load Deflection

The live load deflection limits for steel vehicular bridges specified in LRFD Article 2.5.2.6.2 shall be met.

Shear Connectors

Stud shear connectors are preferred. Minimum stud shear connector size shall be $\frac{7}{8}$ inch diameter by 4 inches in length. Shear connector lengths shall be selected to provide a minimum haunch adjustment of plus or minus 1 inch. This may require varying shear connector lengths transversely along the girder flange where extreme superelevation rates are present or varying shear connector lengths with varying top flange thicknesses. A minimum clearance of 3 inches should be provided between centerline shear stud and end of the flange splice plates. Shear connectors shall be placed along the full length of the beam/girder at a maximum spacing of 24 inches.

4.4.3.1.2 Detailing

Plan details for steel beams and plate girders typically include:

- Framing plan
 - Beam/Girder spacing
 - Bracing spacing
 - Field splice location(s)
 - Bearing and transverse stiffeners for plate girders
 - Connection plates acting as transverse stiffeners for plate girders
- Beam/Girder elevation
 - Size of beam/plates
 - Shear connector size, type, rows, and spacing
 - Bearing locations
 - Splice locations

- Tension zones for plate girders
- Field splice details
- Diaphragm/Cross-frames, connection plates, and stiffener details
- Shear connector detail
- Weld table
- Alternate clip detail for plate girders
- Lateral bracing details for plate girders
- Bearing stiffener details
- Details of welded splices

Refer to [Standard Dwg. No. 55007](#) for standard details of steel bridge structures.

Additional items:

Adjustment for Slab Thickness Tolerance

The haunch tolerances noted in the detail "Adjustment for Slab Thickness Tolerance" on [Standard Dwg. No. 55007](#) may not be applicable for all combinations of detailed haunch thicknesses and shear connector lengths. For example, haunch thicknesses over 1³/₄ inches or plate girders with significant variation in top flange thickness may be instances in which this standard detail is not applicable. In such instances, a job specific detail of "Adjustment for Slab Thickness Tolerance" shall be included in the plan superstructure details. The goal of any detail for "Adjustment for Slab Thickness Tolerance" shall be to provide a minimum haunch adjustment of plus or minus 1 inch, and to maintain a shear connector embedment of 2 inches into the slab and a clear cover of 2¹/₂ inches, measured from the top of the shear connector to the top of the slab.

Dead Load Deflections

A table of dead load deflections shall be included in the plans with deflections shown for "Structural Steel", "Structural Steel + Slab", and "Structural Steel + Slab + Parapet + ...". The additional concrete and form weight for the permanent steel deck forms applied in the beam/girder design shall be included in the dead load deflections. Deflections may be grouped within the table for similarly loaded beams/girders.

Dead load deflections shall be shown to .001 inch at a minimum interval of 1/10 of the span length. For long spans, consideration should be given to showing deflections at 1/20 intervals of span length.

A dead load deflection diagram shall be included and the following notes as applicable:

Camber for Dead Load Deflection $\pm 1/4$ inch tolerance. Deflections shown are along C.L. Beam/Girder from a chord from C.L. Bearing to C.L. Bearing. Negative sign (-) indicates point above chord. Vertical curve corrections not included. Superelevation transition corrections not included.

For curved beams/girders the above notes shall be replaced with:

Camber for Dead Load Deflection $\pm 1/4$ inch tolerance. Deflections shown are along centerline of beam/girder from the plane perpendicular to the web extending from C.L. Bearing to C.L. Bearing. Negative sign (-) indicates point above plane. Vertical curve corrections not included. Superelevation transition corrections not included.

For beams/girders on chords of concentric arcs, parallel to the chord of an arc, or splayed, the following note shall be added:

Tabulated values shown require an adjustment for cross-slope to beams/girders to achieve proper camber.

Diaphragm and Cross-Frame Bracing

The preferred minimum spacing for staggered bracing along a beam/girder shall be one web depth. Bracing may be placed parallel to skew when permitted by the design specifications.

Stage Construction

Details that may be required due to stage construction include, but are not limited to:

- Longitudinal construction joint for slab
- Lap detail for transverse slab reinforcing bars
- Detail of weld location for expansion joint device
- Deck support at longitudinal construction joint
- When threaded inserts for temporary precast barriers are required to be cast into the bridge deck, include a note specifying this requirement on the superstructure details depicting the “Typical Roadway Section”
- Adjust connection plate details for W-Beam spans to require the use of exterior connection plates (when different from interior plates) at interior beams acting as temporary exterior beams during staged construction
- Additional details as required due to complex geometry, differential deflections, etc.

Structural Steel

Details shall specify grade and payment for structural steel. This information is required even when [Standard Drawing No. 55006](#) is used.

4.4.3.2 W-Beams

4.4.3.2.1 Design

The following should be considered when determining an acceptable design for W-beams:

Beam Size

Acceptable beam sizes range from a W24x68 up to and including W40 beams. Availability and economics of rolled beams should be taken into consideration when selecting a beam size. Visit the mill’s website or contact a Fabricator to see a current Product Availability List.

Bracing

Connection plates for all exterior beams shall be full depth. Interior beams shall have partial depth connection plates if the provisions in the design specifications are met, otherwise full depth connection plates shall be used.

Bracing for W-beams may be offset no more than 6 inches from centerline of bearings, if required, to avoid interference between anchor bolts and connection plates or diaphragms. Diaphragm spacing should not conflict with anticipated splice plate locations.

Diaphragms at exterior beams shall be spaced so that no more than 1/4 inch vertical deflection due to beam rotation occurs for the slab construction loads assuming a 4 foot support bracket spacing with the screed rail supported on the deck overhang. When necessary, an alternate detail requiring the Contractor to place the screed rail support on the top flange of the beam may be included in the plans.

Typical diaphragm sizes are shown in [Table 4.4](#).

Table 4.4: Typical Diaphragm Sizes

Beam Depth (<i>in.</i>)	Typical Diaphragm
24	C12x20.7
27	C15x33.9
30	C15x33.9
33	MC18x42.7
36	MC18x42.7
40	21 in. Bent Plate

Deviation from [Table 4.4](#) may be necessary for severely skewed or curved bridges to reduce stiffness and high connection forces. For curved bridges, diaphragms shall be designed as primary members.

Field Splices

Transitions for W-beams are preferable between beams in the same family (i.e. similar flange width and web depth). For beams within the same family, no inside filler plate should be required. Web and flange splice plates shall not overlap with W-Beam fillets.

4.4.3.2.2 Detailing

See [Appendix A4.2](#) for example details.

4.4.3.3 Plate Girders

4.4.3.3.1 Design

The following should be considered when determining an acceptable design for plate girders:

Bracing

Connection plates at interior and exterior girders shall be full depth and shall be welded to both top and bottom flanges. In cases when the calculated fatigue stress range exceeds the allowable for welding the connection plate to the tension flange, bolted connections may be considered.

Both K-frames and X-frames are typically used as cross-frames and applicability is determined by girder depth and spacing. As a rule of thumb, K-frames should be used when the angle between the bottom chord and diagonals in the cross-frame is less than 30° and X-frames should be used when the angle between the bottom chord and diagonals is greater than 30°. For curved bridges, cross-frames shall be designed as primary members.

Cross-frame spacing shall not exceed 25 feet. K-Frames and X-Frames at exterior girders shall be spaced so that no more than 1/4 inch vertical deflection due to girder rotation occurs for the slab construction loads assuming a 4 foot support bracket spacing with the screed rail supported on the deck overhang.

The need for lateral bracing due to wind loading shall be checked for all span lengths in accordance with the design specifications for both construction and final conditions. Increasing flange plate dimensions so lateral bracing is not required should be considered. Lateral bracing shall be placed near the mid-depth of the web. For lateral bracing required only for the construction condition, the lateral bracing should be designated on the plan details as “Construction Lateral Bracing”.

Dimensions

Within each girder section, it is generally more economical to maintain the same flange width and adjust the flange thickness to meet design requirements. Minimum plate widths, thicknesses, and increments are as follows:

- Top flange plates shall have a minimum width of 12 inches and a minimum thickness of $\frac{3}{4}$ inches
- Bottom flange plates shall have a minimum width of 12 inches and a minimum thickness of 1 inch
- Web plates shall have a minimum thickness of $\frac{7}{16}$ inches
- Web depth increments of 3 inches are preferred, but no less than 1 inch increments shall be used
- Minimum web depth shall be 42 inches
- Use $\frac{1}{16}$ inch increments for web thickness
- Use $\frac{1}{8}$ inch increments for flange thickness

Stiffeners

Bearing stiffeners shall extend from face of web to $\frac{1}{8}$ inch from edge of bottom flange to allow for weld. When lateral bracing is required, bearing stiffeners shall be continuous through the lateral bracing connection plates.

The use of transverse stiffeners should be minimized. Generally, a web with a few stiffeners near supports or a thicker web with no stiffeners is more economical than having a fully stiffened, thinner web due to fabrication costs. Since cross-frame connection plates as well as transverse stiffeners act to stiffen the web, placement of these elements should be considered jointly for economy in design. When lateral bracing is required, transverse stiffeners may be discontinuous. The *AASHTO/AWS D1.5 Bridge Welding Code* [10] uses the terminology “intermediate stiffeners” in lieu of “transverse stiffeners” which shall be considered to be equivalent. The term “transverse stiffeners” shall be used in the plan details.

Longitudinal stiffeners may be used, as required, but increasing web dimensions to avoid the use of longitudinal stiffeners and to reduce fabrication costs should be considered.

Welded Splices

When shipping piece lengths are long, welded splices may be used to change plate sizes at intermediate locations along the girder for economy of design. Welded splices should not be used excessively, and the following criteria shall be met:

- For Design: The larger of the two flanges at a butt weld shall be no more than 1.5 times the smaller flange plate dimensions and no more than 2 times the smaller flange area
- For Fabrication: Girder webs may be made by shop splicing with minimum lengths of 25 feet for sections. Flange plates longer than 50 feet may be made by shop splicing with minimum lengths of 25 feet for sections

4.4.3.3.2 Detailing

Plan details for plate girders may include:

Drip Plates

Drip plates are required for bridges in a grade with a girder depth greater than 54 inches. The drip plate shall be welded to the outer side of the bottom flange of the exterior girder located

approximately 5 feet from C.L. Bearing on the high side of each bent. See [Standard Drawing No. 55007](#).

Screed Rail Support

The screed rail support detail shall be included in plans when web depths are 48 inches or greater. See [Standard Drawing No. 55007](#).

Stiffeners

Connection Plates acting as transverse stiffeners shall be identified in the plans

Inspection Details

Inspection walkways and safety handrails shall be considered for deeper plate girders. The Heavy Bridge Section of the Maintenance Division should be consulted for their recommendations.

See [Appendix A4.3](#) for example details and [Standard Drawing No. 55007](#).

4.4.4 Precast Prestressed Girders & Bulb - Tee Sections Composite with Concrete Deck

4.4.4.1 Design

See [Appendix A4.4](#) for standard shapes. The following should be considered when determining an acceptable design for prestressed girders and bulb-tee sections:

Design Method

Traditionally, prestressed girders and bulb-tee sections are designed as simple spans for non-composite loads and continuous for live and composite dead loads. Additionally, prestressed girders shall be designed to resist simple span force effects of live loads and composite dead loads. Link slabs may be acceptable.

Draped/Straight Strands, Debonding

Draped or straight-debonded strands may be used for design but straight-debonded strands are preferred. Debonding of straight strands may be required in accordance with the design specifications.

Haunch

To provide for variations in camber, a 2 inch minimum haunch is typically used, exclusive of girder. Conjointly, the haunch shall be set to minimize girder projection into the slab. A maximum projection of $\frac{3}{8}$ inch into the slab is typical to avoid interference with the bar support when matching stay-in-place deck forms are used.

4.4.4.2 Detailing

See [Appendix A4.5](#) for example details. Plan details for prestressed girders and bulb-tee sections typically include:

- Girder elevation
- Girder sections
- Section showing positive moment connections at continuity diaphragms
- Elevation of girders at intermediate bents
- End of unit bearing detail
- Camber and deflections
- Girder variables

- Bar list
- Alternate detail for steel mid-span diaphragms

4.4.5 Joints

See [Subsection 2.2.4](#) for additional information.

4.4.5.1 Design

- Bridge skew shall be considered in the design of joints
- For all proprietary joint types, Manufacturer recommendations for movement range, installation, and limitations for use shall be met
- The design temperature range for joints shall be 0 °F to 120 °F for steel beams/girders and 20 °F to 100 °F for concrete girders. A 60 °F installation temperature shall be assumed
- Roadway surface gaps shall meet the requirements of the design specifications
- Parapet gaps on skewed bridges shall be checked to ensure that Manufacturer limitations for movement range are not exceeded
- Consideration should be given to adjusting bent fixities when the above design criteria cannot otherwise be met. Additionally, joints at the design threshold may be considered acceptable if the widths (gaps) for the temperature extremes are not likely to be attained.
- Bumper plates shall be welded to the expansion device at depths which will allow proper installation and function of joints
- Backwall angles for joint armoring shall be of adequate depth for full contact with bumper plates

4.4.5.2 Detailing

See [Standard Drawing Nos. 55008 & 55009](#) for details of poured silicone joints and neoprene strip seal joints, respectively. See [Appendix A4.6](#) thru [A4.9](#) for example details of preformed silicone joints, finger joints, preformed compression joint seals, and inverted tee cap with poured silicone joints. Neoprene strip seal joints may also be considered for use with inverted tee caps.

4.5 Reinforced Concrete Deck Girder (RCDG) Spans

4.5.1 Design

Reinforcing steel shall be epoxy coated. The following should be considered when determining an acceptable design for RCDG spans:

Deflection

Immediate and long-term deflection shall be considered in design.

Span Lengths

End and interior spans shall have the same form length.

4.5.2 Detailing

Concrete Cover

Provide 2¹/₂ inch and 1 inch cover for top and bottom transverse reinforcement in the deck, respectively.

Forming

All girders for all span lengths of same roadway width shall have the same spacing and girder bottom width. All cap widths shall be the same, regardless of pile or column size, unless a wider cap is needed to meet minimum seat widths at expansion joints.

Joints

For Seismic Performance Zone 1, one end of each RCDG span shall be fixed by dowel bars. For Seismic Performance Zones 2 thru 4, both ends of each RCDG span shall be fixed by dowel bars, unless the bridge length requires an expansion joint to allow for thermal movement.

Protective Surface Treatment

All bridges shall have a protective surface treatment applied to the roadway surface and top and front face of parapet rails and sidewalks, if applicable. All State-owned bridges in Districts 4, 5, and 9 shall receive a Class 2 protective surface treatment. All others shall receive a Class 1 protective surface treatment. See AHTD Section 803 for more details.

Class 1 or Class 2 protective surface treatment shall not be used on surfaces where textured coating finish is specified.

Surface Finish

The bridge deck shall be given a tined finish as specified for final finishing in AHTD Subsection 802.19 for Class 5 Tined Bridge Roadway Surface Finish unless a Class 7 Grooved Bridge Roadway Surface Finish is specified on the plans.

Sidewalks shall receive a broomed finish as specified for final finishing in AHTD Subsection 802.19, for Class 6 Broomed Finish.

Taper

For all girders and diaphragms, use a 1¹/₂ inch taper on the sloping face of the member to allow for easier removal of the forms. Continue to hold the bottom 1'-6" width dimension on the girders.

4.6 Reinforced Concrete Slab Spans

4.6.1 Design

Reinforcing steel shall be epoxy coated. The following should be considered when determining an acceptable design for reinforced concrete slab spans:

Dead Load Deflection

Immediate and long-term deflection shall be considered in design. Long-term deflection shall be determined by the limits shown in [Table 4.5](#).

Table 4.5: Long-Term Deflections

Skew	Long-Term Deflection
0°	3.0 * (Immediate) but $\leq 1/2$ in.
15°	2.5 * (Immediate) but $\leq 7/16$ in.
30°	2.0 * (Immediate) but $\leq 5/16$ in.
40°	1.5 * (Immediate) but $\leq 1/4$ in.
$\geq 45^\circ$	1.0 * (Immediate) but $\leq 3/16$ in.

4.6.2 Detailing

Concrete Cover

Provide 2 1/2 inches and 1 inch cover for top and bottom transverse reinforcement in the slab, respectively.

Joints

The slab unit is generally poured from one end of the unit to the other with each span poured separately. A keyed construction joint is formed at all interior span joints. Slab joints shall extend to the outside edge of the deck slab and shall be installed before the falsework is removed and the parapet railing is poured. Joints shall be cleaned by sandblasting or other approved method prior to the installation of a Type 3 or 4 Joint Sealer.

Protective Surface Treatment

All bridges shall have a protective surface treatment applied to the roadway surface and top and front face of parapet rails and sidewalks, if applicable. All State-owned bridges in Districts 4, 5, and 9 shall receive a Class 2 protective surface treatment. All others shall receive a Class 1 protective surface treatment. See AHTD Section 803 for more details.

Class 1 or Class 2 protective surface treatment shall not be used on surfaces where textured coating finish is specified.

Surface Finish

The bridge deck shall be given a tined finish as specified for final finishing in AHTD Subsection 802.19 for Class 5 Tined Bridge Roadway Surface Finish unless a Class 7 Grooved Bridge Roadway Surface Finish is specified on the plans.

Sidewalks shall receive a broomed finish as specified for final finishing in AHTD Subsection 802.19, for Class 6 Broomed Finish.

4.7 Precast Concrete Spans

4.7.1 Design

Reinforcing steel shall be uncoated. The following should be considered when determining an acceptable design for precast concrete spans:

Dowel Bars

Dowel bars shall be designed to resist seismic forces.

Live Load Deflection Limit

The live load deflection limits of LRFD Article 2.5.2.6.2 are hereby waived for the standard 31' spans.

Live Load Distribution Factor

The commentary in the design specification states that dowels should not be considered sufficient to achieve full transverse flexural continuity between the precast units; therefore, spans shall be designed with one wheel path on a unit for moment and shear. No multiple presence factors shall be applied.

Rail Design

Railings for precast concrete spans may be designed for a Test Level Two (TL-2).

4.7.2 Detailing

See [Standard Drawing Nos. 55080, 55081, 55082, & 55083](#) for LRFD precast concrete spans.

4.8 Railing

4.8.1 Design

Railing reinforcing steel shall be epoxy coated, except for railing on precast slab spans in which the reinforcing steel shall be uncoated. The New Jersey shape concrete barrier, meeting Test Level Four (TL-4) criteria and with dimensions shown in [Appendix A4.10](#), is the standard traffic barrier and test level to be used on bridges statewide, except as noted below:

- When sidewalks are required and the design speed is 45 mph or less, a Test Level Two (TL-2) rail design may be acceptable. This exception is typically made to allow aesthetic rails to be used at the request of local agencies.
- When traffic volumes permit the use of precast concrete spans. See [Subsection 2.2.1](#) item 4.
- When local agencies request a particular rail appearance on higher speed facilities, FHWA-approved railings meeting Test Level Four (TL-4) or Test Level Five (TL-5) design criteria may be used with the approval of the Bridge Engineer. See [Subsection 10.3.4](#) for additional information.
- When a 3'-6" single slope rail is required to meet the geometric requirements of the approach roadway on Interstates, a Test Level Four (TL-4) design is still acceptable. This exception is typically made so that the bridge rail conforms to the same shape of the median barrier used on the approach roadway.
- When a 3'-6" tall and Test Level Five (TL-5) railing is required for a high volume of trucks or due to unfavorable site conditions (superelevation, severe grades in curvature, adverse weather conditions, etc.) where rollover or penetration beyond the railing could result in severe consequences. This exception will be considered on a case by case basis with the approval of the Bridge Engineer.

Internal designs for the New Jersey and single slope rails can be found on [ARDOT's network](#). Other railings tested and approved by the FHWA may be used with prior approval of the Bridge Engineer.

4.8.2 Detailing

See [Appendix A4.10](#) and [Appendix A4.11](#) for typical railing details for the New Jersey shape rail and the Sloped Face shape rail, respectively. The following criteria are relative to the above rail types:

Open Parapet Rails

Storm runoff from the bridge deck is typically accommodated by the use of parapet rails with open drains. The number of open drains shall be maximized on spans, within the constraints of these guidelines. For bridges in level grade, a drain located near mid-span is desirable to reduce lateral spreading. Open drains shall not be placed within 7'-0" from centerline bent or centerline joint at end bents. Deeper girders may require a greater distance. Open parapet rails are not used adjacent to sidewalks or on the high side of superelevated decks and are not permitted:

- Directly over roadways, sidewalks, bike paths or trails
- Within railroad right of way
- Directly over bridge end slopes not protected by riprap
- Over environmentally sensitive waterways
- Over waterways near water supply intakes

When open parapet rails are not permitted and the allowable ponding widths of [Subsection 3.10.2](#) are exceeded, a bridge drainage system to collect deck runoff will be required.

Parapet Joints

The location of full and partial depth joints shall be labeled on the superstructure details. Panel lengths shall be selected so the parapet joints align with required slab joints and pouring sequence construction joints. The number of different panel lengths should be minimized to simplify detailing, and appearance should be considered.

Full depth parapet joints shall be placed at all required slab joints. Partial depth joints shall be placed near the dead load point(s) of contraflexure and at all other locations. Refer to [Subsection 4.4.2.2](#) for additional information on slab joints.

Parapet Enhancements

A ± 3 inch tall continuous inset shall be provided along the back face of all parapet railing at the junction with the deck slab. Additional insets, used for architectural enhancement, may be made continuous or the “picture-frame” effect used. Slip-forming can only be used with continuous insets. Use of architectural enhancements on the parapet railing may reduce the slab extension to a minimum of 1 inch beyond the outside face of railing. Vertical joints and drain openings will still be required as discussed above. Refer to [Section 10](#) for aesthetics.

Bridge Name Plate

Bridge name plates shall be placed on the right side of the railing (when looking ahead station) near the beginning of the bridge for two-way traffic bridges. For one-way traffic bridges, the bridge name plate shall be placed on the right side of the railing (when looking in the direction of travel) near the traffic approach end of the bridge. Future traffic pattern conditions shall be considered. Type D bridge name plates shall be used for state bridges. Type C bridge name plates shall be used for city and county bridges.

4.9 Pedestrian and Bicycle Railing

Pedestrian railing at sidewalks shall have a minimum height of 42 inches. A Type H Metal Bridge Rail mounted to the top of a New Jersey parapet is the preferred detail for meeting this requirement. See [Standard Drawing No. 55014](#). When requested by local agencies for aesthetics and TL-2 rail design criteria for the highway is acceptable, a 42 inch tall combination rail may be used. Railings along shared use paths shall have a minimum height of 54 inches. See [Subsection 2.1.2](#) for additional information.

4.10 Fencing

Fencing is typically required on grade separation structures over railroads and shall be provided in conformance with the railroad company’s individual guidelines. Chain link fencing mounted to the top of the parapet railing, as shown in [Standard Drawing No. 55018](#), is used unless decorative fencing is approved as part of the architectural enhancement criteria for the project.

4.11 Rating Models

The bridge design section shall produce a LARS Bridge model of the superstructure during the design phase of in-house projects. After bridge plans have been signed and sealed, the LARS Bridge model shall be archived on [ARDOT’s network](#). At the completion of the construction phase of the bridge, the Staff Bridge Design Engineer shall thoroughly review the LARS Bridge model to assure it accurately models the final plans and update the model for as-built conditions as necessary.

Section 5

Bearings

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5.1 General

Rectangular steel-reinforced elastomeric bearings are predominantly used in ARDOT projects; however the use of other types of bearings may be warranted for greater economy, large vertical loads or to meet special design constraints.

5.2 Steel-Reinforced Elastomeric Bearings

5.2.1 Bearing Design

Steel-reinforced elastomeric bearings shall be designed in accordance with LRFD and Bridge Division design criteria shown in [Appendix A5.1](#).

Method B (LRFD Article 14.7.5) is the preferred design method, however Method A (LRFD Article 14.7.6) may be used when design constraints prohibit a solution using Method B. All bearings on a bridge should preferably be designed using the same method. If it becomes necessary to mix design methods on a bridge, long-duration testing of all bearings shall be specified.

AHTD Section 808 currently requires 50-durometer hardness for elastomer material. For design purposes, the shear modulus shall be taken from LRFD Table 14.7.6.2-1 using the least favorable (more conservative) of the values in the range for calculations.

In addition to meeting the anchorage requirements of LRFD Article 14.7.5.4 for Method B designs, the following anchorage requirement shall also be met for both Method B and Method A designs:

- If the factored shear force sustained by the deformed pad at the Strength Limit State exceeds 20% of the vertical force due to minimum dead load, the pad shall be secured against horizontal movement by the use of a masonry plate.

A masonry plate vulcanized to the bottom of the elastomer pad may be used if anchorage requirements cannot be met at expansion bearings. The masonry plate shall have a hole for the anchor bolts rather than a slot as used for the external load plate. If masonry plates are required, the peak hydrostatic stress requirement of LRFD Article 14.7.5.3.3 shall be met for both Method B and Method A designs to ensure that upward movement of the plate does not cause internal rupture during the construction condition. The construction condition shall consist of the dead load due to the beam and diaphragm weight only and the corresponding dead load rotation (beam/girder camber) prior to pouring the deck.

A “pintle-type” elastomeric bearing may be used when the rotation criteria for design will not yield a reasonable solution. This type elastomeric bearing eliminates the rotation from the design of the pad by applying it at the pintle plate. Pintle-type bearings shall not be used in Seismic Performance Zones 2, 3, and 4.

Excel analysis programs are available for internal use and can be accessed on [ARDOT's network](#). The designer shall copy the applicable spreadsheet when needed so that the most current version is used. One copy of the “documentation sheet” (design criteria) shall be included in the design calculations for the permanent job record. In addition to the Bridge Division design criteria shown in [Appendix A5.1](#), the following provisions should be considered when selecting pad variables:

- Use 1/2 inch increments when selecting pad width and length (maximum pad width should be bottom flange width plus 4 inches)
- Minimize pad volume within design criteria constraints
- Minimize the number of different pad area combinations when feasible and when not sacrificing too much economy

- The need for masonry plates can often be eliminated by adding an additional interior layer which may prove more cost effective

5.2.2 Anchor Bolt Design

Material Specifications

Table 5.1 shows anchor bolt material specifications. Grade 55 is typically used.

Table 5.1: AASHTO M 314 Galvanized Anchor Bolts

Grade 36	Grade 55	Grade 105 ¹
$F_y = 36ksi$	$F_y = 55ksi$	$F_y = 105ksi$
$F_u = 58 \text{ to } 80ksi$	$F_u = 75 \text{ to } 95ksi$	$F_u = 125 \text{ to } 150ksi$

¹ Supplementary Requirement S1 does not apply to Grade 105 anchor bolts. Grade 105 bolts should be used with caution as they cannot be welded.

Design Procedure

1. Determine the factored loads to the anchor bolts.

The resistance of the anchor bolts shall be adequate for loads at the Strength Limit State and for maximum loads at the Extreme Event Limit State in accordance with LRFD Article 14.8.3.1. Equal distribution of loads to all bolts within a bearing line may be assumed.

By inspection of LRFD Table 3.4.1-1, Extreme Event I will typically control the design of anchor bolts. Wind, braking, and temperature forces would also be transferred to the anchor bolts; however, when considering the use of deep girders and the 1.4 factor for WS at the Strength III Limit State, these forces should typically be less than the applied percentage of the tributary dead load and any live load assumed for the Extreme Event I Limit State. Checking the load combinations for the Strength Limit States should be investigated when it is not evident that the Extreme Event I Limit State will control.

When both longitudinal and transverse seismic loads are applied to a bolt, the resulting force effect shall be determined in accordance with LRFD Article 3.10.8. Anchor bolts in Seismic Performance Zones 2, 3, and 4 shall be sized to meet Zone 1 requirements at a minimum. The seismic force that the anchor bolts shall be designed for shall be determined in accordance with the requirements shown below:

Zone 1

100% of bolts effective, design force as determined from LRFD Article 3.10.9. The vertical reaction shall be considered to include the tributary dead load and the live load assumed to exist during an earthquake.

Zone 2

100% of bolts effective, design for the greater force of 25% of the vertical reaction due to the tributary dead load and the live load assumed to exist during an earthquake or the seismic force effects determined by seismic modeling.

Zones 3 & 4

100% of bolts effective, design for 25% of the vertical reaction due to the tributary dead load and the live load assumed to exist during an earthquake. Transverse shear blocks and longitudinal restrainers shall be used to resist seismic forces.

Inclusion of live load force effects for Extreme Event load combinations should be considered on a case by case basis. Generally, some percentage of live load force effects should be included for longer bridges, bridges with high traffic volumes and bridges with a critical operational classification. Dynamic load allowance shall not be applied to anchor bolts.

2. Determine the resistance of the anchor bolts.

All resistance factors for ASTM F1554 bolts used as anchor bolts for the Extreme Event Limit State shall be taken to be 1.0 in accordance with LRFD Article 6.5.5. AASHTO M 314 anchor bolts are essentially equivalent to ASTM F1554 bolts. A reduction factor per LRFD C6.13.2.12 will be used to account for the non-uniform distribution of loads since all bolts will most likely not engage simultaneously.

Shear Resistance

Shear resistance of anchor bolts determined per LRFD Article 6.13.2.12 in accordance with LRFD Article 14.8.3.1.

$$R_r = 0.8 * 0.48\Phi_s A_b F_{ub} N_s \quad (5.1)$$

Solving for bolt diameter:

$$D = \sqrt{\frac{4P}{0.8\pi\Phi_s 0.48F_{ub}N_s}} \quad (5.2)$$

Where:

$$R_r = 0.8\Phi_s R_n$$

$$R_n = 0.48A_b F_{ub} N_s$$

$$\Phi_s = 1.0$$

$$D = \text{bolt diameter (in.)}$$

$$P = \text{factored design load to anchor bolt (kips)}$$

$$F_{ub} = 58/75/125 \text{ksi (Grade 36/55/105 bolts)}$$

$$A_b = \text{area of bolt (in}^2\text{)}$$

$$N_s = \text{number of shear planes per anchor bolt (Typically 1)}$$

Tensile Resistance

Tensile resistance of anchor bolts determined per LRFD Article 6.13.2.10.2 in accordance with LRFD Article 14.8.3.1.

$$T_r = 0.8 * 0.76\Phi_t A_b F_{ub} \quad (5.3)$$

Solving for bolt diameter:

$$D = \left[\frac{32Py}{0.8\pi\Phi_t 0.76F_{ub}} \right]^{\frac{1}{3}} \quad (5.4)$$

Where:

$$T_r = 0.8\Phi_t T_n$$

$$T_n = 0.76A_b F_{ub}$$

$$\Phi_t = 1.0$$

$$D = \text{bolt diameter (in.)}$$

$$P = \text{factored design load to anchor bolt (kips)}$$

$$F_{ub} = 58/75/125 \text{ksi (Grade 36/55/105 bolts)}$$

$$A_b = \text{area of bolt (in}^2\text{)}$$

$$y = \text{moment arm (in.)}$$

= top of pad to top of cap (No shear blocks or pintles)

= bottom of shear block to top of cap (With shear blocks)

= bottom of curved plate to top of cap (With Pintles)

When bolt diameters required to resist bending become too large, shear blocks can be used to reduce the bolt diameter by decreasing the applied moment arm. The adjusted moment arm shall not be less than 1/2 inch and plan details for shear block depth shall coincide with the moment arm used for design.

5.2.3 Detailing

Although the design specifications indicate additional testing and quality control is required for Method B due to its higher capacity, no recommendations for more rigorous testing are provided. Therefore, when Method B design is used, long-duration testing per AHTD Subsection 808.05 is required. A Special Provision is required with Method A bearing designs to eliminate the long-duration testing requirement. Proof loading of finished bearings is still required for both design methods at 1.5 times the maximum design load.

Plan drawing templates for rectangular elastomeric bearings are available for internal use and can be accessed on the Department's EDM under Job "bridgestd" and Filename "belastobrg.dgn". The "Tables of Design Variables" shown in [Appendix A5.2](#) shall be used to determine the fabricator variables shown on the plan drawing. An example of a plan drawing showing bearings with and without shear blocks is shown in [Appendix A5.3](#). Example details for additional modifications of elastomeric bearings are included for bearings with masonry plates in [Appendix A5.4](#) and for bearings with pintles in [Appendix A5.5](#).

When shear blocks 4 inches or thicker are required, the following note shall be included on the bearing details:

Shear blocks 4 " or thicker may be fabricated from built-up plates with a 5/16 " groove weld on all sides. No plate shall be less than 2 " nominal thickness.

All bearings with external load plates shall be positively secured to beams by welding and to caps with the use of anchor bolts. Anchor bolt lengths and related variables shall be calculated as shown below using values from the "Table of Design Variables".

- Pipe Sleeve Length = $H + \frac{1}{4} \text{in.}$ (round up to nearest 1/8 in.)
- $G = \text{Pipe Sleeve Length} + W$
- Anchor Bolt Length = $G + \text{Minimum Embedment Length}$ (round up to nearest whole inch)

- Sheet Metal Sleeve Length = Distance from highest cap seat elevation to the bottom of lowest layer of flexural reinforcement in the top of the cap (round up to nearest whole inch)

The cap depth should be checked relative to the required length and location of the anchor bolts to ensure that there is adequate cap depth for the bolt embedment and no conflict with piling.

5.3 Steel Rocker Bearings

Steel rocker bearings consisting of a flat masonry plate and single curved face sole plate may be used in lieu of steel-reinforced elastomeric bearings when vertical loads and rotations due to thermal movements are not significant. Rocker bearings shall not be used without prior approval from the Bridge Engineer or for bridges in Seismic Performance Zones 2 thru 4.

Steel rocker bearings shall be designed in accordance with the LRFD with the dynamic load allowance applied. Refer to [Appendix A5.6](#) for standard details for Type B1 thru B4 bearings with an expansion length limit of 60 feet. Custom plate and anchor bolt sizes may be designed for bearings with greater loads and expansion lengths. Proposed anchor bolt size and spacing shall be checked to ensure there is adequate clearance from the bolt to the rolled beam edge and from the beam fillet to the washer.

Bearing plates shall be painted when used with painted beams/girders.

5.4 Isolation Bearings

Isolation bearings may be warranted in high seismic zones to reduce seismic forces in foundations and to allow for redistribution of forces throughout the structure. Isolation bearings may also be used for seismic retrofit projects to modify the dynamic properties of the bridge as an alternative to strengthening weak elements or non-ductile substructure members. These bearings can provide more economy for large bridges and those with significant pier height differences (stiffness), and greater options for aesthetic foundations.

The design, testing, fabrication, and installation of isolation bearings are custom and proprietary; therefore, a special provision must be included in the contract. Dimensional limits and performance requirements of the isolation bearings shall be included in the plans and specifications. Example details for an isolation bearing are shown in [Appendix A5.7](#). Special provisions from past projects are available for reference on [ARDOT's network](#).

5.5 Disc Bearings

Maximum vertical load capacity for disc bearings is typically 10,000 kips; therefore, this bearing type should only be considered as an alternative to Isolation Bearings or when vertical loads are significant. The design, testing, fabrication, and installation of disc bearings are custom and proprietary; therefore, a special provision must be included in the contract. Dimensional limits, performance requirements, and preferred connection details for the disc bearings shall be included in the plans and specifications.

Section 6

Substructure

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6.1 General

6.1.1 Terminology

The following is a list of terms defined for use in this Section:

Bent

A unit of substructure, either end or intermediate, supporting the spans of the bridge

End Bent

Where a bridge span meets the adjacent ground; an abutment

Intermediate Bent

A bent supporting the ends of two spans, continuous or simple; a pier

Cap

The horizontal element of a bent which supports the superstructure

Column

Vertical element of the bent which transfers load to the foundation

Foundation

Element which transfers loads to the supporting bearing strata

Shallow Foundation

Supported directly on bearing strata near the surface

Deep Foundation

Carries loads to lower bearing strata

Footing

A horizontal foundation element which distributes load to a group of supports, called a Pile/Shaft Footing, or to a bearing area, called a Spread Footing

Drilled Shaft

A deep foundation element consisting of a cylindrical hole drilled into the earth and filled with concrete and steel reinforcing

Driven Pile

A deep foundation element consisting of a structural member driven to supporting strata

Pile Bent

A cap supported on the tops of driven piles

6.1.2 Design Specifications

For the design of new bridges, use the edition of the *AASHTO LRFD Bridge Design Specifications* established by the project's design criteria. For the widening or rehabilitation of existing bridges, the substructure may be designed in accordance with the following:

- Use the *AASHTO Standard Specifications for Highway Bridges, 17th Edition, 2002* [7] for all existing bridges with original designs that did not use load resistance factor design.
- Use the applicable edition of the original design specifications or the latest edition of the *AASHTO LRFD Bridge Design Specifications* for all existing bridges designed using load resistance factor design.

6.1.3 Materials

The materials and strengths shown below and their application to various substructure components are typical. Deviations may be required when necessitated by project scope or special design requirements.

AHTD Section 611

Pipe Underdrains

Application: End bents — tall backwalls, integral

AHTD Section 802

Class B Concrete

$$f'_c = 3,000psi$$

Application: Large pours, mass concrete

Class S Concrete

$$f'_c = 3,500psi$$

Application: Caps, backwalls, wingwalls, columns, footings, drilled shafts, pile encasement, and filling for steel shell pipe piles

Class S(AE) Concrete

$$f'_c = 4,000psi$$

Application: Precast concrete piling (non-prestressed)

Class S(AE) Concrete

$$f'_c = 5,000psi$$

Application: Precast prestressed concrete piling

Seal Concrete

$$f'_c = 2,100psi$$

Application: Seal footings

Prestressing Strands (AASHTO M 203, Grade 250 or 270)

$$f_{pu} = 250,000 \text{ or } 270,000psi$$

Application: Strands for precast prestressed concrete piles

AHTD Section 804

Reinforcing Steel – Deformed Bars (AASHTO M 31 or M 322, Type A)

$$f_y = 60,000psi$$

Application: All, use black (uncoated) bars except epoxy-coated bars shall be used for reinforcing connecting the substructure to the superstructure or between adjacent components susceptible to corrosion (backwall to approach slab, for example)

Reinforcing Steel – Plain Bars (AASHTO M 31)

$$f_y = 60,000psi$$

Application: Spiral reinforcing only

Reinforcing Steel – Wire (AASHTO M 32 or M 225)

$$f_y = 70,000psi$$

Application: Spiral reinforcing only

AHTD Section 805

Steel H-Piles (Gr. 36 or 50)

Application: Foundation Piling

Structural Steel Pipe (ASTM A252, Grade 3)

$$F_y = 45,000psi$$

Application: Steel shell foundation piling, permanent casing

AHTD Section 807**Structural Steel (ASTM A709, Gr. 36, 50, or 50W)**

$$F_y = 36,000 \text{ or } 50,000psi$$

Application: Joint armor, seismic restraints

AHTD Section 815**Type C Membrane Waterproofing**

Application: Vertical construction joints in end bents

6.1.4 Design Loads

Loads shall be in accordance with the design specifications. See [Sections 4](#) and [7](#) for additional loading considerations.

6.2 Expansion End Bents**6.2.1 Caps**

The transverse cap length shall accommodate support of the beams/girders and provide a minimum of 6 inches from center of anchor bolt and 9 inches from edge of piling to end of cap. Extension of the cap length beyond the bridge deck width should be avoided.

The longitudinal cap width shall accommodate the minimum seat width “N”, defined in LRFD Article 4.7.4.4 and provide a minimum of 6 inches from center of anchor bolt, 3 inches from edge of bearing, and 9 inches from edge of piling to end of cap. Accommodation shall also be made for the joint width and thermal movement of the beam/girder. All of these constraints shall be considered when setting the C.L. Joint to C.L. Bearing dimension. When bearing seats would require excessive width due to skew, beam/girder flanges and external load plates for bearings may be clipped to provide a minimum clearance of 1/2 inch from the backwall at the maximum design temperature.

Bridge deck cross-slope, longitudinal grade and bent skew can cause beam seat elevations to vary. These variations should be accommodated using steps, risers, or pedestals. Beam seat elevation differences of less than 3/8 inch should be made by thickening bearing external load plates to simplify cap forming. The minimum cover to anchor bolts and bearings specified previously also applies at edges of steps or pedestals.

The cap depth shall be proportioned to provide a reasonable balance between concrete and reinforcing to achieve the required shear and moment resistance and shall not be less than 2 ft-6 in. The depth may need to be increased above design requirements for piles with increased embedment, to provide clearance for pile anchorage and anchor bolt embedment, and to accommodate embankment slopes and berms.

The minimum shear reinforcement shall be No. 4 stirrups at 12 inch spacing. The minimum flexural reinforcing to be used in both the top and bottom of the cap is six No. 6 bars. However, an equivalent area of smaller bars at a tighter spacing may be necessary to meet temperature requirements. In the top, reinforcing is typically in a single layer terminated with standard hooks. In the bottom of pile bent

caps, flexural reinforcing is usually placed in vertical columns along front and back cap faces to leave the bottom open for the piling. When cap steps produce a concrete cover greater than 6 inches over the main flexural reinforcement, additional reinforcement shall be provided in the steps, pedestals, or risers.

6.2.2 Backwalls

The backwall thickness shall be 18 inches, unless approved otherwise. The top-most portion, which serves as the roadway surface, shall be 12 inches thick. The remaining 6 inches on the embankment side, referred to as the “paving notch” or “paving bracket”, shall be lower than the roadway surface to support the approach gutters and pavement or approach slab (if used). Typical top of backwall to top of paving notch dimensions are 9.5 and 15 inches to accommodate the 9 and 14.5 inch thick standard slabs or gutters. The paving notch may be uniform in depth and sloped to parallel the deck cross-slope or variable in depth.

If the bridge has shoulders, the paving notch should extend from face to face of rail. If the bridge has sidewalks, the paving notch should extend from gutterline to gutterline at a minimum. The upper portion shall match the profile of the curb and sidewalk and is typically the full backwall thickness.

The roadway surface of the backwall shall match the bridge deck including any crown, rounding, superelevation, or longitudinal grade.

The back face vertical reinforcing should be designed to resist lateral earth pressure and live load surcharge (when no approach slabs are used). The reinforcing requirements shown in [Appendix A6.1](#) may be used to determine the back face vertical reinforcing for standard loadings which conform to the criteria defined therein. For specific designs, the earth pressure loading should also be designed for the backfill material and conditions expected in construction. If granular free-draining material, underdrains, or prevention of construction load surcharge are required for design, the plans and specifications shall coincide.

Front face vertical reinforcing should meet the minimum reinforcing requirements of the design specifications and should be spaced to match the back face vertical bars when possible. Vertical reinforcing in both faces may need to be increased for atypical situations and seismic loading.

Approach slabs and gutters shall be doweled to the backwall in Seismic Performance Zones 2 thru 4.

6.2.3 Wings/Rails/Fillets

Wingwalls and rails are used to retain the embankment material behind the backwall and to provide a transition from the approach guard rail to the bridge rail. The rail length shall match the wingwall length. The depth of the wingwall at the face of backwall shall be adequate to keep the fill slope from undermining the cap which is also dependent on the slope intercept station selected. Preferably, a minimum overlap of 1 ft-9 in. shall be provided between the cap seat and bottom of wingwall. Wingwall depths are typically specified in 6 inch increments.

Wingwalls shall be designed to resist lateral earth pressure, live load surcharge, rail impact loading, and seismic forces, when applicable. Wingwall thickness is typically dictated by the railing width it supports. Rails shall conform to Division details or shall meet the requirements of the test level criteria required for the facility. Approach gutters shall be doweled to the wingwalls in Seismic Performance Zones 2 thru 4.

Longitudinal wingwalls are typically used with a minimum length of 10 feet measured from front face of backwall to provide for the standard 10 foot transition rail. Details of example rail transitions are shown in [Appendix A6.2](#). Wingwall lengths 13 feet or greater shall include a foundation pile at the end of the wingwall and at other locations as required by design. Additional wingwall and rail length may be required for the following conditions:

- Use of strip seal joints, finger joints, or other joints requiring armoring in the rail
- Use of longer slope intercepts or flatter end slopes
- Need to retain more embankment
- Limitations on right of way
- Rock cuts

Triangular concrete fillets placed at the intersection of the wingwall and backwall provide improved resistance to vehicular impact forces and typically extend from the top of the paving notch to the bottom of the wingwall. Fillet leg dimensions shall be approximately 1 ft-6 in.

6.2.4 Foundations

End bent foundations are usually driven piles, but drilled shafts, columns on spread footings or pier walls on spread footings or foundation pile footings may be used when justified by subsurface conditions. A combination of vertical and battered (12V:4H) piles is recommended in Seismic Performance Zone 1 to provide adequate lateral resistance. Piling in Seismic Performance Zones 2 thru 4 is typically vertical, but reduced batters (12V:1.5H) may be considered when non-seismic lateral loading concerns outweigh seismic concerns. The front face of the cap is typically sloped to match pile batter, if used.

Maximum pile spacing is generally limited to 10 to 12 feet with consideration to the beam spacing and pile size chosen.

6.3 Integral End Bents

6.3.1 General

Integral end bents are jointless and beam ends are cast into a concrete diaphragm tied to the cap. In order for thermal movement and rotations to be accommodated, only vertical piles shall be used in the end bents. Concrete and steel shell piles shall be prebored 10 feet below bottom of cap and backfilled with loose granular material to allow for movement. Prebored holes shall be 6 inches greater than the pile diameter or diagonal. H-Piles shall be installed with the weak axis parallel to C.L. Anchor Bolts. Pipe underdrains in accordance with [Standard Drawing PU-1](#) are also required behind the cap and adequate outfall through embankment slopes shall be provided.

The end of beam is typically located 6 inches from end of bridge measured perpendicular to the end bent. The centerlines of bearing, cap, and piles should be at the same location.

6.3.2 Caps

The cap shall extend the full out to out width of the bridge deck. Two anchor bolts are used as vertical supports for the beam, deck concrete, and associated non-composite loadings. They should also resist moments and shears generated by the thermal movements and rotations of the beams prior to the diaphragm pour.

A minimum clearance of 4 inches is typically provided between the bottom of the beam at its centerline and the top of cap. Variations in beam seat elevations are accommodated by sloping the top surface of the cap.

Paving notches, wingwalls, rails, and fillets are similar to those required for expansion end bents, except wingwall and rail details are included with the superstructure details. The minimum longitudinal reinforcing specified in [Subsection 6.2.1](#) shall apply. Epoxy coated tie bars shall extend from the cap into

the concrete diaphragm and shall be designed to resist shear at the cap-diaphragm interface. They shall meet minimum development length requirements and lap sufficiently with tie bars in the diaphragm.

Approach slabs and gutters shall be doweled to the superstructure for all seismic zones.

6.3.3 Diaphragms

The concrete diaphragm serves as a backwall to retain embankment and shall resist resulting earth pressures. To resist beam pullout, shear studs shall be welded to the embedded ends of beams. In higher seismic regions, some transverse reinforcing bars in the diaphragm may be placed continuously through holes in the beam webs. In lower seismic regions, the transverse reinforcing bars do not have to be continuous.

6.4 Intermediate Bents

6.4.1 Caps

The transverse cap length shall accommodate support of the beams/girders and provide a minimum of 6 inches from center of anchor bolt and 9 inches from edge of piling to end of cap. Adequate length for seismic restrainer engagement shall be considered. Extension of the cap length beyond the bridge deck width should be avoided.

For all intermediate bents, the longitudinal cap width shall provide the minimum clearances shown above for anchor bolts and piling, and a minimum of 3 inches from edge of bearing pad to edge of cap. For expansion-expansion bents, the cap width shall also accommodate the minimum seat width "N", defined in LRFD Article 4.7.4.4. For column bents the cap should generally be 6 inches wider than the column(s) to allow for reinforcing clearances and improved constructability. Where standard reinforcing clearances are adequate, the cap width may be the same size as the column.

Bridge deck cross-slope, longitudinal grade and bent skew can cause beam seat elevations to vary. These variations should be accommodated using steps, risers, or pedestals. Beam seat elevation differences of less than $\frac{3}{8}$ inch should be made by thickening bearing external load plates to simplify cap forming. The minimum cover to anchor bolts and bearings specified previously also applies at edges of steps or pedestals.

The cap depth shall be proportioned to provide a reasonable balance between concrete and reinforcing to achieve the required shear and moment resistance. The cap depth is typically not less than 2 ft-6 in. or less than its width. The depth may need to be increased above design requirements for piles with increased embedment, and to provide clearance for pile anchorage and anchor bolt embedment. Cap overhangs are typically haunched on overpasses when aesthetics is a concern.

For pile bents, the top reinforcing is typically in a single layer terminated with standard hooks and the bottom reinforcing is usually placed in vertical columns along front and back cap faces to leave the bottom open for the piling. For single/multi-column bents, flexural reinforcing in both the top and bottom of the cap is placed in single or multiple rows as required. The top row of reinforcing in the top of the cap is typically terminated with a standard hook. Anchor bolt size and location should be considered when designing the reinforcing bars required in the top of the cap.

The minimum shear reinforcement shall be No. 4 stirrups at 12 inch spacing. The minimum flexural reinforcing to be used in both the top and bottom of the cap is six No. 6 bars. However, an equivalent area of smaller bars at a tighter spacing may be necessary to meet temperature requirements. Adequate spacing shall be provided between longitudinal reinforcement in horizontal layers and between vertical layers in caps. The minimum clearance between edge of cap and ends of bars or shear reinforcement

shall be 2 inches. When cap steps produce a concrete cover greater than 6 inches over the main flexural reinforcement, additional reinforcement shall be provided in the steps, pedestals, or risers.

6.4.2 Columns

Columns shall have a minimum cross-sectional dimension of 2 ft-6 in. and shall meet slenderness requirements. Dimensions shall be increased in 6 inch increments up to 5 feet and 12 inch increments thereafter. The minimum clearance between edge of column and transverse reinforcement shall be 2.5 inches.

For hammerhead columns with rounded ends, it is preferable to specify an even foot dimension for the straight (transverse) sides of the column. This allows contractors to use standard metal forms.

The p-delta analysis or moment magnification method shall be used in the design of columns. When possible, columns in a bent should be positioned to balance the negative and positive cap moments and to minimize the dead load moment occurring at the bottom of the columns. Considerations for cap and column relative proportions include, but are not limited to: economy of design, appearance, and requirements for stage construction. See [Section 7](#) for additional considerations for seismic design.

Optional or required construction joints shall be detailed for significantly tall and/or wide columns to prevent blow out of column forms during the concrete pour.

6.4.3 Footings

6.4.3.1 Spread Footings

For limitations on the use of spread footings, minimum embedment in rock, and bearing capacity, see [Subsection 6.5.1](#). The preferred minimum thickness for spread footings is 2 ft-6 in., but 2 ft-0 in. may be used for small bridges.

Spread footings are assumed to behave like beam cantilevers and are considered infinitely rigid. Negative footing pressure at the Service Limit State should be avoided. Negative footing pressure may be permitted at Strength and Extreme Limit States as long as the eccentricity requirements of the design specifications are met and the footing designed accordingly. If top tension reinforcing is required, the bars shall terminate with standard hooks. If top reinforcing is only required for temperature and shrinkage requirements, the bars do not need to be hooked.

Reinforcement in the bottom mats shall not be less than No. 6 bars at 6 inch spacing. The minimum clearance between the faces of the footing and reinforcement shall be 3 inches. Reinforcement in the bottom mats shall be terminated with standard hooks.

6.4.3.2 Pile Footings

The minimum thickness for pile footings shall be 3 ft-6 in. Piles may be battered when needed for lateral resistance, except when used in high seismic zones.

Pile uplift at the Service Limit State should be avoided. Pile uplift at Strength and Extreme Limit States may be permitted when skin friction can be developed. For strength loading, 50% of the skin friction may be used to resist uplift. For extreme event loading, 100% of the skin friction may be used. If top tension reinforcing is required, the bars shall terminate with standard hooks. In Seismic Performance Zones 2 thru 4, laps shall be provided for top reinforcing that intersects with confinement reinforcing extending from the column into the footing. See [Section 7](#) for additional seismic information.

Bottom mat reinforcing shall be designed to be placed above top of piling, but may be dropped to the bottom of footing between piling for detailing. Reinforcing bars shall not rest on concrete piles or concrete filled steel shell piles, but may rest on steel H-piles.

Reinforcement in the bottom mats shall not be less than No. 6 bars at 6 inch spacing. The minimum clearance between the faces of the footing and reinforcement shall be 3 inches. Reinforcement in the bottom mats shall be terminated with standard hooks.

6.5 Foundations

6.5.1 Shallow Foundations

Generally, shallow foundations such as strip or spread footings shall only be used when bearing on competent rock. When site conditions or special considerations require bearing on soil, prior approval shall be obtained from the Bridge Engineer. The permissible bearing resistance shall be determined by the Materials Division.

Shallow foundations shall be keyed a minimum of 2ft-0in. into competent rock or greater when recommended by the Materials Division. A minimum cover of 2 feet shall be provided unless erosion resistant rock is at or near the surface, in which case, the top of footing(s) may be set at or below the channel bottom as determined by the lowest channel elevation within the footprint of the footing area. Additional cover may be required for scour.

6.5.2 Deep Foundations

Deep foundations typically used include driven piling and drilled shafts. Other types of deep foundations may be used with prior approval from the Bridge Engineer.

6.5.2.1 Driven Piles

6.5.2.1.1 Design

Piling shall conform to AHTD Section 805 with typical sizes, grades and usage as listed below. Larger piles may be used if warranted. For widening projects, piling in intermediate bents shall typically match the shape and size of existing piling.

Steel H-Piles

- HP 12x53, HP 14x73
- ASTM A709, Grade 50
- When used as a point bearing pile, approved steel H-pile driving points are required
- Generally used in Seismic Performance Zones 1 and 2
- May be driven as long piles without a follower in seal footings to determine minimum pile penetration. See AHTD Subsection 805.07(f).

Concrete Filled Steel Shell Piles

- 14 in. to 24 in. diameter, inclusive (Larger diameters are acceptable with approval from the Bridge Engineer)
- ASTM A252, Grade 3, $F_y = 45ksi$
- Minimum shell thickness of 1/2 in.
- Driving tips shall be designed to resist driving forces

- May be left unfilled when used for temporary detour bridges
- Generally used in Seismic Performance Zones 2 thru 4, to meet slenderness requirements in pile bents, or for flexural strength in integral end bents

Concrete Piles

- 14 in. to 24 in. square, inclusive
- Prestressed concrete piles are preferred over non-prestressed
- Shall not be used in Seismic Performance Zones 3 and 4

The ultimate design bearing capacity should be determined from the structural strength of the pile and the soil resistance.

The following shall be considered as applicable:

Minimum Pile Spacing/Clearances

Arrange piles in cap or footing to meet minimum pile spacing clearances and cover as defined by the design specifications while accounting for accuracy of driving tolerances (3 inches for pile bents and 4 inches for pile footings). Pile group reduction factors shall be applied to the nominal vertical and horizontal pile resistances, when appropriate, for closely spaced piles.

Pile Anchorage

Pile anchorage shall be used for all piling in Seismic Performance Zones 2 thru 4 and shall be designed to meet seismic requirements. The anchorage shown on [Standard Drawing No. 55021](#) meets the minimum resistance required for uplift per the design specifications.

6.5.2.1.2 Bearing Capacity Determination

AHTD Section 805, and when amended by Special Provision “Determination of Bearing Values” provides for three methods of determining pile bearing capacity. The method used is determined by the designer. The three methods and their general application are as follows:

Method A – Empirical Pile Formulas

The Engineering News Formula (ENR), as defined by AHTD Subsection 805.09(a), is typically used for steel H-piles bearing on rock. Due to its low reliability, this method has an extremely low resistance factor in the design specifications; therefore, the Service Limit State is used to design piles and the minimum safe bearing capacity specified in the plans shall not exceed $0.25F_yA$.

The FHWA-Modified Gates Formula (MGF), as defined by Special Provision “Determination of Bearing Values,” allows steel HP piles and steel shell piles (maximum diameter of 18 in.) to be driven to an ultimate bearing capacity. If MGF is specified, the Strength Limit State shall be used for design, and the minimum required ultimate bearing capacity specified in the plans.

Method B – Wave Equation Analysis (WEAP)

Method B shall be used for concrete piles and for steel shell piles with a diameter greater than 18 inches, unless approved otherwise. Bridge Division uses the software program DRIVEN to model the soil/pile interaction to determine the estimated pile length. The pile and soil parameters are then modeled with an assumed driving system using the GRLWEAP software. The assumed driving system shall consist of a diesel hammer with an energy rating that will produce blow counts near the upper limiting range (12 blows per 1 inch) for the required bearing capacity and that will not exceed the allowable pile driving stresses at refusal (20 blows per inch) as defined in AHTD Subsection 805.07(h). The assumed hammer’s energy rating shall be shown on the plans for the Contractor’s use in determining a suitable hammer.

After the job has been awarded and the Contractor submits a proposed driving system for approval, the GRLWEAP model should be updated and evaluated. A response memorandum is sent to the Construction Division recommending the approval or rejection of the hammer. If the driving system is approved, the pump setting to be used during driving with the approved hammer shall be specified and appropriate bearing graphs and tables included in the response. See [Appendix A6.3](#) for example correspondence.

Test piles are typically used only for concrete piles. Test piles for steel shell pipe piles are usually not required, but may be driven for the Contractor's information in estimating pile lengths. The pile driving system and recommended pile lengths shall be approved for test piles before production piles are ordered. See [Appendix A6.4](#) for example correspondence. Revised bearing graphs and tables may be required for recommended production pile lengths.

Method C – Dynamic Load Test

Method C requires the same analysis process discussed in Method B as well as including dynamic testing on the test pile(s). Method C should be considered for friction piles when there is a large quantity of piling, sometimes in conjunction with a lack of confidence in pile length determinations so that more exact production pile lengths can be fabricated (concrete piles), and sometimes in conjunction with higher required bearing capacities. The use of Method C shall be approved by the Bridge Engineer.

6.5.2.1.3 Determining Pile Lengths

1. For end bearing piles, pile length is typically determined by inspection of the soil borings anticipating bearing capacity being obtained in rock. For friction piles, pile length is determined using the DRIVEN program. The estimated plan length, at a minimum, is the length at which the nominal bearing capacity is obtained. Concrete piles are typically rounded up to the nearest 5 foot increment and steel H-Piles and steel shell pipe piles are rounded up to the nearest foot.
2. When required, the results of a liquefaction analysis shall be considered in determining the minimum pile plan length. Division personnel use an Excel spreadsheet to estimate liquefaction potential. When modeling the pile and soil interaction in DRIVEN, the skin friction is typically reduced by 90% for liquefiable soil layers. Pile tips should generally be placed below liquefiable layers.
3. Hard clays may be problematic when modeled in the DRIVEN program. Due to the loss of adhesion when undrained shear strength increases, this program typically indicates that longer piles will be required to obtain capacity. When blow counts indicate that refusal should be reached at a much shorter length, engineering judgment should be used to estimate plan pile length.
4. Pile plan length shall provide for minimum fixity and capacity below anticipated scour depths.
5. The effects of down drag shall be considered when applicable.

6.5.2.1.4 Details

The following Standard Drawings are available:

- [55020 “Standard Details for Steel H-Piles and Pile Encasements”](#)
- [55021 “Standard Details for Concrete Filled Steel Shell Piles and Pile Encasements”](#)
- [55022 “Standard Details for Concrete Piles”](#)

The following shall be considered as applicable:

Pile Cap Embedment

Piling shall be embedded a minimum of 12 inches into footings or non-integral bent caps for pile sizes 18 inches or less and a minimum of 15 inches for pile sizes greater than 18 inches. Piling shall be embedded a minimum of 18 inches into integral bent caps for all pile sizes.

Pile Casings for MSE Retaining Walls

Piles shall not be driven through the constructed reinforcement zone of mechanically stabilized earth (MSE) retaining walls. When piles are to be installed within a reinforcement zone, casings are typically installed prior to or during embankment construction and the piles driven through the open casings after embankment to bottom of cap is in place. Driving the piling prior to embankment construction may also be considered, but any other methods will require prior approval of the Bridge Engineer.

Pile Encasement

Pile encasement is required for steel piles in intermediate pile bents. Encasement shall extend from 3 feet below natural or finished ground surface to 1 foot above the ordinary high water elevation unless extending encasement to bottom of cap is more desirable. Exposed portions of steel piling not protected by pile encasement shall be painted in accordance with AHTD Subsection 805.02. See [Standard Drawing Nos. 55020 & 55021](#) for additional information.

The Contractor typically has the option of using galvanized corrugated steel pipe or reinforced concrete for the pile encasement unless otherwise indicated in the plans. Considerations should be given to appearance, the pile encasement type used on adjacent bridges, and corrosion issues due to farm chemicals in the waterway. Districts 1 and 10 should always be consulted for their preference.

Preboring or Water Jetting

Preboring, water jetting, or other methods approved by the Engineer may be required to achieve the minimum pile penetration. Preboring is typically specified for rock or stiff clays. Water jetting is typically specified for sands.

6.5.2.2 Drilled Shafts**6.5.2.2.1 General**

The use of drilled shafts for deep foundations is typically limited to rock-socketed shafts. Shafts in soil may be used, but the use of slurry displacement shafts in loose sands is discouraged. The Environmental Division shall be consulted for approval and use of slurry.

Specifications for drilled shafts and non-destructive testing of drilled shafts are not included in the AHTD Standard Specifications; therefore, special provisions are required. Division examples of special provisions for “Drilled Shaft Foundations” and “Non-Destructive Testing of Drilled Shafts” are available on [ARDOT’s network](#).

6.5.2.2.2 Design

For general requirements, use Publication No. FHWA-NHI-10-016 *Drilled Shafts: Construction Procedures and LRFD Design Methods* [15] as a reference.

Shaft diameter should preferably be larger than the column diameter to allow for construction tolerances in alignment. The use of permanent casing should be considered for the following conditions:

- Large diameter shafts
- Deep Shafts

- Construction through surface water
- Vibration from adjacent traffic/railroad
- Karstic formations/cavities
- Springs/Water Intrusion likely
- Gravel or sand upper layers

When permanent casing is used, the following should be considered:

- The casing diameter shall be a minimum of 6 inches greater than the rock-socket.
- A casing diameter of 12 inches or greater than the rock-socket should be considered on large diameter shafts or when the rock quality or bedding planes are anticipated to spall or splinter making sealing difficult. A wider support ledge for the casing may provide a better seal in these conditions.
- Should sealing at the rock interface become problematic during construction, a boring fluid may be used. Prior to its acceptance as a means of remediation, the Environmental Division shall be consulted for any potential environmental issues.

6.5.2.2.3 Details

In Seismic Performance Zone 1, lapped splices for transverse reinforcing in the top of the shaft within the column dowel zone may be used when there are conflicts between column and shaft reinforcing steel. The plans shall include a note for the laps to be staggered. In Seismic Performance Zones 2 thru 4, spirals shall be used for transverse reinforcing.

Temporary casing may be specified when water infiltration is anticipated, but its use should be limited. Soil type, as well as depth and size of casing, may make removal of the casing difficult.

Non-destructive testing in the form of Crosshole Sonic Logging (CSL) shall be applied to some or all drilled shafts on a project with the following considerations:

- Dependent on design needs (site conditions, number of shafts in a bent, etc.), CSL testing may be required on each shaft in a project or on only a select few to provide for on-going quality assurance.
- Tubes shall be placed in all shafts to allow for testing subsequent shafts (if not all specified) as directed by the Engineer when materials, operational procedures, equipment, sequence of construction, time and/or site conditions vary from the initial shaft construction.

Section 7

Seismic



Section 8

Plans, Specifications, and Quantities

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8.1 Plan Details

Plan drawings shall accurately and thoroughly provide all information necessary for the successful construction of the bridge and other structures in conjunction with the project specifications and the AHTD. Details within drawings should be organized to group related details together when possible and should be scaled appropriately for legibility.

In order to simplify the development of electronic bridge details, Bridge Division has created a cell library for common bridge details, notes, and drawing borders.

For developing bar lists and bending diagrams, standard tables of bar bends for Grade 60, AASHTO M 31 or M 322 reinforcing steel are available in [Appendix A8.1](#). Maximum bar lengths used in detailing shall be 45 ft. for No. 4 reinforcing bars and 60 ft. for No. 5 and larger reinforcing bars.

8.1.1 Plan Drawing Scale

Final bridge and structural drawings shall be half-size (11" x 17") based on a "theoretical" original full-size plan drawing. Scales used and shown shall also be based on the "theoretical" full-size original. The Bridge Engineer's seal shall have a minimum diameter of 1.25 inches on half-size drawings.

When developing plan details and layouts, refer to [Appendix A8.2](#) for drawing scales and for standardized border and text sizes relative to each scale and [Appendix A8.3](#) for standardized element attributes. All drawings for a project should be similar in appearance and consistent in the format and text size used for title blocks.

8.1.2 Plan Drawing Order

Plan drawings should be assembled in an order that generally reflects the sequence of bridge construction. A typical organization of non-standard drawings is shown below. This list is not intended to be comprehensive and not all details will be required for every project.

- Schedule of Bridge Quantities
- Bridge Layout
- Hydrographs
- Exhibit A (railroad overpasses only)
- Temporary Bridge Layout
- Stage Construction Details
- Retaining Wall Layout and Details
- Substructure Details (in order of bent number)
- Transitional Approach Railing (after end bent details)
- Arkansas Form Insert Details (after appropriate details)
- Special Piling Details
- Elastomeric Bearings
- Superstructure Details
- Deck Drainage System
- Handrail and Fencing Details

- Approach Slabs and Gutters
- Temporary Bridge Details
- Sign Structure Details

When multiple bridges are in a project, layouts and details shall be assembled per bridge in order of project stationing. Common details for bridge construction are generally included in the bridge drawing sequence where first required. For bridge drawing naming convention, see [Appendix A8.4](#).

Concrete box culvert drawings are considered “Special Details” and shall be included with other special details in the project by the Roadway Design or State-Aid Division.

8.1.3 Bridge, Sign Structure, and Drawing Numbers

8.1.3.1 Bridge Numbers

All bridges within state-awarded contracts shall be assigned a bridge number for inventory and archival purposes. Bridge numbers shall be determined by Bridge Division based on the following:

Locally-owned Bridges: Use 4000 series, then next available number
 State-owned Bridges: Use 7000 series, then next available number

Generally for locations with multiple bridges, such as interstate main lanes and frontage roads, one bridge number shall be selected with a letter variable placed at the beginning. Typical bridge numbering for multiple structures at one location is shown in [Figure 8.1](#).

Box culverts will not be assigned a bridge number during plan development. Bridge length box culverts will be assigned a bridge number by the bridge inspector during the first inspection. Bridges within local public agency-awarded contracts will also not be assigned a bridge number during plan development. They too will be assigned a bridge number by the bridge inspector during the first inspection.

8.1.3.2 Sign Structure Numbers

All overhead, bridge mount, cantilever, and tee mount sign structures shall be assigned a structure number for inventory and archival purposes. Sign structure numbers shall be determined by Bridge Division based on the next available number from the Division’s Sign Structure Inventory Log for the applicable route and county. Sign structure numbers from existing structures to be replaced shall not be reused.

Sign structure numbers shall be formatted as shown below. The first number is the Route and the second is the County Number. Arkansas County Numbers are provided in [Appendix A8.5](#). The third number represents the next available structure number for the route and county. Number sequences shall not be repeated among the different types of structures (BM, OH, OC, or TM).

Example Bridge Mount No. = BM 065-21-06
 Example Overhead No. = OH 040-60-48
 Example Cantilever No. = OC 530-35-03
 Example Tee Mount No. = TM 030-46-16

8.1.3.3 Drawing Numbers

In general, all bridge and structural drawings, except concrete box culverts, shall be assigned a drawing number for tracking and archival purposes. Drawing numbers shall be determined by Bridge Division based on the next available number(s). Occasionally a drawing may be developed at the request of the Roadway Design or State-Aid Division and included as a “Special Detail” with no drawing number(s) assigned. Concrete Median Barriers or Barrier Walls are examples of possible “Special Details” drawings.

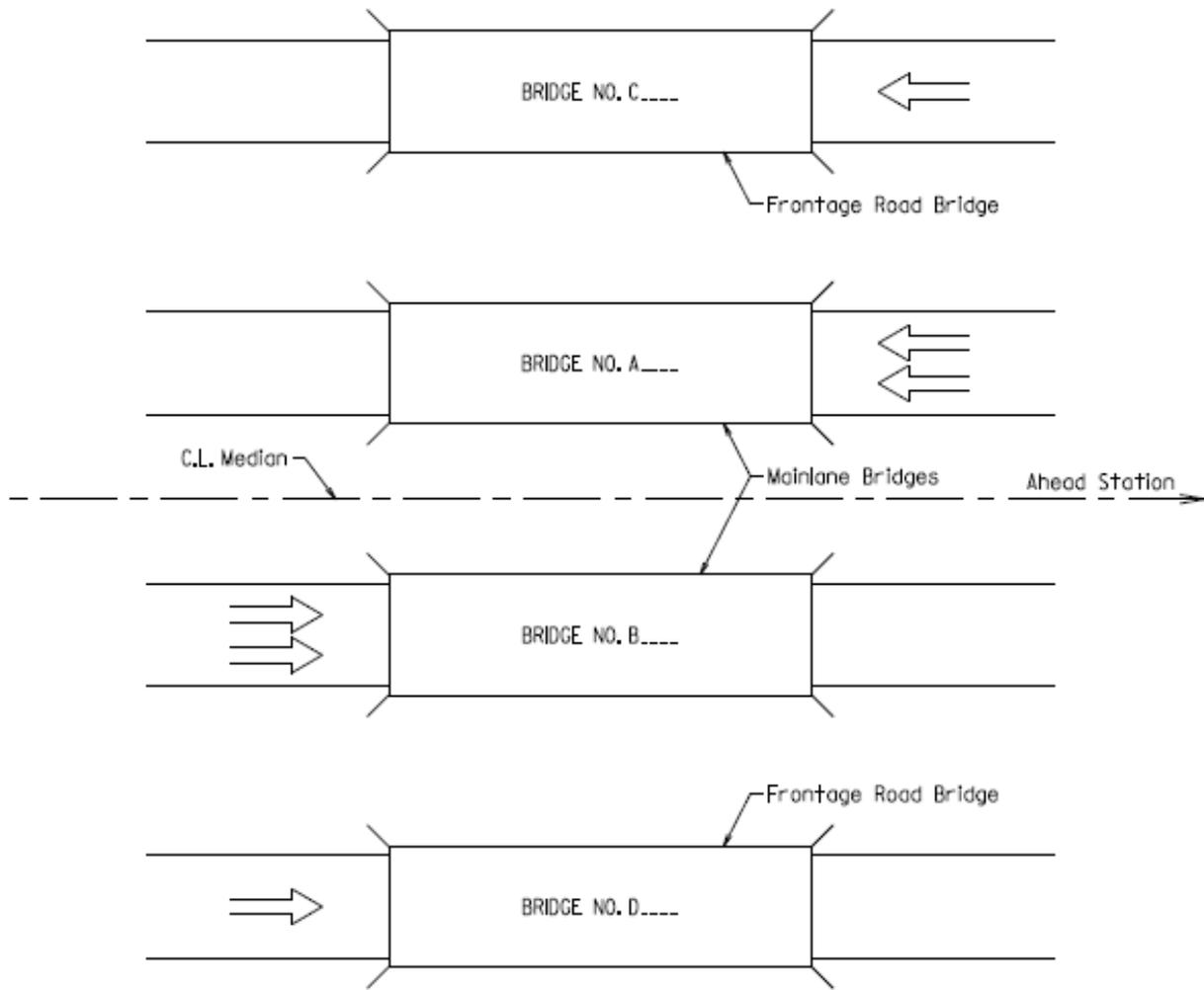


Figure 8.1: Example Bridge Numbering for Multiple Structures at One Location

8.1.4 Standard Drawings

When applicable, bridge standard drawings shall be used over project specific details to reduce effort and provide consistency. Refer to [Appendix A8.6](#) for a list of currently available bridge standard drawings. For additional guidance on the applicability of standard drawings and plan detailing which accompanies their use, refer to [Appendix A8.7](#) “Standard Drawing Detailing Aids”.

In addition to the above, there are “standardized” drawings available for the following details. These drawings require additional information for completion and shall be assigned drawing numbers.

- Details of Elastomeric Bearings
- Details of 40’ to 54’ Steel Overhead Sign Structure
- Details of 55’ to 69’ Steel Overhead Sign Structure
- Details of 70’ to 85’ Steel Overhead Sign Structure
- Details of 86’ to 100’ Steel Overhead Sign Structure
- Details of 101’ to 115’ Steel Overhead Sign Structure
- Details of 35’ Steel Cantilever Sign Structure

8.2 Quantities

8.2.1 Computation of Quantities

Specific information regarding “Method of Measurement” and “Basis of Payment” for each pay item may be found in the appropriate Section of the AHTD or applicable Supplemental Specifications or Job Special Provisions.

The method of measurement and standard weights used by Bridge Division for structural steel components and reinforcing steel are included in [Appendix A8.8](#). Also included is a table of the permitted variations in weight given in ASTM A6 for use in calculating the additional percentage of overrun for plates more than 36 inches wide in accordance with AHTD Subsection 807.89.

8.2.2 Schedule of Bridge Quantities

A “Schedule of Bridge Quantities” drawing is required for each project with one or more bridges. An example is shown in [Appendix A8.9](#). The schedule shall include all pay items required for removal of the existing bridge(s), for temporary bridge(s), and for all components of the new bridge(s) or for remodeling of the existing bridge(s). Pay items shall be shown in numerical order with the exact pay item name shown in the Standard Specifications, Supplemental Specifications or applicable Job Special Provisions. When Supplemental Specifications or Special Provisions are applicable to standard pay items, “SS & __”, “SP, SS, & __”, and “SP & __” shall be included with the pay item. When a non-standard pay item is established with a Special Provision, the item shall be listed after all standard pay items and the item number shown as “SP Job __”.

The name plate title for a Type D name plate shall be "ROUTE OVER CROSSING FEATURE". The name plate title for a Type C name plate shall be "CROSSING FEATURE". For example, the name plate title for a bridge on Highway 278 over the Union Pacific Railroad would be as follows:

Type D Name Plate Title:	HIGHWAY 278 OVER UNION PACIFIC RAILROAD
Type C Name Plate Title:	UNION PACIFIC RAILROAD

Site Numbers for removal of existing bridges shall be coordinated with the Roadway Design or State-Aid Division, including any bridges replaced by culverts.

Quantities for retaining walls, approach slabs and gutters, and other items related to the bridge, but not part of the bridge construction, shall be included in the Roadway Design or State-Aid Division’s summary of quantities.

Quantities shall be tabulated for each Unit of Structure, Totals for Each Bridge, and the Totals for the Job. Quantities shall be “rounded” in accordance with Bridge Division’s “Standard Rounding for Bridge Quantities” shown in [Appendix A8.10](#).

In addition to the quantities, “footnotes” should be included to provide unique job information, as applicable to quantities, which may assist with bidding and construction. “Footnotes” which are commonly used include:

- Approximate quantity of rock excavation included in Unclassified Excavation
- Grade of steel piling
- Special driving tips required for h-piling
- Description of existing bridge(s) to be replaced by culvert(s)
- Restrictions on use of flat tips for steel shell piling (driven thru geogrid)

- Quantities included for estimating and bidding purposes with actual quantities determined in the field.

8.3 Specifications

8.3.1 Supplemental Specifications

Supplemental Specifications are revisions to the AHTD that are adopted subsequent to issuance of the printed book. The Roadway Design Division is responsible for developing guidelines for where and when to use governing specifications. Refer to [Subsection 8.4.3](#) for additional information.

8.3.2 Special Provisions

Special Provisions are additions, modifications, or revisions to the Standard and Supplemental Specifications for conditions unique to an individual project. Both common and more unique Special Provisions are located on [ARDOT's network](#).

8.4 Additional Project Submittals

Final plans shall be submitted to the Bridge Administration for review in advance of the Program Management due date by two months for both State-Oversight (S) and Federal-Oversight (F) jobs. In addition to the plan drawings, the following items shall be included in the submittal: Job Submission Form, Drawing List, Specifications List, Cost Estimate, and Scour Form 113. The layout and checklist submitted for the preliminary layout approval shall also be attached. Examples of the required submittals are included in [Appendix A8.11](#) thru [A8.16](#). Final project submittal to the Roadway Design or State-Aid Division for letting processing shall include the bridge plans, drawing list, specifications list, Special Provisions, and cost estimate(s).

8.4.1 Job Submission Form (Internal Use)

The table in the job submission form shall be completed and comments provided for unique designs or details that would assist with the review process. This form can be accessed on [ARDOT's network](#).

8.4.2 Drawing List

The drawing list shall include the drawing number and title, and the bridge numbers applicable to that specific drawing. This list shall be developed in EXCEL with all text in capital letters. The drawing titles shown shall match the plan drawings. Standard Drawings are not included in the Drawing List, but are shown in the Specifications List.

8.4.3 Specifications List

A specifications list shall be provided which defines the Supplemental Specifications, Special Provisions, and Bridge Standard Drawings to be used in the project. In addition, any Roadway Standard Drawings which are applicable to the bridge construction shall also be included. A template list can be accessed on [ARDOT's network](#).

8.4.4 Cost Estimate

A cost estimate shall be prepared for each bridge based on pay items and quantities shown in the "Schedule of Bridge Quantities". The estimate shall include a line item showing the cost per square foot

based on the out-to-out area of the bridge excluding any costs for the temporary bridge and removal of the existing bridge.

Useful resources for determining unit costs include:

- Bridge Division “Bid Tabulations” stored on [ARDOT’s network](#)
- Program Management Division “Weighted Average Unit Prices” located on the ARDOT website under “Contractor and Consultant Information/Construction Contractors”

8.4.5 Scour Form 113

Scour Form 113 shall be completed for each bridge whether over a hydraulic crossing or not. A copy of this form shall be forwarded to the Bridge Inventory, Rating, and Management Section. This form can be accessed on [ARDOT’s network](#).

8.5 Plan Revisions

The following process will be used for plan revisions after the letting advertisement is published:

After the project is advertised, but before the letting

All revisions to contract documents will be submitted to the Roadway Design Division for their processing of an Addendum. The Roadway Design Division will make changes to the Roadway Summary of Quantities and Revisions.

After the project is let to contract

Drawing and quantity revisions will be made as applicable for submittal by interoffice memorandum to the State Construction Engineer via Doc Express. The Roadway Summary of Quantities and Revisions box will not be revised. The Reprographics Section shall be copied on the memorandum and original plan drawings submitted for scanning to the Reprographic Archives.

Section 9

Miscellaneous Structures

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9.1 Reinforced Concrete Box Culverts

9.1.1 Existing Box Culverts

Existing box culverts designed using the AASHTO Standard Specifications and typically constructed prior to 2012 may be widened or extended using the "X-Series" Standard Drawings which can be accessed at: \\SAN1\ReproductionArchive\Z_StandardsHistory\Standards\ENGLISH. [Standard Drawings RCB-1](#) & [RCB-2](#) will always be required. [Standard Drawing RCB-3](#) will be required when the existing culvert is to be extended.

The means of widening and extending existing box culverts designed using the LRFD is under development. [Standard Drawing RCB-3](#) will be required when the existing culvert is to be extended.

9.1.2 LRFD Box Culverts

- Box Culvert standard designs are based on *AASHTO LRFD Bridge Design Specifications, 5th Edition with 2010 Interim Revisions* [2]
- All completed drawings shall be half-size (11"x17")
- All four (4) "General Details of R.C. Box Culverts" sheets shall be included in a job regardless of whether a single or multi-barrel culvert is designed
- Drawings may be accessed on [ARDOT's network](#)

9.1.2.1 Applicability

The embedded spreadsheets will produce designs for the following:

- Barrel Size: See [Table 9.1](#) for available barrel sizes
- Barrel Skew: Any skew 45° or less in 5° increments
- No. of Barrels: 1 to 6 inclusive
- Fill Height: 0 to 40 feet inclusive
- Wingwall Skew: Default skews for wingwalls are measured 30° from a perpendicular to the roadway centerline, but are limited to a range from 0° to 60°. Wingwalls may also be parallel to the barrel.

Special designs are required for box culverts that do not meet the above limitations.

Table 9.1: Available Culvert Sizes up to Six Barrels

Height (ft)	Span (ft)									
	4	5	6	7	8	9	10	11	12	
3	4x3	5x3	6x3							
4	4x4	5x4	6x4	7x4	8x4					
5	4x5	5x5	6x5	7x5	8x5	9x5	10x5			
6	4x6	5x6	6x6	7x6	8x6	9x6	10x6	11x6		
7		5x7	6x7	7x7	8x7	9x7	10x7	11x7	12x7	
8			6x8		8x8	9x8	10x8	11x8	12x8	
9						9x9	10x9	11x9	12x9	
10							10x10	11x10	12x10	
11								11x11	12x11	
12									12x12	

9.1.2.2 Procedure for General Detail Sheets

Add Job Number at top of sheet and PE Stamp.

9.1.2.3 Procedure for Tabular Data Sheets

1. Select the appropriate Microstation drawing for the number of barrels in the culvert
2. Enter data into Input Fields for “Job No.,” “Tabular Data By:”, and culvert “Station”
3. Place Final PE stamp
4. Enter Data and Answer Questions, as appropriate, in the Yellow Highlighted Cells of all Embedded Spreadsheets in the order listed below. *Enable macros after embedded spreadsheets are opened.*

Skewed End Section Tables

- If box is not skewed, no input is required
- Input skew, slope of fill, maximum fill depth for entire box, clear span, and clear height
- The embedded spreadsheet internally calculates the design fill depth for the skewed end section based on the input. The user will determine whether both the slope section and mid-section tables are required or only the mid-section table by comparing the skewed end section fill depth with the maximum fill depth for the entire box.

Slope Section Tables

Input fill depths as described below, clear span, clear height, skew, and slope of fill and then answer questions as appropriate. The embedded spreadsheet internally calculates the design fill depths to apply to the slope section and mid-section tables when the “maximum fill depth for entire box” is input. The “maximum fill depth for entire box” is the largest depth of fill occurring within the total box length rounded up to the nearest 5 feet. For maximum fill depths less than 2 feet, input 2 feet.

For fill depths 10 feet or less for the entire box length:

- The Slope Section Tables are required for square boxes only
- Input the maximum fill depth (2’, 5’, or 10’) for the entire box. The minimum fill depth input shall equal the maximum fill depth. The slope section table is required for square boxes to obtain headwall quantities.

For fill depths greater than 10 feet:

- And the Skewed End Section Table is not required, the minimum fill depth shall be 10 feet and the maximum fill depth shall be the maximum fill depth for the entire box
- And the Skewed End Section Table is required, the minimum fill depth shall be the calculated design fill depth shown in the Skewed End Section plus 5 feet and the maximum fill depth shall be the maximum fill depth for the entire box

For wider culverts with large skews and greater fill depths, it may be possible to eliminate the Slope Sections and only have a Skewed End Section and Mid-Section. See [Appendix A9.1](#) for details showing how the embedded spreadsheet calculates section length.

Mid-Section Table

- The Mid-Section fill depth shall be the maximum fill depth rounded up to the nearest 5 feet for fill depths > 5 feet. Input 2 feet if the fill depth is ≤ 2 feet. Input 5 feet if the fill depth is > 2 feet and ≤ 5 feet.
- Section Length = Total Box Length – Sum of all Section Lengths (SL and LL) for both the inlet and outlet.

Wingwall Tables

- Input “OW”, “H” and “C” from whichever section (Skewed, Sloped, or Mid-Section) abuts the wingwalls.
- When wingwalls are parallel to barrel, input positive and negative values of the skew for the appropriate Wing A or Wing B angle.

9.1.2.4 File Naming Convention

Drawing Files shall be named as follows and stored on the EDM:

bJobNo_culvert	Box Culvert General Detail Sheets
bJobNo_c1	Tabular Data for Box Culvert @ Sta. ____+__
bJobNo_c2	Tabular Data for Box Culvert @ Sta. ____+__
bJobNo_c3	Tabular Data for Box Culvert @ Sta. ____+__

9.1.2.5 Procedure for Submittal

Submit the following information to the Assistant Bridge Engineer for review and approval:

- Route Slip Memo with quantities (Example located on [ARDOT's network](#))
- Original Roadway Design or State-Aid Division request memo and attachments
- General Detail Sheets with PE Stamp
- Tabular Data Sheets with PE Stamp

9.1.2.6 Procedure for Archiving

Bridge Division's Administrative Assistant will scan the following documents for archival and store on [ARDOT's network](#):

- Route Slip to Roadway Design or State-Aid Division
- Original Roadway design request memo and attachments
- Tabular Data Sheets with PE Stamp

9.1.2.7 Design Examples

See [Appendix A9.2](#), [A9.3](#), and [A9.4](#) for culvert details based on the examples in [Table 9.2](#).

Table 9.2: Culvert Design Examples

Example No.	1	2	3
Station	100+00	200+00	300+00
Maximum Fill Depth (Measured from Top of Top Slab)	1.80'	22.40'	37.85'
Minimum Fill Depth (Measured from Top of Top Slab)	1.25'	5'	5'
Number of Barrels	3	6	5
Span of Barrel	8'	8'	6'
Height of Barrel	4'	8'	6'
Roadway Slope at Wings	2:1	3:1	4:1
Skew Angle of Box	0°	45°	35°
Skew Angle of Wings	45°	Std.	Std. @ Inlet Parallel @ Outlet
Length of Barrel	74'	190'	310'
Class S Concrete	170.89 CY	1,214.94 CY	1,121.29 CY
Reinforcing Steel	21,635 LB	208,273 LB	171,540 LB

9.2 Three-Sided Precast Culverts (Bottomless)

This Section will be developed in the future.

9.3 Retaining Walls

9.3.1 General

Retaining walls are typically required when the site characteristics or right of way available is not adequate for the construction of sloped embankments or excavations. Wall types frequently used include mechanically stabilized earth (MSE), modular block, and cast in place walls. Less frequently used wall types include gravity block, welded-wire, or fabric faced MSE (for temporary walls), and soil nail walls.

MSE and modular block walls are commonly used in fill sections where the placement of the soil reinforcing can be easily accommodated during embankment construction. Cast in place walls are typically used in cut sections where the more extensive excavation required for soil reinforcement is not economical or practical.

Retaining walls shall be designed using the edition of the *AASHTO LRFD Bridge Design Specifications* established by the project's design criteria and applicable Special Provisions. Typical special provisions for retaining walls can be accessed on [ARDOT's network](#).

Consideration shall be given to existing utilities and drainage structures to remain in place, proposed drainage structures, and vertical clearances and structural elements of adjacent bridge construction when establishing the wall layout and details.

9.3.2 Mechanically Stabilized Earth (MSE) Retaining Walls

9.3.2.1 Design

The design of MSE walls is proprietary and only approved wall systems on the Department's Qualified Products List (QPL) will be considered acceptable. A Special Provision is required for this wall type. Two methods of backfill construction (Method A and Method B) are permitted by this specification and should be addressed in the plan details.

MSE walls used to retain fill at end bents shall be located so that there is no conflict between any battered piling and the leveling pad. Piles shall not be driven through the MSE wall reinforcement zone; therefore pile casings will be required from bottom of leveling pad to bottom of cap. Spread footings are not permitted for bridge end bent foundations located behind MSE walls and within the zone of reinforced backfill unless approved by the Bridge Engineer.

Unless otherwise approved by the Bridge Engineer, railing required for vehicular traffic shall not be placed directly on top of MSE walls. Railing shall be placed immediately behind MSE walls, separated by a joint, and designed using a moment slab for vehicular impact loading.

9.3.2.2 Detailing

The Design Engineer shall establish the required wall geometry, including the horizontal alignment along wall face, top and bottom wall profiles, and length.

When practical, provide smooth grade transitions along the top of the wall and avoid abrupt changes in slope. Information to be shown on the retaining wall layout includes, but is not limited to, the following:

- Plan and Elevation of wall
- Top of wall elevations at appropriate intervals along wall

- Finished ground profile at face of wall, or adjacent ditch grade near face of wall, including actual elevations at appropriate intervals along wall
- Soil borings at appropriate intervals along wall
- Typical sections of wall for Backfill Methods A and B with undercut limits, as applicable (see [Appendix A2.11](#) for example details)
- Underdrain or chimney drain system
- General notes, as applicable
- Factored bearing resistance of existing foundation material
- Architectural finish
- Coping detail
- Table of Quantities (For Information Only)

Materials Division will provide recommendations for the factored bearing resistance and any undercut depths and backfill materials required.

The pay quantities for MSE walls and related items will be included in the Roadway quantity summaries and not on the Schedule of Bridge Quantities.

See [Section 10](#) for information on aesthetics.

9.3.2.3 Temporary MSE Walls

Temporary MSE walls are used to provide for stage construction of the roadway embankment and may be removed, or retained and buried once the roadway portion immediately adjacent to the wall is constructed. They generally consist of compacted soil layers reinforced with geotextile, geogrid, or welded wire and a wire-form or fabric facing system.

The wall system provider shall design the temporary wall in accordance with the Special Provision, and it shall be compatible with the permanent wall system, if any, used on the project. A modular block wall system will not be considered for a temporary wall.

Plans shall include a temporary retaining wall layout showing the plan and elevation of the wall, including the appropriate ground profile at face of wall.

9.3.3 Modular Block Retaining Walls

9.3.3.1 Design

The design of modular block walls is proprietary and only approved wall systems listed on the Department's QPL will be considered acceptable. A Special Provision is required for this wall type.

Modular block walls shall not be used to retain fill at end bents unless approved by the Bridge Engineer. If permitted at bridge ends, they shall be located so that there is no conflict between any battered piling and the leveling pad. Piles shall not be driven through the modular block wall reinforcement zone; therefore, pile casings will be required from bottom of wall to bottom of cap. Spread footings are not permitted for bridge end bent foundations located behind modular block walls and within the zone of reinforced backfill unless approved by the Bridge Engineer.

9.3.3.2 Detailing

The Design Engineer shall establish the required wall geometry, including the horizontal alignment along wall face, top and bottom wall profiles, and length. When practical, provide smooth grade transitions along the top of the wall and avoid abrupt changes in slope. Information to be shown on the retaining wall layout includes, but is not limited to, the following:

- Plan and Elevation of wall
- Top of wall elevations at appropriate intervals along wall
- Finished ground profile at face of wall including actual elevations at appropriate intervals along wall.
- Soil borings at appropriate intervals along wall
- Typical section of wall
- General notes, as applicable
- Factored bearing resistance
- Architectural finish
- Table of Quantities (For Information Only)

Materials Division will provide recommendations for the factored bearing resistance and any undercut depths and backfill materials required.

The pay quantities for modular block walls and related items will be included in the Roadway Design or State-Aid Division's quantity summaries and not on the Schedule of Bridge Quantities.

Modular block units are available in a wide variety of textures and colors, and manufacturer's product brochures should be consulted for aesthetics.

9.3.4 Gravity Block Retaining Walls

9.3.4.1 Design

The design of gravity block walls is proprietary. The Contractor will be required to submit a precast gravity wall system that provides for the stability of the retained soil using the weight of blocks and any in-fill material without the use of soil reinforcements or tie-backs. A Special Provision is required for this wall type.

9.3.4.2 Detailing

The Design Engineer shall establish the required wall geometry, including the horizontal alignment along wall face, top and bottom wall profiles, and length. Information to be shown on the retaining wall layout includes, but is not limited to, the following:

- Plan and Elevation of wall
- Top of wall elevations at appropriate intervals along wall
- Finished ground profile at face of wall including actual elevations at appropriate intervals along wall
- Soil borings at appropriate intervals along wall
- Typical section of wall

- General notes, as applicable
- Factored bearing resistance
- Architectural finish
- Table of Quantities (For Information Only)

Materials Division will provide recommendations for the factored bearing resistance and any undercut depths and backfill materials required.

The pay quantities for gravity block walls and related items will be included in the Roadway Design or State-Aid Division's quantity summaries and not on the Schedule of Bridge Quantities.

9.3.5 Cast-in-Place Semi-Gravity Cantilever Retaining Walls

9.3.5.1 Materials

Concrete

Class S with a minimum 28 day compressive strength of $f'_c = 3,500psi$.

Reinforcing Steel

Grade 60 (yield strength = 60,000psi) conforming to AASHTO M 31 or M 322, Type A, with mill test reports.

9.3.5.2 Design

Roadway Design or State-Aid Division shall prepare the details for all cast in place walls within the design limits of [Standard Drawing SI-2](#) (Maximum wall height of 9 feet and without live load). Bridge Division shall design and develop details for walls greater than 9 feet in height or when [Standard Drawing SI-2](#) is inadequate for the site characteristics.

Design of semi-gravity cantilever walls should consider minimizing stem thickness without requiring excessive reinforcement. Battering the back face of the stem towards the heel of the retaining wall improves design economy and assists with obtaining an acceptable deflection at the top of wall. A vertical front wall face is preferred, however when long term deflections are excessive, the Design Engineer should consider detailing a stem offset in an effort to keep the front face from going beyond vertical.

Structural components of the wall system shall provide the required capacity and internal stability. The following guidelines should be considered in design:

- The wall stem shall have a minimum top width of 1 foot. Stem dimension at the base is typically increased by 1/2 inch to 3/4 inch per foot of retained height.
- For the Service 1 Load Combination, a maximum deflection of 1 inch at the top of the wall is recommended.
- The difference in long term deflections between adjacent retaining wall sections shall be less than 1/4 inch.
- The footing shall have a minimum thickness of 1 foot. Typical footing widths are in the range of one-half to two-thirds of the total wall height.

The wall system shall meet the external stability requirements for overturning, sliding, and bearing capacity. The following guidelines should be considered in design:

- The minimum toe width (front face of wall to front face of footing) of the footing shall be 1 foot.
- A shear key may be used when necessary to meet design requirements for sliding.

- Sliding may be neglected when the retaining wall footing is founded on rock. The footing shall be keyed a minimum of 2 feet into competent material or the entire footing embedded as determined by the Design Engineer.

Materials Division will provide recommendations for the factored bearing resistance, and any undercut depths and backfill materials required.

9.3.5.3 Detailing

The Design Engineer shall establish the required wall geometry, including the horizontal alignment along wall face, top and bottom wall profiles, and length. When practical, provide smooth grade transitions along the top of the wall and avoid abrupt changes in slope. Information to be shown on the retaining wall layout includes, but is not limited to, the following:

- Plan and Elevation of wall
- Top of wall elevations at appropriate intervals along wall
- Finished ground profile at face of wall including actual elevations at appropriate intervals along wall
- Soil borings at appropriate intervals along wall
- Typical section
- Limits of pay for excavation
- Expansion and contraction joint details
- Drainage system
- Footing step detail
- General notes, as applicable
- Architectural finish
- Table of Quantities (For Information Only)

The pay quantities for cast-in-place walls and related items will be included in the Roadway quantity summaries and not on the Schedule of Bridge Quantities.

When form liners are used for aesthetics, additional concrete cover may be required on the front face of the wall. See [Section 10](#) for information on aesthetics.

9.4 Temporary Bridges

Temporary bridge structures, typically constructed on detour alignments, are often required when the existing alignment needs to be maintained and neither stage construction nor accelerated bridge construction techniques are practical. Roadway Design or State-Aid Division typically establishes the need for detours.

Occasionally, temporary culverts may be utilized in lieu of temporary bridge structures for special conditions or when flows are small. The Hydraulics Section should be consulted for acceptability of use and assistance with sizing pipes.

Temporary bridges shall be designed in accordance with the *AASHTO Standard Specifications for Highway Bridges, 17th Edition* [7] using an H15 minimum live load. Seismic design shall be in accordance with Division I-A of these specifications. When temporary bridges are anticipated to be in place for 5

years or less, the acceleration coefficient shall be reduced by a factor of 2 when determining the applicable seismic performance category. Minimum seat width provisions shall apply to all temporary bridges. Adjustment of the response modification factors shall be considered for construction sites close to active faults.

9.4.1 Temporary Bridge Elevation

Use Q_2 or Q_5 unconstricted water surface elevation + 1.5' freeboard + superstructure depth (typically 1'-5" for old style precast units) to establish a minimum deck elevation. The low chord of the existing bridge should also be considered as it may be undesirable to reduce the vertical clearance excessively.

Coordinate with the Roadway Design or State-Aid Division to set the temporary bridge grade. The roadway approaches to the temporary bridge may control the temporary bridge elevation to provide for smooth transitions to the existing roadway grade and to meet Green Book criteria for the detour design speed.

9.4.2 Temporary Bridge Length

General criteria for determining the length of temporary bridges include, but are not limited to the following:

1. The main channel shall be spanned, as a minimum, using 1V:1.5H spill-through end slopes and the controlling deck elevation. Temporary bridge lengths of 75% to 80% of the existing bridge length are typical. If the Contractor elects to use vertical wall abutments, the minimum temporary bridge length shown on the plans will still be required.
2. Lengths for temporary bridges located in more restrictive flood hazard areas (Permit Types I, III, and V) need to be checked hydraulically to ensure that the backwater requirements permitted for temporary conditions is not exceeded.
3. Skewed temporary bridges shall be avoided when possible. Skewed crossings may require additional bridge length to span the channel using a square bridge.
4. Specify a minimum temporary bridge length on the plans to the nearest 5 feet. This length should be close to a multiple of the standard precast span lengths of 19', 25', or 31' (31' typically used) rounded down.
5. The length of time a temporary bridge will be in operation should be considered.

9.4.3 Temporary Bridge Width

The general criteria in [Table 9.3](#) shall be used for determining temporary bridge widths, however consideration should be given to site specific traffic such as high truck volume or use by farm equipment.

Table 9.3: Temporary Bridge Widths

Roadway Designation	Temporary Bridge Width
Interstate and Arterials	Use 24 ft minimum
Collectors, Local, City, & County Roads	Use 24 ft if current ADT exceeds 2,000vpd Use 20 ft if current ADT 2,000vpd or less

The use of temporary bridge structures on interstates will require prior approval of the Bridge Engineer.

9.4.4 Standard Design

Standard drawings are available for temporary bridges in Seismic Performance Category A with timber or precast concrete spans and for 20' or 24' roadway widths. [Standard Drawing No. 55054](#) "Bridge End Protection System" shall be specified in conjunction with applicable standard drawings in [Table 9.4](#).

Table 9.4: Standard Drawings for Temporary Bridges

Drawing No.	Drawing Title
55050	Timber Spans – 20' Roadway Width (Sheet 1 of 2)
55051	Timber Spans – 20' Roadway Width (Sheet 2 of 2)
55052	Precast Concrete Spans – 20' Roadway Width (Sheet 1 of 2)
55053	Precast Concrete Spans – 20' Roadway Width (Sheet 2 of 2)
55054	Bridge End Protection System
55055	Precast Concrete Spans – 24' Roadway Width (Sheet 1 of 2)
55056	Precast Concrete Spans – 24' Roadway Width (Sheet 2 of 2)
55057	Timber Spans – 24' Roadway Width (Sheet 1 of 2)
55058	Timber Spans – 24' Roadway Width (Sheet 2 of 2)

Timber spans shall not be used on interstates or temporary bridges where present ADT is 1,500 or greater. Projects with a present ADT between 1,000 and 1,500 or a high percentage of trucks should be considered on a case by case basis.

For temporary bridges carrying interstate traffic, unfilled steel shell pipe piles shall be used in lieu of timber piles. Unfilled pipe piles should also be considered as an alternate bent design to the standard drawings where a significant number of tower bents are required due to the exposed height of timber piling. These conditions may require a combination of the standard details for the spans and alternate or custom design and details for the bents.

When timber piling is used, the plans shall specify whether treated or untreated timber piling shall be used in accordance with the following criteria:

1. Untreated timber piling and untreated pine timber may be used on collectors and local roads where the temporary bridge length is 125' or less. Include the following note on the Layout:

Untreated timber piling and untreated pine timber may be used in the construction of the temporary bridge structure.

2. Treated timber piling and treated pine timber will be required for all other highways, except interstates. Include the following note on the Layout:

If timber piling and pine timber are used on this temporary bridge structure, the materials shall be treated with a preservative in accordance with Subsection 817.04.

If treated timber is required by at least one temporary bridge in the project, require treated timber for all temporary bridges in the project.

9.4.5 Custom Design

Custom design and detailing of temporary bridges may be required for wider bridge widths, skewed bridges, and those assigned Seismic Performance Categories of B, C, or D. Custom designs may require separate temporary bridge layouts similar to the permanent bridge, depending on the scope of details needed.

Timber spans and timber piling will not be permitted on interstates or for temporary bridges in Seismic

Performance Categories B, C, and D. The minimum seat width requirements of the specifications shall be met. Liquefaction potential shall not be considered for temporary bridges anticipated to be in place for 5 years or less.

On longer temporary structures, where a significant number of tower bents are required due to the exposed height of timber piling, consideration should be given to providing an alternate or custom bent design. When steel shell pipe piles are used, it is preferred that they remain unfilled and with no pile encasement specified.

9.5 Sign Support Structures

Bridge Division is responsible for designing structural supports for overhead highway signs and variable message boards. Common structural supports include, but are not limited to: overhead, cantilever, tee-mount and bridge-mount.

9.5.1 Clearances

Except when mounted on median barriers, columns shall be protected by guardrail or concrete barrier unless clear zone requirements are met. When protected by guardrail, the minimum distance provided from outside edge of shoulder to centerline column shall be $2' + 57''$ of guardrail deflection + one-half the column width, but not less than $8'-0''$. Additional clearance may be required due to the excavation footprint and existing features such as ramps, ditches, pipes, and utilities.

A minimum vertical clearance of $17'-6''$ shall be provided between the pavement surface and the bottom of the sign for the entire width of the roadway including shoulders.

9.5.2 Materials

All components of sign supports shall be structural steel conforming to the requirements of Special Provision "Steel Sign Structures".

9.5.3 Design

Either of the following specifications may be used for design:

- *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 6th Edition, with 2015 Interims* [8]
- *AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals* [3]

When the AASHTO Standard Specifications are used for design, structural supports shall be designed for a 50 year design life and Fatigue Category I. Fatigue design for galloping loads may be excluded.

The span shall consist of a quadri-chord horizontal truss and the individual members of the truss may be round pipes, angles, or other accepted structural shapes. The end supports shall consist of multi-column round pipes. The column to base plate connection shall use full-penetration groove welds or a socket-type joint with two fillet welds.

Unless otherwise warranted by site conditions, the column design height shall be $30'-0''$ and structural supports shall be designed for the minimum sign areas shown below:

- Overhead sign supports shall be designed for a minimum sign area equal to 75% of the span length times a sign height of 15 feet.

- Cantilever sign supports shall be designed for a minimum sign area equal to 45% of the cantilever length times a sign height of 15 feet.
- Tee-mount and Bridge-mount sign supports shall be designed for the actual sign or variable message panel areas.

9.5.3.1 Dead Loads

The dead load shall include the sign support structure self-weight and the weight of all sign panels, luminaires (if used), and their attachments.

9.5.3.1.1 Sign Panels

Sign panels are typically made from extruded aluminum and shall have an unfactored design weight of 2.45 pounds per square foot of surface area.

9.5.3.1.2 Variable Message Sign Panels

The weights of proprietary variable message panels can vary; therefore the Maintenance Division shall be contacted for a design weight.

9.5.3.2 Wind Loads

Wind loads shall be applied in both longitudinal and transverse directions. The wind gust factor shall be taken as 1.14.

9.5.3.3 Foundations

9.5.3.3.1 Spread Footings

For spread footings designed in accordance with the *AASHTO Standard Specifications for Highway Bridges* [7] and with no soil investigation, an allowable bearing pressure of 2 ksf shall be used based on a recommended minimum bearing capacity for clays by the Materials Division. A higher allowable bearing pressure may be used for design when confirmed by soil investigation and testing.

For footings designed in accordance with the LRFD, the ultimate bearing capacity shall be determined using appropriate factors.

9.5.3.3.2 Drilled Shafts

Drilled Shafts may be considered for sign structure foundations when relocating the structure or modifying span length is not an option, and when conditions such as existing utilities, ditches, pipes, restrictive work space, and potential for slope failure make the use of a spread footing impractical.

9.5.4 Detailing

9.5.4.1 Support Foundations in Medians

For sign support foundations located in medians, within the clear zone, and not protected by guardrail or barrier, the following median barrier geometric requirements shall be met:

- The minimum barrier height shall be 54 inches above the roadway surface. This barrier height shall extend a minimum of 25 feet each side of the sign support and have a vertical face throughout this length.

- A transition in height and/or shape to the typical barrier section shall occur outside the above limits.
- The minimum barrier width shall be 2'-0" and shall match the footprint of the typical barrier section.

9.5.4.2 Drawings

“Standardized” drawings are available for the following sign structure supports designed under the *AASHTO Standard Specifications for Structural Supports Highway Signs, Luminaires and Traffic Signals* [8]. These drawings require additional tabular data for completion and assigned drawing numbers.

- Details of 40' to 54' Steel Overhead Sign Structure
- Details of 55' to 69' Steel Overhead Sign Structure
- Details of 70' to 85' Steel Overhead Sign Structure
- Details of 86' to 100' Steel Overhead Sign Structure
- Details of 101' to 115' Steel Overhead Sign Structure
- Details of 35' Steel Cantilever Sign Structure

9.6 Pedestrian Bridges

Bridges intended solely to carry pedestrians, bicyclists, equestrian riders and light maintenance vehicles shall be designed in accordance with the latest edition of the *AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges* [1], unless modified herein. Bridges intended for both vehicular and pedestrian loading shall be designed in accordance with the latest edition of the *AASHTO LRFD Bridge Design Specifications*. This Subsection is to address additional guidelines applicable to the design and detailing of bridges without vehicular traffic.

9.6.1 Collision Mitigation

In order to mitigate the risk from vehicular collision, pedestrian bridges located over highways shall have a minimum vertical clearance 1.0 foot higher than that required for highway clearance as stated in [Subsection 2.2.2.2](#).

9.6.2 Design

No additional dead load for a future wearing surface shall be considered.

9.6.3 Detailing

9.6.3.1 Geometric Requirements

Bridges that serve pedestrian and wheelchair users only shall have a clear width of 8 feet unless exceptionally high volumes of pedestrian traffic warrant a greater width, such as in downtown areas or adjacent to sporting arenas.

Bridges that serve as two-directional “shared use paths” for pedestrians, bicycles, wheelchair users, and other non-motorized vehicles shall have clear width of 14 feet. Shared use path bridges shall meet the geometric requirements specified in the *Guide for the Development of Bicycle Facilities, 2012, 4th Edition* [6].

9.6.3.2 Railing

Railing shall have a minimum height of 54 inches. Railing shall not restrict the required stopping sight distance for bicyclists.

9.6.3.3 Protective Screening

Historically, the Department has provided semi-circular, fully enclosed, chain-link type protective screening on pedestrian bridges over highways and some streams to provide protection to the highway/waterway traveler. The minimum vertical clearance shall be 8 feet. Greater clearance may be required for equestrians or light maintenance or emergency vehicles.

With the concurrence of the ACE-Design, Bridge Division's policy for the provision of protective screening (fencing) on pedestrian bridges is shown below:

- For state-owned pedestrian only bridges over traffic, a semi-circular fence should be provided.
- For locally-owned pedestrian only bridges over traffic, a semi-circular fence should be provided, unless requested otherwise.
- If requested otherwise, the current accepted edition of the *AASHTO Roadside Design Guide* [5] shall be used as the determining factor for decision making.
- If, at the discretion of the Department the fence is not required, the owner will be required to install the fence if incidents begin to occur. This provision will be coordinated with the Right of Way Division for inclusion into the Air Space Agreement.

Protective screening consisting of a partially enclosed, curved top is an acceptable alternative. Decorative screening may also be acceptable if aesthetics are a concern.

Section 10

Aesthetics

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10.1 General

In general, aesthetically pleasing bridges integrate into their surroundings and consist of uncomplicated, clean, and balanced proportions that provide continuity in appearance. Architectural features should enhance the overall appearance and not detract from or obscure the structural design. Aesthetic design should consider the following visual design elements and characteristics from *Aesthetic Guidelines for Bridge Design, Minnesota Office of Bridges and Structures, March 1995* [18]:

1. Line

- (a) Profiles of railings, spans, piers, abutments, and wingwalls
- (b) Junctures of different materials and construction joints
- (c) Vertical and horizontal lines are seen as formal and stable
- (d) Oblique lines are seen as dynamic
- (e) Curved lines are seen as either dynamic or tranquil

2. Shape and Form

- (a) Delineates horizontal and vertical dimensions and depth
- (b) Stands out most when clearly separated from background by tone or color contrast or when viewed from head on

3. Color

- (a) Defines, clarifies, accentuates or subdues the visual effects of structural elements
- (b) “Warm” colors tend to emphasize the presence and size of forms
- (c) “Cool” colors tend to diminish the visual importance of elements
- (d) Intensity of color can reverse the above
- (e) Different theories on whether colors selected should match the environment or just be harmonious since manufactured objects are not natural elements

4. Texture

- (a) Helps to define form, soften scale, and add visual interest
- (b) Generally, the greater the distance or larger the object, the coarser or larger the texture should be

5. Proportion

- (a) Balanced and harmonious geometric proportions produce graceful bridges
- (b) Helps define relationship between structural elements implying order of significance

6. Rhythm, Order, and Harmony

- (a) Repetition of like elements
- (b) Arrangement of design elements

7. Balance

- (a) Perceived equilibrium of design elements

8. Contrast

- (a) Relieves monotony by complementing characteristics of design elements with their opposites or with the environment
- (b) Influences which is the dominant feature

9. Scale

- (a) Relationship between the elements of the structure and between the total structure and its surroundings

10. Unity

- (a) Perfect application of all qualities simultaneously

There are numerous references available on the aesthetic design of structures and these should be consulted when the appearance of a structure is a significant concern. Special Provisions for architectural and aesthetic enhancements have been developed for past projects and are available for reference on [ARDOT's network](#).

10.2 Policies

The following departmental policies are applicable unless otherwise modified by the Administration:

10.2.1 Painting of Structural Steel

Typically, structural steel beam or girder bridges constructed over Interstates shall be painted. The selection of a paint color shall consider adjacent bridges on the corridor and preferences coordinated with local agencies. The use of unpainted weathering steel for bridges over Interstates requires approval from the Bridge Engineer.

Environmental constraints should be considered when choosing to paint in lieu of using weathering steel on a bridge over a waterway or context sensitive area.

10.2.2 Textured Coating Finish

To reduce the appearance of staining, white colored textured coating finish shall not be allowed and the color requirements of AHTD Subsection 802.19(b)(3) shall be used. Alternate colors to concrete gray may be used as an architectural enhancement when coordinated with the Bridge Engineer or local agency and shall be shown in the contract documents.

10.2.3 State of Arkansas Form Inserts

State of Arkansas Form Inserts shall be used on all wingwalls of bridges constructed over Interstates unless a mechanically stabilized earth (MSE) retaining wall is used at the end bents. When MSE retaining walls are used at end bent locations, form inserts shall be included on wall panels at locations coordinated with the Bridge Engineer. Form inserts shall be located on wingwalls with consideration to providing visibility and aesthetic proportion after the finished ground surface is in place.

10.2.4 Architectural Finish for Retaining Walls

Ashlar Stone shall be used as the architectural finish for cast-in-place concrete and MSE retaining walls unless precedence for another architectural finish has already been established for a particular region in the State, or as directed by the Bridge Engineer.

10.3 Architectural Enhancements

Architectural enhancements are typically considered on bridges that are highly visible, have significant public impact, including environmental and recreational, when requested by local agencies, and for conformance with Departmental policies. The use of enhancements beyond Departmental policy or for special circumstances shall be coordinated with the Bridge Administration.

The need for architectural enhancements on a bridge should be considered early in the design process as they can affect decisions in the choice of design components, detail dimensions, and material strengths used. An example of this is when an architectural finish is desired on the outside face of concrete parapet rails and standard rail dimensions are increased to provide adequate concrete cover to reinforcing steel.

10.3.1 Parapet Enhancements

Generally, parapet enhancements are applied to the back face of the parapet rail to improve the bridge appearance in elevation. Typical parapet details include a continuous recess (approximately 3 x 3/4 inch) located at the base of the parapet. An additional 12 "x3/4 " recess may be located partially within the parapet panel (picture frame) or run continuous. This additional recess is generally used on overpass structures, and may include textured coating of the recesses. See [Appendix A4.10](#) for example details.

For overpasses over interstates and major divided arterials, a full depth Ashlar Stone architectural finish shall be applied to the back face of the parapets, unless otherwise approved by the Engineer. Typically the base recess is eliminated and 6 " of smooth concrete is provided at the top of the parapet face to appear as a frame for the finish. When form liners are required, standard rail dimensions may need to be increased to provide adequate cover to reinforcing steel.

10.3.2 Painting Structural Steel

The color of paint for steel structures shall be in accordance with AHTD Subsection 807.75, unless otherwise specified by the Bridge Engineer, by the District, by a local agency, or by precedence from other adjacent structures along the corridor. Available paint colors can be viewed at <http://www.colorsver.net>.

10.3.3 Textured Coating Finish

Subject to the policy defined in [Subsection 10.2.2](#), the use of textured coating finish with a project specific color is an enhancement option. Typical surfaces of bridge elements where textured coating finish may be applied include:

- Outside face of parapet rails
- Parapet enhancements
- Outside faces of the slab and the undersides of the slab outside exterior girders
- Exposed surfaces of intermediate bents, excluding top of cap
- Exposed surfaces of end bents including outside face and top of wingwall rails, but excluding top of backwall and cap, and front face of backwall between exterior girders.
- Exposed surfaces of retaining walls (and/or coping)
- Arkansas form recess including chamfer

If textured coating finish is specified for the project, a Special Provision will be required defining the color and locations of application. Payment for this work may be made incidental if a small quantity is involved. Otherwise, payment for this work should be included in the Special Provision. Typically,

the same paint color designations available for structural steel are used to select the color(s) of textured coating finish. Available paint colors can be viewed at <http://www.colorservers.net>.

Environmental constraints should be considered prior to specifying the use of textured coating finish on a bridge over a waterway or context sensitive area (staining of concrete may be a better option). In addition, if environmental constraints preclude the use of textured coating finish, the plans or specifications should disallow the Contractor's option to use textured coating finish as permitted in AHTD Subsection 802.19(a).

10.3.4 Form Liners

Subject to the policy defined in [Subsection 10.2.4](#), architectural form liners are typically considered for use on the following:

- Cast-in-place concrete or MSE retaining walls
- Columns, piers, and abutment walls
- Outside face of concrete parapet rails

Custom designed panels may also be considered when requested by local agencies and authorized by the Administration. The Design Engineer shall investigate the need for any additional concrete cover over reinforcing when using form liners.

10.3.5 Ornamental Bridge Railing

Ornamental bridge railing may be used when requested by local agencies, approved by the Administration, and when its design test level is compatible with the highway classification and design speed.

One type of ornamental railing is a combination railing which is used on bridges with sidewalks, where design speed is lower. It consists of a concrete barrier with open or closed windows and a 42 inch vertical height that serves both vehicular and pedestrian traffic. Example details for a combination railing are shown in [Appendix A10.1](#). These details were based on the Texas Type C411 Railing, evaluated and FHWA-approved for test level two (TL-2) as discussed below.

Other types of non-conventional railing may be used for aesthetic reasons with approval from the Administration.

These railings are considered acceptable for use on Federal-aid projects by virtue of their crash test performance. They should only be used on facilities where their design test level is compatible with the highway classification and design speed. When used, the railing details shall conform to the FHWA-approved railings which may involve contacting the sponsoring State. Special design may be required for the termination of non-conventional railing.

10.3.6 Ornamental Fencing

Fencing is typically only provided on pedestrian structures or on railroad overpasses to meet railroad company guidelines. Ornamental fencing, in lieu of chain link fencing, may be used when requested by local agencies, and approved by the Administration. The spacing between pickets on ornamental fences are, in general, greater than the 2 inch maximum opening allowed by the railroad company; therefore they will require the installation of an expanded metal mesh along the face of the fence. Example details of an ornamental fence with metal mesh are shown in [Appendix A10.2](#).

Ornamental fencing with or without expanded metal mesh shall be specified and paid for using a Special Provision.

10.3.7 Native Stone for Riprap

For bridges over scenic waterways, located in parks, or with cultural significance, the use of native stone for dumped riprap or gabion baskets may be specified to harmonize with the environment. This stone is typically defined as native stone with color and appearance approximating that occurring locally. A Special Provision will be required to modify the following AHTD Subsections:

- Subsection 629.02 for gabion baskets
- Subsection 816.02 for dumped riprap

10.3.8 Stone Masonry Facing

Stone masonry facing may be used on the exposed surfaces of retaining walls, and abutments and piers when requested by local agencies and authorized by the Administration. Custom specifications will be required to address the attachment of the facing to these surfaces, the type of stone, and any construction techniques required to achieve the desired appearance of the facing.

10.4 Lighting

Bridge lighting may be requested by local agencies to provide illumination for pedestrians or for historical or aesthetic reasons. Plans may be developed in one of two ways. Most frequently, the Department installs the conduit, junction boxes, and light pole support or pedestals and the local agency installs the light poles, lamps, and other necessary appurtenances. Otherwise, the Department installs all lighting components turn-key. For this option, reimbursement from the local agency for the light poles and appurtenances may be requested dependent on the presence of existing lighting and project funding. The local agency may also be responsible for utility costs for the lighting.

Considerations when developing lighting plans and details for bridges include, but are not limited to:

- Energy Source
- Location and size of conduit
- Junction box access and size
- The pole spacing, height, and type of lamp chosen affects the intensity of and uniformity of the illumination and should meet AASHTO guidelines for the highway classification
- Support design and details that can accommodate the weight of the light pole assembly and provide adequate area for the base plate footprint
- Lamps and details that lessen potential damage from vandalism
- Accommodation for future installation of light poles and appurtenances by others such as anchor bolt pattern relative to conduit location and method of installation

Plan preparation for bridge lighting details shall be coordinated between the Bridge and Maintenance Divisions. Generally, the Bridge Division contacts the local agency for their preferences and develops plans for the light pole layout, junction box locations, and support details.

The Maintenance Division will design and develop the plans for the electrical components of the lighting system, provide specifications and quantities, and review photometric calculations, as necessary, for conformance to AASHTO guidelines.

Section 11

Utilities

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11.1 General

The Utilities Section of the Right of Way Division is responsible for the overall management and coordination of utilities located on existing or proposed State right of way. A Utility Coordinator within this Section is assigned to oversee utility issues for a particular project.

For state aid projects, the State-Aid Division is responsible for the coordination of utilities on county and local roads.

11.2 Layout Development and Utilities

The presence of utilities within the anticipated footprint of the bridge and retaining walls should be considered during layout development. Depending on the type of utility, adjustments can be costly and can affect the timeliness of project lettings. The Utilities Coordinator or State-Aid Division can be contacted to determine if there are any significant difficulties involved in relocating a particular utility. Some utilities which are of special concern include:

- Sanitary Sewer Lines, especially when large and deep
- Fiber Optic Lines
- High-Voltage Overhead Transmission Lines
- Energy Substations

The constructability of bridge components adjacent to utilities remaining in place shall also be considered. Examples of potential concerns include: pile driving or drilled shaft construction near overhead transmission lines or adjacent to sanitary sewer lines, and bent construction affected by water releases from upstream dams.

Although utilities are located by the Survey Division, the Design Engineer should consider that the actual location of the utility line can be imprecise. When design constraints are tight, additional surveys and/or coordination with the utility owner through the Utility Coordinator or State-Aid Division may be advantageous to secure the exact location of the utility and eliminate potential field problems and post-letting redesign.

At times it may be beneficial to include a Special Provision for Utility Coordination in the project specifications. This Special Provision can provide notification to the Contractor of utility issues on the project and owner contact information for coordination during construction.

11.3 Utility Attachments to New Bridges

Occasionally there are known utility attachments required for new bridges. This can be due to a request from a private utility company or local agency, or a request from the Roadway Design Division for signalization or lighting conduit, or when an existing bridge-attached utility cannot be relocated to an alternate location.

The bridge design shall include the additional anticipated dead load due to the utility. Bridge details shall include component dimensions that provide adequate clearances for installation of the utility. Special details shall be included when necessary. The “General Guidelines for Attaching Utilities to Bridges” shown in [Appendix A11.1](#) shall be considered when developing any plan details for utility attachments.

The utility company or local agency will be responsible for the actual installation of their utility.

11.4 Utility Permit Requests

The submittal of a utility request by a Utility Company or Consultant on state-owned bridges shall be in accordance with the *Utility Accommodation Policy* [11], developed by the Right of Way Division. The general procedure for submittal is:

1. Requesting party contacts the Utilities Section of the Right of Way Division for the “General Guidelines for Attaching Utilities to Bridges” which are shown in [Appendix A11.1](#). Compliance with these guidelines will expedite the processing of the permit.
2. Requesting party contacts the District Permit Officer regarding how to prepare the permit.
3. Requesting party submits the permit application to the District Permit Officer for processing.
4. The District Permit Officer forwards the permit application to the Utilities Section for review and coordination.
5. The Utilities Section forwards application details to the Bridge Division for review and approval.
6. The Bridge Division returns approved details to the Utilities Section for issuance of a permit.

The Bridge Division shall review the utility permit request application for conformance with the guidelines and for impacts to the bridge which may affect its performance and load-carrying ability, and long-term maintenance.

The Bridge Division will respond by interoffice memorandum to the Utilities Section. A scanned copy of the memorandum and pertinent utility application details shall be archived on [ARDOT's network](#) and documented in the Utility Permit Log.

The Bridge Division will only review details for state-owned bridges. City and County bridges and certain bridges on USACE dams are examples of non-state ownership. In the case of non- ARDOT bridges, although the Department may issue a permit for the portion of the work along a state highway, the requesting party must also obtain separate permission from the bridge owner.

Section 12

Shop Drawings

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12.1 General

Prior to fabrication, shop drawings for the following items shall be submitted to the Engineer via Doc Express for review and/or approval:

- Structural Steel
- Prestressed Concrete Girders
- Elastomeric Bearings
- Permanent Steel Deck Forms
- Preformed Joint Seal
- Metal Bridge Railing
- Retaining Walls
- Aggregate Piers
- Overhead, Cantilever, Bridge-Mount, or Tee-Mount Sign Structures
- Other items as required by the job specifications

12.2 Review Process

The purpose for the review of shop drawings is to ensure that the fabricator produces a finished product meeting the materials and design requirements shown in the contract plans and specifications. In general, Bridge Division will not verify the accuracy of all dimensions relative to fabrication.

12.2.1 Structural Steel

The governing specifications for Structural Steel are located in AHTD Section 807. The review shall include verification of the following:

- General dimensions
- All materials (including paint)
- Cleaning designations versus paint type or steel type
- All member sizes (beams, plates, etc.)
- Size and spacing of all bolts, shear connectors, connection plates, and stiffeners
- Size and type of welds
- Expansion device details such as stud and vent holes, rounding, weld locations of connection and bumper plates
- For painted bridges, all coatings shall be supplied by the same Manufacturer to ensure compatibility of primer with paint system and all components to be painted shall use the same paint system

Generally, the review does not need to include verification of camber, detail dimensions, bolt lists or quantities. However when necessary, the review should include verification of additional unique or more complicated details which may require greater assurance of fabrication.

For fabrication approval and distribution, each sheet shall be stamped, dated, and initialed. The digital stamp shown in [Figure 12.1](#) is for internal Bridge Division use.

Reviewed for General Conformity to Plans and Specifications. Detail Dimensions and Quantities not Completely Checked. Contractor's Responsibility is in no way Relieved by this Review.	
Date	Signature
APPROVED <input type="checkbox"/>	REVISE <input type="checkbox"/>
ARDOT BRIDGE DIVISION	

Figure 12.1: Shop Drawing Stamp for Approval

12.2.2 Prestressed Concrete Girders

The governing specifications for Prestressed Concrete Structures are located in AHTD Subsection 802.22. The review shall include verification of the items shown in [Appendix A12.1](#). For fabrication approval and distribution, each sheet shall be stamped, dated, and initialed using the stamp shown in [Figure 12.1](#).

ARDOT allows the Contractor to propose an “optional design”. Prior to submittal of the shop drawings, the alternate design shall be submitted via Doc Express for review and approval. A common alternate design is to revise the strand pattern from “draped” to “straight”. This is usually acceptable; however, larger diameter strands or clustering of strands is not permitted. Debonding and additional “bonded” reinforcing may be required due to these changes and shall be shown on the shop drawings. The Standard Specifications do not require that a Licensed Professional Engineer seal the “optional design”; therefore, the Design Engineer should determine if the revised design is acceptable and if revised contract plans are necessary.

AHTD Subsection 802.22(b) “Prestressing Methods” are details usually addressed in the plant approval process by the Materials Division. When draped strand patterns are utilized, the girder casting bed layout is critical to the tensioning procedures. When this occurs, the casting bed layouts should be reviewed as a part of the shop drawings.

12.2.3 Elastomeric Bearings

The governing specifications for Elastomeric Bearings are located in AHTD Section 808. The review shall include verification of the following:

- Materials, strengths, dimensions, and cleaning methods
- Vulcanization of bearing pad to external load plate and masonry plate
- Correct testing procedures
- How the bearings are marked for proper field identification and orientation
- Maximum design load
- Bevels of external load plate
- Paint limits are shown on external load plate and do not interfere with beam welding
- Compatibility of primer with paint system Contractor plans to use

For fabrication approval and distribution, each sheet shall be stamped, dated, and initialed using the digital stamp shown in [Figure 12.1](#).

12.2.4 Permanent Steel Deck Forms

The governing specifications for Permanent Steel Deck Forms are located in AHTD Subsection 802.14(b). Deck form properties for various fabricators can be found on [ARDOT's network](#), but can often vary. The review shall include verification of the following:

- Design calculations
- Drawing conformity with design calculations such as: use of matching or non-matching forms, form size and gage, concrete cover to reinforcing
- Dimension from the top of slab to the top of the deck form. This dimension is shown in Section C-C on [Standard Drawing No. 55005](#).
- Materials, dimensions, and notes
- Minimum bearing length
- Method of form closure at end bents, between beams, and for stage construction
- Angle support to flange weld length (1 $\frac{1}{2}$ inch maximum)

Prior to approval of the shop drawings, the girder dead load deflections may require investigation for effects due to the permanent deck forms. The use of non-matching forms can add significant concrete and form weight to girders designed assuming matching forms. The detail drawings shall be revised if a change of more than $\frac{1}{4}$ inch occurs. It is preferable that coordination for dead load deflection revisions occurs prior to fabrication of the structural steel. All costs associated with such revision, including re-cambering of a previously approved girder, will be borne by the Contractor. See the "General Notes" on [Standard Drawing No. 55005](#).

For fabrication approval and distribution, each sheet of the calculations (Fabricator and Bridge Division only) and all drawings shall be stamped using the digital stamp shown in [Figure 12.1](#).

12.2.5 Preformed Joint Seal

The governing specifications for Preformed Joint Seal are located in AHTD Subsection 809.02(a). The review shall include verification of the following:

- Materials
- Uncompressed seal width
- Depth, for confirmation of seal support location on structural steel drawings
- Location of any factory-made splices

For fabrication approval and distribution, each sheet shall be stamped using the digital stamp shown in [Figure 12.1](#).

12.2.6 Metal Bridge Railing

The governing specifications for Metal Bridge Railing are located in AHTD Section 806. The review shall verify that the materials and dimensions are in conformity with the plans and specifications.

For fabrication approval and distribution, each sheet shall be stamped using the digital stamp shown in [Figure 12.1](#).

12.2.7 Retaining Walls

The governing specifications for Retaining Walls are provided in the project's retaining wall Special Provision(s). The Construction Division shall submit a request for review of the design and fabrication drawings to the Bridge and Materials Divisions via Doc Express. If fabrication drawings are received from another source, submittals shall be routed back to the Staff Construction Engineer for their handling.

The Bridge Division shall review fabrication drawings and design calculations for conformance with plans, materials, and specifications (including special provisions), except for global stability and bearing pressure. The program MSEW (3.0) is available to model and check the wall at critical locations, if desired. Any questions or revisions shall be submitted by interoffice memorandum to the Construction Division (C: Materials Division) via Doc Express for their further coordination with the Resident Engineer and Contractor.

The Materials Division shall review the fabrication drawings, design calculations, global stability, and bearing pressure. They shall respond directly to the Construction Division with their comments or approval.

The Bridge Division shall coordinate any issues with the Materials Division prior to final approval so that all in-house concerns are addressed prior to stamping the fabrication drawings. Example transmittal memorandums to Construction are included in the Appendix as shown below:

- Appendix A12.2 Example Transmittal Memo-MSE Retaining Wall Revisions
- Appendix A12.3 Example Transmittal Memo-MSE Retaining Wall Distribution
- Appendix A12.4 Example Transmittal Memo-Modular Block Retaining Wall Distribution
- Appendix A12.5 Example Transmittal Memo-Gravity Block Wall Distribution

For fabrication approval and distribution, stamp, date, and initial documents as follows:

- Place a digital stamp on all fabrication drawings showing wall layout, notes, and details that are specific to the job
- Place a digital stamp on the front sheet only of design calculations
- Place a digital stamp on the front sheet only of casting (standard) drawings-MSE walls only

Since retaining wall shop drawings are reviewed but not approved in accordance with the Special Provision, the digital stamp in [Figure 12.2](#) shall be used.

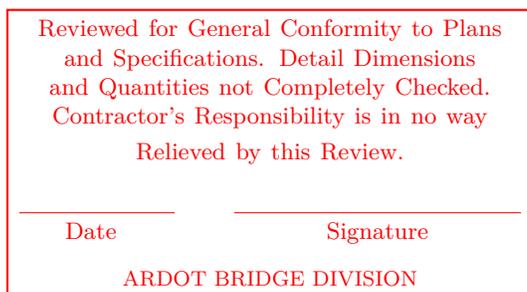


Figure 12.2: Shop Drawing Stamp for Review

12.2.8 Foundation Improvement-Aggregate Piers

The governing specifications for Aggregate Piers are provided in the project's Special Provision. The process for review of submittals and stamping documents for Aggregate Piers shall be the same as for Retaining Walls. Refer to [Appendix A12.6](#) for an example transmittal to the Construction Division via Doc Express for distribution of drawings and design calculations.

12.2.9 Sign Structures

The governing specifications for Steel Sign Structures are provided in the Special Provision *Steel Sign Structures*. The review shall verify that the materials and dimensions are in conformity with the plans and specifications. The Special Provision allows the Contractor to submit a “commercial alternate” in place of the design and details shown in the plans. This commercial alternate must be accompanied by design calculations and certification stamped by a Professional Engineer licensed in Arkansas. The shop drawings shall be checked to ensure that the details conform to the alternate design. No plan revisions are required.

For fabrication approval and distribution, each sheet shall be stamped, dated, and initialed using the digital stamp shown in [Figure 12.1](#).

12.3 Distribution Process

Except for retaining walls and aggregate piers, shop drawing review and coordination shall be conducted directly with the Fabricator using the transmittal form shown in [Appendix A12.7](#) for any revisions. A comment shall be provided in Doc Express noting the shop drawings have been sent back to the Fabricator for revisions. Approved shop drawings for fabrication shall be uploaded into Doc Express and shared via email to the Construction Division for distribution to the Resident Engineer, Contractor and Fabricator. The Concrete and Steel Fabrication Engineer shall be cc'd on all approved shop drawings, except for SIP Forms, retaining walls, and aggregate piers.

Review and distribution of design calculations and fabrication drawings for retaining walls and aggregate piers shall be coordinated through the Construction Division as discussed in [Subsections 12.2.7](#) and [Subsections 12.2.8](#).

Any post-letting plan revisions or Fabricator substitutions that affect previously approved shop drawings will require revision of the shop drawings and re-submittal for review and approval.

Section 13

Archival

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13.1 General

The Bridge Division requires archival of various items for the purposes of monitoring Departmental assets through the Bridge Inventory Program and for maintaining records of bridge correspondence, design calculations, contract plans, and shop drawings. Archival of bridge designs, contract plans, and shop drawings is valuable for future widening, rehabilitation or repair, and for reference when developing new projects. The following tools are used for archival:

- Bridge Cards (Electronic and Hard Copy)
- Project Inventory Log (Frank's Book)
- Job Record Cards
- PaperVision
- Reprographics Archives

13.2 Bridge Cards

A bridge card shall be completed for each new bridge. An example is shown in [Figure 13.1](#). For determining bridge and drawing numbers, refer to [Subsection 8.1.3](#). Bridge cards shall be created using the access database located on [ARDOT's network](#).

In addition to creating bridge cards for new bridges, existing bridge cards shall be updated for any future work that affects a bridge. Examples of future work that requires documenting includes approach gutter retrofits, hydro-demolition and concrete overlays, polymer overlays, widening, and any rehabilitation measures completed under contract.

13.3 Project Inventory Log (Frank's Book)

After the bridge plans are completed, and prior to submittal to the Bridge Administration for final review, the work shall be documented in the project inventory log located in the Division office. This log is an internal Division archive that provides a brief summary of all completed bridge projects and aids personnel in referencing previous designs and details.

13.4 Job Record Cards

Job record cards are developed by the Division Administrative Assistant and provide project letting information such as the Resident Engineer and Contractor that facilitates submittals for project correspondence. These cards also serve the purpose of cross-referencing job numbers to bridge numbers. Job record cards can be accessed at the same link as the Bridge Cards in [Subsection 13.2](#) by selecting "Job Record" and entering "Job Number" in the select job number box.

13.5 Bridge Construction Plans

The Roadway Design or State-Aid Division is responsible for processing projects for letting and for submitting original drawings to Reprographics for digitizing and archival.

The Reprographics Section of the Public Information Office manages and maintains the archival of all bridge and roadway standard drawings, construction plans, and shop drawings. Bridge plans are available after project letting and can be accessed at: \\SAN1\ReproductionArchive\Job #####.

[Bridgenumber.docx](#)**BRIDGE RECORD**Feature Intersected UPRR & S. Rice Street Str. No 07284Route 70 Section 12 County Pulaski Let Date: 12/17/2014Job Title Union Pacific RR Str. & Apprs. (Roosevelt Rd.) (LR) (S) Job No. 061277Clear Bridge Width 50'-0", 66'-2" Out-Out Total Str. Length 662' - 2-1/2" LiveLoa HL93

Superstructure Type	Span Lengths	Substructure Type	Special Features
Continuous Composite Plate Girder Units Unit1 = 400' Unit 2 = 260'	Unit 1 = (104'-148'-148')	Steel H-Piles @ End Bents w/17' Wingwalls	*6' Sidewalks both sides *Fence over RR ROW *Electrical for Lighting by Others & for Access Rd.
	Unit 2 = (130'-130')	Multi-Columns @ Int. Bents on Steel H-Pile Footings	*MSE Wall along SE approach

Drawing Numbers 54032-54066 (Layout 54039-54041, Retaining Wall 54032-54034, Ornamental Fence 54065)Remarks Addl. aesthetic features at request of State FairgroundsReplaces Str. No. 01810 Replaced By Str. No. _____ Seismic Zone 2Layout \\San1\reproductionarchive\061277\ConstSet\061277055.tifBid Tab: ..\.WebPage\BIDTABS\2015\Dec 2014\061277.pdf Job Record: _____**Figure 13.1: Bridge Card Example**

13.6 Archival of Completed Plans

13.6.1 Definition of Completed Project

A project is considered officially complete when a signed release has been sent to the Construction Division. The Division Administrative Assistant will maintain the completion status of all bridge projects and periodically provide updates to Section Supervisors for initiation of the archival process.

13.6.2 Bridge Designs

PaperVision is the current tool used to archive project correspondence and bridge designs. It is a software program that uses a digital imaging process in conjunction with a document management system that is maintained by the Records Management Section of the Human Resources Division. In addition to bridge information, the Bridge Division also has access to the archived records of the Construction Division through PaperVision which is useful for locating pile driving records and other as-built bridge information.

PaperVision requires the organization of files for digitizing in a particular manner to allow for search criteria established by the Bridge Division. A bridge design search can be conducted using any of the Document Index Field Search Criteria shown in [Figure 13.2](#). Once the desired bridge is located, the Document Types field will permit you to refine your search for more specific information.

Design files shall be maintained and stored in the Division until the project is officially complete unless litigation or other concerns require their preservation for a longer period of time. Design files should be cleaned out after plan completion and organized with the format shown in [Subsection 13.6.2.1](#) to

The screenshot shows a web-based search interface titled "Search: Bridge Design Files". On the left is a sidebar with a "System" and "Folders" tab. Under "Folders", there are sections for "Available Projects (2)" containing "Bridge Design Files" and "Construction Job Files", "Global Searches", "System Settings", and "Downloads". At the bottom of the sidebar is the "Powered by PaperVision" logo and copyright information. The main search area is divided into two sections: "Document Index Field Search Criteria" and "Project Search Options". The "Document Index Field Search Criteria" section contains five input fields: "Job Number:", "Bridge Number:", "Route:", "Feature Intersected:", and "Document Types:" (with a dropdown arrow). The "Project Search Options" section contains two dropdown menus: "Search Type:" set to "And" and "Sort By:" set to "Job Number [+]". At the bottom of the search area are two buttons: "Search" and "Clear Criteria".

Figure 13.2: PaperVision

simplify preparation for digitizing. All significant work: designs, documents, quantities, etc. which may be needed during the construction phase should be retained. However, items such as trial program outputs, non-bid alternate designs, and other miscellaneous documents and calculations that will not be needed for final archiving should be labeled as DO NOT ARCHIVE to reduce errors during the archival process.

13.6.2.1 Preparation for Digitizing

For all documents and final design to be digitized, papers shall be unfolded and the paperwork shall be free of staples, paper clips, and binders. Header sheets shall be used (along with a large font for text) so that digitized pages can be included in appropriate search fields. See [Appendix A13.1](#) for example header sheets on a single bridge job and multiple bridge job. Header template sheets can be accessed on [ARDOT's network](#).

13.6.2.2 Design to be Retained

Correspondence

- All significant correspondence
- Permits (USCG, USACE, etc.)
- Railroad agreements
- Field problems
- Plan revisions

Layout Development

- Hydraulic calculations/output summaries (Note: HEC-RAS files for the final design should be stored for future access on [ARDOT's network](#))
- Geometry calculations/program data (when unusually complex or not easily duplicated)
- Scour calculations

Superstructure Design

- Hand or spreadsheet calculations
- Program input data and significant output summaries

Examples include slabs, beams, girders, bearings, and rail designs.

Substructure Design

- Hand or spreadsheet calculations
- Program input data and significant output summaries
- Seismic/Liquefaction calculations and significant program input/output

Examples include caps, columns, retaining walls, piling, drilled shafts, seismic, and foundation designs.

13.6.2.3 Design to be Discarded

- Quantity calculations
- Alternate designs that were not constructed
- Cost estimates
- Special Provisions & Supplemental Specifications
- Soil boring logs
- Existing bridge plans and Roadway plan sheets
- Product ads and information
- Designer sketches used for detailing
- Construction review items (temporary bridges, cofferdams, overhangs, etc.)

13.6.3 Shop Drawings

The Reprographics Section is responsible for the archival of all bridge shop drawings. The archival process for approved shop drawings, except for sign structures, shall be as follows:

- Approved and stamped shop drawings shall be maintained and stored in the originating Design Section until the job is officially complete.
- Periodically, when storage becomes limited, shop drawings shall be submitted to the Reprographics Section for archival on the network location referenced in [Subsection 13.5](#).
- Only the following final shop drawings stamped as “approved” shall be retained:
 - Structural Steel
 - Prestressed Girders or Bulb-Tees
 - Elastomeric Bearings
 - Metal Bridge Railing
 - Retaining walls (design calculations & fabrication drawings)
 - Ornamental Fencing
 - Others as deemed appropriate, i.e. Aggregate Pier, Gravity Block, etc.

- Prior to submitting shop drawings to Reprographics for scanning, an index of sheets shall be prepared and all documents shall be unfolded and free of staples, paper clips, and binders. Pages shall be ordered in accordance with the index. An example index is shown in [Figure 13.1](#).
- The original shop drawings will be discarded by Reprographics after archival.

Table 13.1: Example Index of Shop Drawings

BRIDGE SHOP DRAWING INDEX	
BRIDGE NO(S).	A&B7074, A&B7075, 07076
JOB NO.	070074
ITEM	PAGE NUMBER
STRUCTURAL STEEL	2-43 (A7074), 44-79 (B7074) 80-137 (A7075), 138-183 (B7075) 184-258 (07076)
ELASTOMERIC BEARINGS	259-273 (All)
PRESTRESSED GIRDERS	
BRIDGE HAND RAILS	274-276 (07076)
MSE RETAINING WALLS	277-292 (Dwgs.) 293-518 (Design Calc.)

Approved shop drawings for sign structures shall be scanned to PDF format and archived immediately on [ARDOT's network](#) using a hyperlink. Drawings applicable to multiple sign structures shall be given a single title and documented with each logged sign number as appropriate. Approved and stamped shop drawings shall be maintained in the originating Design Section until the job is officially complete, when they may be destroyed.

13.6.4 Consultant Designs

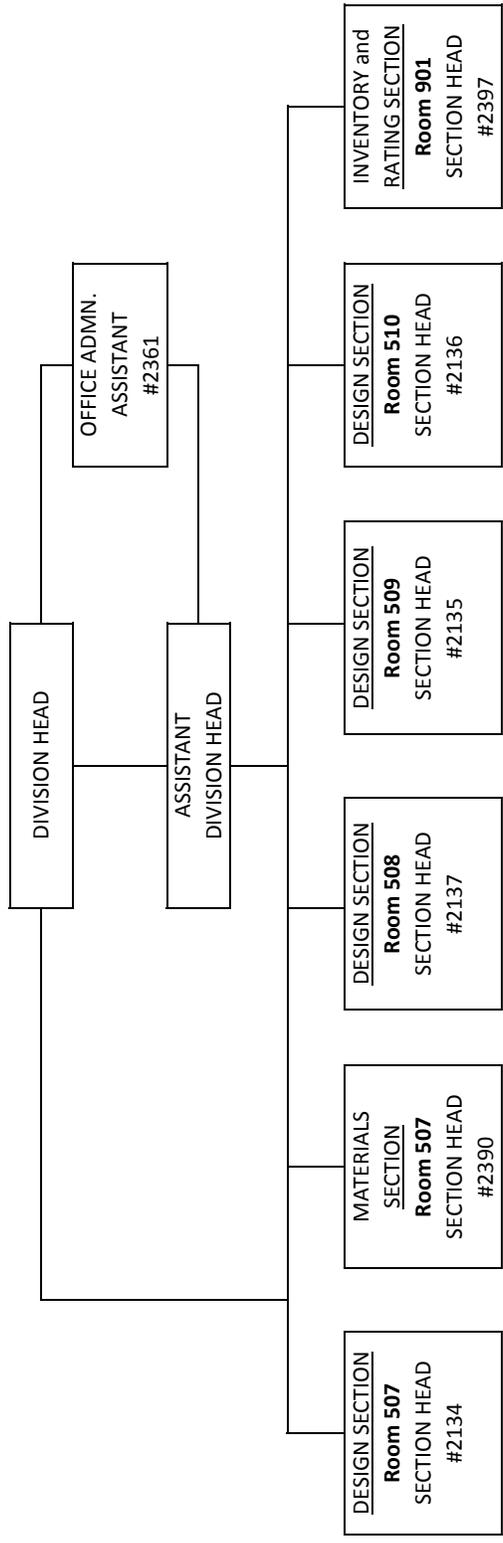
After the construction plans are complete and no additional revisions anticipated, the Consultant shall scan their bridge design documentation to PDF format. The organization of files shall be by bridge number and in a manner that will allow easy search and retrieval. Use of the headers and layout discussed in [Subsection 13.6.2.1](#) is preferred. The electronic files shall then be placed on a DVD and submitted to the Bridge Division for storage and later archival in PaperVision after project completion.

Appendix A1

Introduction

A1.1 Bridge Division Organizational Chart A1-1

A1.1 Bridge Division Organizational Chart



Appendix A2

Bridge Layouts

A2.1	ARDOT Bicycle Facility Accommodation & Sidewalk Policies	A2-1
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A2.17	Bridge Layout Checklist	A2-30
A2.18	General Notes for Bridge Layouts	A2-32
A2.19	Example Letters & Interoffice Memorandums	A2-41

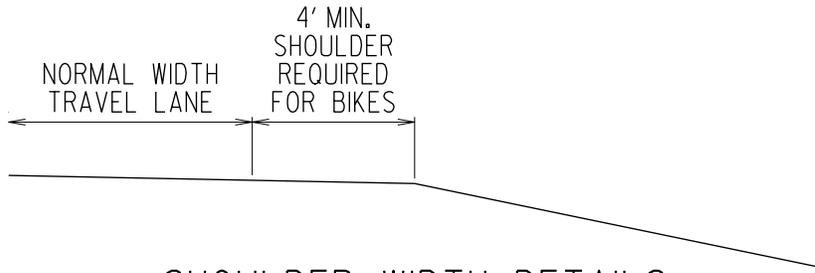
A2.1 ARDOT Bicycle Facility Accommodation & Sidewalk Policies

ARDOT Bicycle Facility Accommodation Policy

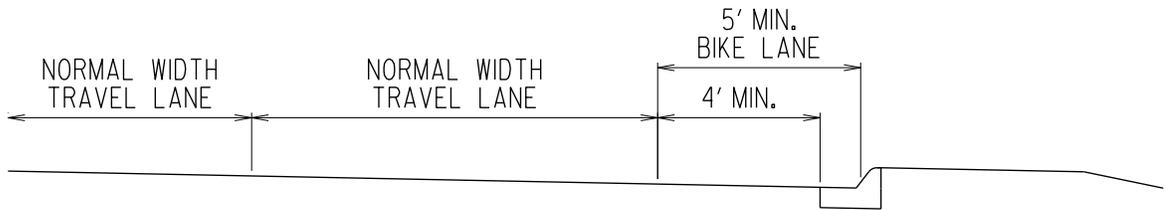
1. Accommodation of bicycles will be given due consideration when a proposed highway project is on a route that has been designated as a bicycle route by a locally adopted bicycle plan or master street plan and the Department concurs that the route should be a designated bicycle route. Coordination with local jurisdictions may be necessary to determine the recommended accommodations.
2. Bicycle accommodations on routes that have not been designated as bicycle routes by a locally adopted bicycle plan or a master street plan will be considered if the local jurisdiction will provide the required additional funds.
3. When bicycle accommodations are to be made on routes with an open shoulder section, the paved shoulder will be used to accommodate bicycles. Shoulder widths shall conform to the widths recommended in the American Association of State Highway and Transportation Officials (AASHTO) Green Book.
4. When bicycle accommodations are to be made on routes with a curb and gutter section, the bicycle lane will be in accordance with recommendations in the AASHTO Guide for the Development of Bicycle Facilities. Generally, a bicycle lane width of 4 feet (measured from the lane edge to the edge of the gutter) will be considered.
5. If local or regional design standards specify bicycle facility widths greater than the standards noted above, the additional right of way and construction costs associated with the greater width shall be funded by the local jurisdiction that adopted the higher design standards.
6. Shared use paths (joint pedestrian/bicycle facilities separated from the roadway) are used primarily for recreational purposes, and as such will not normally be considered for bicycle accommodation on the state highway system. Exceptions will be considered when the local jurisdiction specifically requests the shared use path. In such cases, the minimum shared use path width shall be 10 feet and the local jurisdiction shall bear any additional right of way and construction costs required for the shared use path and shall assume all future maintenance of the facility.

ARDOT Sidewalk Policy

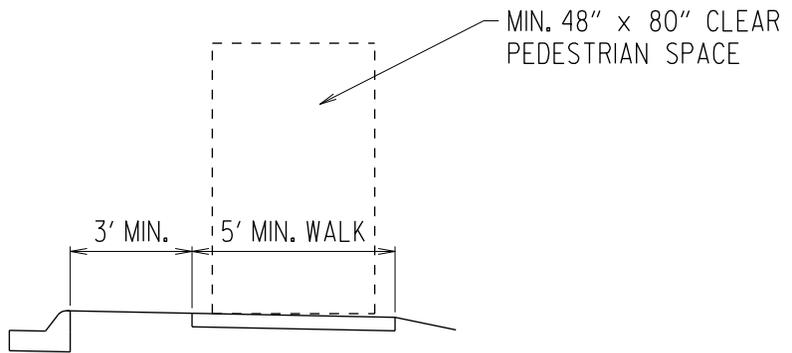
1. When curb and gutter sections are proposed along a highway with existing sidewalks, the sidewalks will be replaced in accordance with this policy.
2. When curb and gutter sections are proposed along a highway with no existing sidewalks, sidewalks will be constructed on both sides of the roadway in developed areas. In undeveloped areas, sidewalks will be considered on one side of the roadway unless evidence of pedestrian traffic warrants sidewalks on both sides of the roadway.
3. All sidewalk construction will conform to the latest edition of the *Americans with Disabilities Act Accessibility Guidelines (ADAAG)*.
4. The minimum sidewalk width will be 5 feet, and the minimum offset from the back of the curb to the sidewalk edge will be 3 feet. No obstructions (mailboxes, signs, etc.) will be allowed in the sidewalk. The minimum vertical clearance to the bottom of any obstruction overhanging the sidewalk will be 80 inches.
5. If local or regional design standards specify pedestrian facility widths greater than the standards shown above, the additional right of way and construction costs associated with the greater width will normally be funded by the local jurisdiction that adopted the higher design standards.



SHOULDER WIDTH DETAILS



BIKE LANE DETAILS



SIDEWALK DETAILS

A2.2 Pedestrian Accommodation Policy

The Department's Pedestrian Accommodation Policy was implemented in August, 2005, and continues to serve as the guideline for both new construction and alternations to existing roadways and bridges. Full compliance with the *Americans with Disabilities Act Accessibility Guidelines* is expected at every location unless it is determined that the accommodation is "technically infeasible" or an "undue burden". These conditions are defined as:

Technically infeasible – Applies to elements that are within the scope of the project when constructing a new or altering an existing transportation facility, such as; when existing structural conditions would require removing or altering a load-bearing member which is an essential part of the structural frame (e.g., in the case of a highway project, a bridge support); or because other existing physical or site constraints prohibit modification or addition of elements, spaces, or features which are in full and strict compliance with the minimum requirements. Where making an alteration that meets accessibility requirements is "technically infeasible" the ARDOT will ensure the alteration provides accessibility to the maximum extent feasible.

Undue Burden – Applies to a stand-alone accessibility improvement identified in a Transition Plan on a facility not scheduled for an alteration. In determining whether the accessibility improvement presents an undue financial and administrative burden, the cost of the improvement must be compared to all of the ARDOT's resources available for use in the funding and operation of the service, program or activity and not simply the project cost.

To determine if these conditions apply, the Division Head/District Engineer will evaluate the need for the accommodation, who and how many it may serve, and the cost of the accommodation. If an "undue burden" or "technical infeasibility" condition is concluded, then the Division Head/District Engineer will make a recommendation to the appropriate Assistance Chief Engineer and the Deputy Directory and Chief Engineer for final determination.

A2.4 Example Railroad Email Submission

To: camcmana@up.com
Subject: Overhead Grade Separation, Preliminary, Thornton, AR, U.S. Hwy. 167, MP 311.3, Pine Bluff Sub, DOT # 790-822P - AHTD Job CA0704, 33.7875N/92.4675W
Attachments: CA0704 UPRR Overpass-Alternate 1.pdf; CA0704 UPRR Overpass-Alternate 2.pdf

Mr. McManaman,

In accordance with the recommendations developed from the SHRP-2 Workshop, we are forwarding two alternate proposals for your preliminary review prior to the development and formal submittal of an Exhibit A drawing. These proposals are for the construction of twin overpass structures on Hwy. 167 southwest of Fordyce, Arkansas. These bridges will replace existing bridge No. 03637 which is 33.4' wide and 188' long.

A sketch of each alternate is attached and a brief description and cost estimate included below. Alternate 1 is preferred by the Department. Both alternates will provide a minimum vertical clearance of 23'-6" for a future track on both sides of the existing track.

Alternate 1 (Preferred): Bridges do not span UPRR Right of Way

- 250' long Continuous W-Beam Units (Spans= 70'-110'-70')
- Clear Bridge Width = 38'-0"
- One bent in UPRR ROW for each bridge
- Estimated Cost = \$ **3.2 Million** (Includes both bridges)

Alternate 2: Bridges span UPRR Right of Way

- 180' long Simple Plate Girder Spans
- Clear Bridge Width = 38'-0"
- Requires the use of retaining walls to reduce bridge length
- Requires an additional grade raise of 3.5' over Alternate 1
- Requires additional right of way for approaches (not included in estimate)
- Estimated Cost = \$ **4.1 Million** (Includes both bridges, retaining walls, & additional approach embankment for additional grade raise)

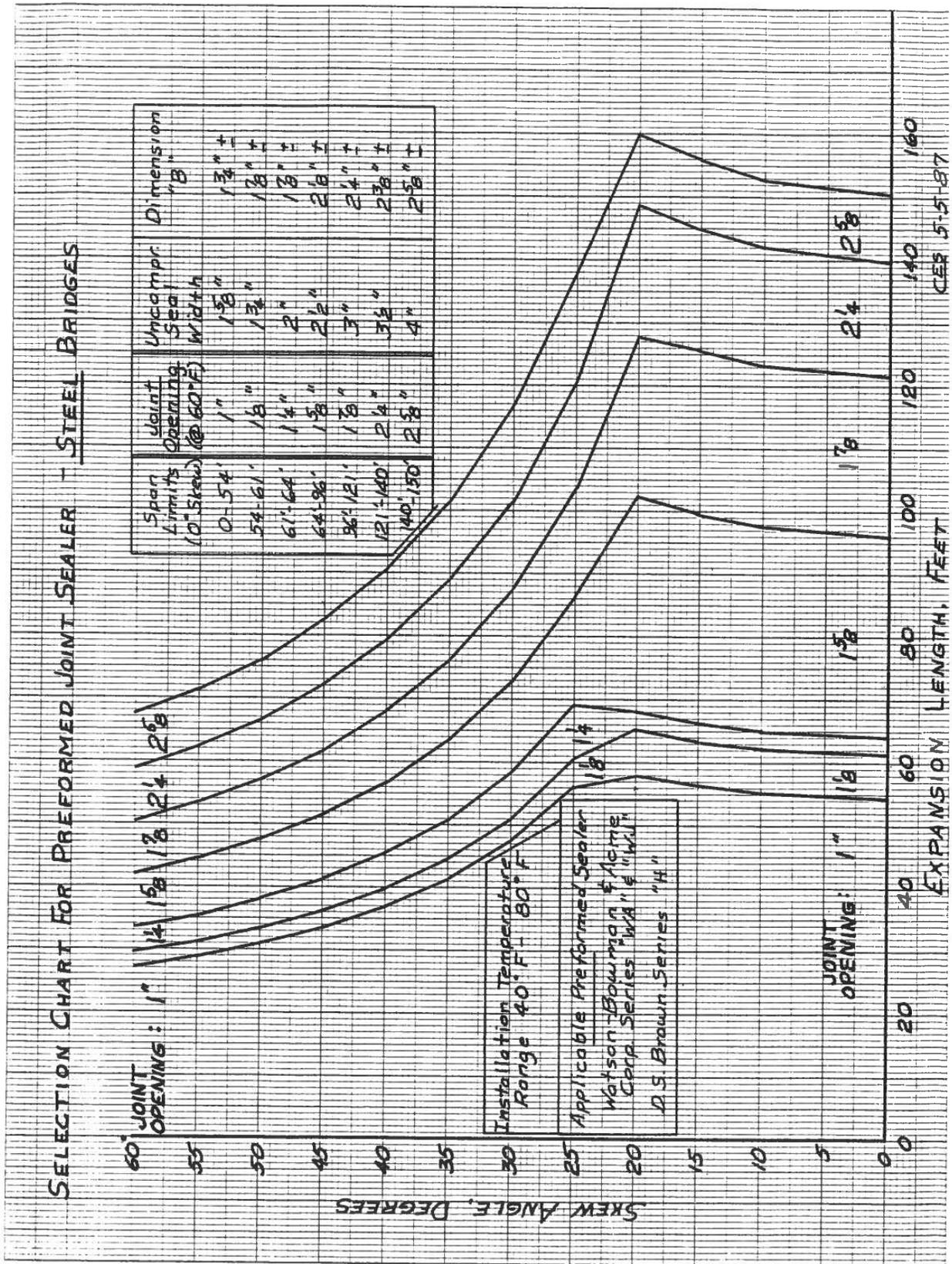
We would appreciate your review and comments on these preliminary proposals for conformance with UPRR needs, and the acceptability of the preferred Alternate 1 proposal. If you have any questions or need additional information, please do not hesitate to contact me.

Thank you,
Rick

Charles "Rick" Ellis, P.E. | Division Head - Bridge
Arkansas State Highway & Transp. Dept.

P.O. Box 2261 | Little Rock, Arkansas 72203
501-569-2361 Phone | 501-569-2623 Fax
e-mail: Rick.Ellis@ahtd.ar.gov

A2.5 Preformed Compression Joint Seal



A2.6 Subsurface Investigation: Rock



ARKANSAS DEPARTMENT OF TRANSPORTATION
 ARDOT.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director
 10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2000

INTEROFFICE MEMORANDUM

Date

TO: Mr. Michael Benson, Engineer of Materials

FROM: Rick Ellis, Bridge Engineer

SUBJECT: Request for Subsurface Investigation
 Job No. _____
Job Title
 _____ County
 Route __, Section __

Design Engineer Requesting Information: _____
 Phone No.: 501-569-_____

Attached are the preliminary layout and title sheet for your use in making a subsurface investigation for the bridge site on this project. The proposed bridge width is XX'-X" out-to-out. The desired boring locations are shown in red.

It is anticipated that spread footings on rock will be likely at the intermediate bents and that h-piling bearing on rock will be used at the end bents. Borings should be advanced to a depth sufficient to develop information for the anticipated foundations, with a minimum penetration of 10 feet into competent rock. Please adjust the boring locations and depths as necessary based on site conditions, subsurface variability, and the presence of undesirable geology such as voids or cavities.

The information checked on the attached sheet, as appropriate for the encountered material, is requested. In addition to the boring information, please provide a D50 analysis of the bed material in the main channel of XXXXX.

CRE:xxx
 Attachments

Bridge Foundation Subsurface Investigation Checklist
Job No. _____

Piles:

- Soil Unit Weight
- Standard Penetration Tests
- Groundwater Elevation
- Coefficient of Horizontal Subgrade Reaction
- Nominal and Ultimate Capacity vs. Depth Curves

Cohesive Soil

- Undrained Shear Strength
- Adhesion

Cohesionless Soil

- Friction Angle

Rock

- SCR
- RQD
- Nominal Bearing Resistance

Spread Footings:

- SCR
- RQD
- Nominal and Ultimate Bearing Resistance

Drilled Shafts:

- Effective Unit Weight
- Undrained Shear Strength
- Groundwater Elevation
- Nominal and Ultimate Side Resistance
- Nominal and Ultimate Tip Resistance

Seismic Analysis:

- Groundwater Elevation
- Slope Stability Analysis
- Liquefaction Potential
- Unified Soil Classification System Identifiers

Slope Stability at Bridge Ends: Recommendation on acceptability of slope for anticipated fill height and any measures or special embankment material required for slope stability.

- 1V:2H Slope (Anticipated Fill Height Approx. ___ Ft.)
- 1V:2.5H Slope (Anticipated Fill Height Approx. ___ Ft.)
- 1V:3H Slope (Anticipated Fill Height Approx. ___ Ft.)
- Settlement Analysis

A2.7 Subsurface Investigation: Questionable Rock Depth and Tall Embankments



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10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2000

INTEROFFICE MEMORANDUM

Date

TO: Mr. Michael Benson, Engineer of Materials
FROM: Rick Ellis, Bridge Engineer
SUBJECT: Request for Subsurface Investigation
Job No. _____
Job Title
_____ County
Route __, Section __

Design Engineer Requesting Information: _____
Phone No.: 501-569-_____

Attached are the preliminary layout and title sheet for your use in making a subsurface investigation for the bridge site on this project. The proposed bridge width is XX'-X" out-to-out. The desired boring locations are shown in red.

The type of foundation at the intermediate bents will be dependent upon whether rock is encountered and, if encountered, at what depth. If rock is encountered at more than approximately 15 feet below the existing ground line, foundation h-piling bearing on rock is anticipated. Spread footings will be likely if rock or rock-like soil is encountered at shallower elevations. It is anticipated that h-piling bearing on rock will be used at end bents.

Borings should be advanced to a depth sufficient to develop information for the anticipated foundations, with a minimum penetration of 10 feet into competent rock. Please adjust the boring locations and depths as necessary based on site conditions, subsurface variability, and the presence of undesirable geology such as voids or cavities.

It should be noted that the anticipated fill height at the abutments is exceeding 15 feet. Please provide us with any special fill requirements, including details and specifications, necessary for construction of these embankments for incorporation into our plans.

The information checked on the attached sheet, as appropriate for the encountered material, is requested. In addition to the boring information, please provide a D50 analysis of the bed material in the main channel of XXXXX.

CRE:xxx
Attachments

Bridge Foundation Subsurface Investigation Checklist
Job No. _____

Piles:

- Soil Unit Weight
- Standard Penetration Tests
- Groundwater Elevation
- Coefficient of Horizontal Subgrade Reaction
- Nominal and Ultimate Capacity vs. Depth Curves

Cohesive Soil

- Undrained Shear Strength
- Adhesion

Cohesionless Soil

- Friction Angle

Rock

- SCR
- RQD
- Nominal Bearing Resistance

Spread Footings:

- SCR
- RQD
- Nominal and Ultimate Bearing Resistance

Drilled Shafts:

- Effective Unit Weight
- Undrained Shear Strength
- Groundwater Elevation
- Nominal and Ultimate Side Resistance
- Nominal and Ultimate Tip Resistance

Seismic Analysis:

- Groundwater Elevation
- Slope Stability Analysis
- Liquefaction Potential
- Unified Soil Classification System Identifiers

Slope Stability at Bridge Ends: Recommendation on acceptability of slope for anticipated fill height and any measures or special embankment material required for slope stability.

- 1V:2H Slope (Anticipated Fill Height Approx. ___ Ft.)
- 1V:2.5H Slope (Anticipated Fill Height Approx. ___ Ft.)
- 1V:3H Slope (Anticipated Fill Height Approx. ___ Ft.)
- Settlement Analysis

A2.8 Subsurface Investigation: Seismic Performance Zone 2



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 10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2000

INTEROFFICE MEMORANDUM

Date

TO: Mr. Michael Benson, Engineer of Materials

FROM: Rick Ellis, Bridge Engineer

SUBJECT: Request for Subsurface Investigation
 Job No. _____
Job Title
 _____ County
 Route __, Section __

Design Engineer Requesting Information: _____
 Phone No.: 501-569-_____

Attached the preliminary layout and title sheet for your use in making a subsurface investigation for the bridge site on this project. The desired boring locations are shown in red. Additional information is as follows:

- Type of Proposed Foundation: Concrete Filled Steel Shell Pile Bents
- Proposed Bridge Width: XXXXX Out-to-Out
- Elevation at Bridge Ends: XXXXX

It is possible that the bridge site will be in a Seismic Performance Zone 2 and the seismic hazard may be such that an embankment analysis is required. If determined that the proposed fill height warrants an analysis or if undercutting and other site improvements might be necessary, please submit the draft boring logs when available so that we can determine the seismic acceleration coefficient for your use.

The information checked on the attached sheet, as appropriate for the encountered material, is requested. In addition to the boring information, please provide a D50 analysis of the bed material in the main channel of XXXXXX.

CRE:xxx
 Attachments

Bridge Foundation Subsurface Investigation Checklist
Job No. _____

Piles:

- Soil Unit Weight
- Standard Penetration Tests
- Groundwater Elevation
- Coefficient of Horizontal Subgrade Reaction
- Nominal and Ultimate Capacity vs. Depth Curves

Cohesive Soil

- Undrained Shear Strength
- Adhesion

Cohesionless Soil

- Friction Angle

Rock

- SCR
- RQD
- Nominal Bearing Resistance

Spread Footings:

- SCR
- RQD
- Factored and Nominal Bearing Resistance

Drilled Shafts:

- Effective Unit Weight
- Undrained Shear Strength
- Groundwater Elevation
- Nominal and Ultimate Side Resistance
- Nominal and Ultimate Tip Resistance

Seismic Analysis:

- Groundwater Elevation
- Slope Stability Analysis
- Liquefaction Potential
- Unified Soil Classification System Identifiers

Slope Stability at Bridge Ends: Recommendation on acceptability of slope for anticipated fill height and any measures or special embankment material required for slope stability.

- 1V:2H Slope (Anticipated Fill Height Approx. ___ Ft.)
- 1V:2.5H Slope (Anticipated Fill Height Approx. ___ Ft.)
- 1V:3H Slope (Anticipated Fill Height Approx. ___ Ft.)
- Settlement Analysis

A2.9 Subsurface Investigation: Seismic Performance Zone 3 or 4



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 10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2000

INTEROFFICE MEMORANDUM

Date

TO: Mr. Michael Benson, Engineer of Materials

FROM: Rick Ellis, Bridge Engineer

SUBJECT: Request for Subsurface Investigation
 Job No. _____
Job Title
 _____ County
 Route __, Section __

Design Engineer Requesting Information: _____
 Phone No.: 501-569-_____

Attached are the preliminary layout and title sheet for your use in making a subsurface investigation for the bridge site on this project. The desired boring locations are shown in red. Additional information is as follows:

- Type of Proposed Foundation: Concrete Filled Steel Shell Pile Bents
- Proposed Bridge Width: XXXXX Out-to-Out
- Elevation at Bridge Ends: XXXXX

It is anticipated that this bridge site will be in a high seismic zone and may require an embankment analysis. If determined that the proposed fill height warrants an analysis or if undercutting and other site improvements might be necessary, please submit the draft boring logs when available so that we can determine the seismic acceleration coefficient for your use.

The information checked on the attached sheet, as appropriate for the encountered material, is requested. In addition to the boring information, please provide a D50 analysis of the bed material in the main channel of XXXXX.

CRE:xxx
 Attachments

Bridge Foundation Subsurface Investigation Checklist
Job No. _____

Piles:

- Soil Unit Weight
- Standard Penetration Tests
- Groundwater Elevation
- Coefficient of Horizontal Subgrade Reaction
- Nominal and Ultimate Capacity vs. Depth Curves

Cohesive Soil

- Undrained Shear Strength
- Adhesion

Cohesionless Soil

- Friction Angle

Rock

- SCR
- RQD
- Nominal Bearing Resistance

Spread Footings:

- SCR
- RQD
- Factored and Nominal Bearing Resistance

Drilled Shafts:

- Effective Unit Weight
- Undrained Shear Strength
- Groundwater Elevation
- Nominal and Ultimate Side Resistance
- Nominal and Ultimate Tip Resistance

Seismic Analysis:

- Groundwater Elevation
- Slope Stability Analysis
- Liquefaction Potential
- Unified Soil Classification System Identifiers

Slope Stability at Bridge Ends: Recommendation on acceptability of slope for anticipated fill height and any measures or special embankment material required for slope stability.

- 1V:2H Slope (Anticipated Fill Height Approx. ___ Ft.)
- 1V:2.5H Slope (Anticipated Fill Height Approx. ___ Ft.)
- 1V:3H Slope (Anticipated Fill Height Approx. ___ Ft.)
- Settlement Analysis

A2.10 Subsurface Investigation: Shafts



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 10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2000

INTEROFFICE MEMORANDUM

Date

TO: Mr. Michael Benson, Engineer of Materials

FROM: Rick Ellis, Bridge Engineer

SUBJECT: Request for Subsurface Investigation
 Job No. _____
Job Title
 _____ County
 Route __, Section __

Design Engineer Requesting Information: _____
 Phone No.: 501-569-_____

Attached are the preliminary layout and title sheet for your use in making a subsurface investigation for the bridge site on this project. The proposed bridge width is XX'-X" out-to-out. The desired boring locations are shown in red.

The type of foundation at the intermediate bents will be dependent upon whether rock is encountered and, if encountered, at what depth. If rock is encountered at more than approximately 15 feet below the existing ground line, drilled shafts are anticipated. Spread footings will be likely if rock or rock-like soil is encountered at shallower elevations. It is anticipated that h-piling bearing on rock will be used at end bents.

Requested boring locations at intermediate bents are based on estimated footing areas and drilled shaft locations. If used, it is estimated that the diameter of the drilled shafts will be X' and that they will be socketed XX feet into rock. Borings at drilled shaft locations should penetrate a minimum of YY (XX+10') feet into competent rock. Borings at end bent locations should penetrate a minimum of 10 feet into competent rock. Please adjust the boring locations and depths as necessary based on site conditions, subsurface variability, and the presence of undesirable geology such as voids or cavities.

The information checked on the attached sheet, as appropriate for the encountered material, is requested. In addition to the boring information, please provide a D50 analysis of the bed material in the main channel of XXXXX.

CRE:xxx
 Attachments

Bridge Foundation Subsurface Investigation Checklist
Job No. _____

Piles:

- Soil Unit Weight
- Standard Penetration Tests
- Groundwater Elevation
- Coefficient of Horizontal Subgrade Reaction
- Nominal and Ultimate Capacity vs. Depth Curves

Cohesive Soil

- Undrained Shear Strength
- Adhesion

Cohesionless Soil

- Friction Angle

Rock

- SCR
- RQD
- Nominal Bearing Resistance

Spread Footings:

- SCR
- RQD
- Nominal and Ultimate Bearing Resistance

Drilled Shafts:

- Effective Unit Weight
- Undrained Shear Strength
- Groundwater Elevation
- Nominal and Ultimate Side Resistance
- Nominal and Ultimate Tip Resistance

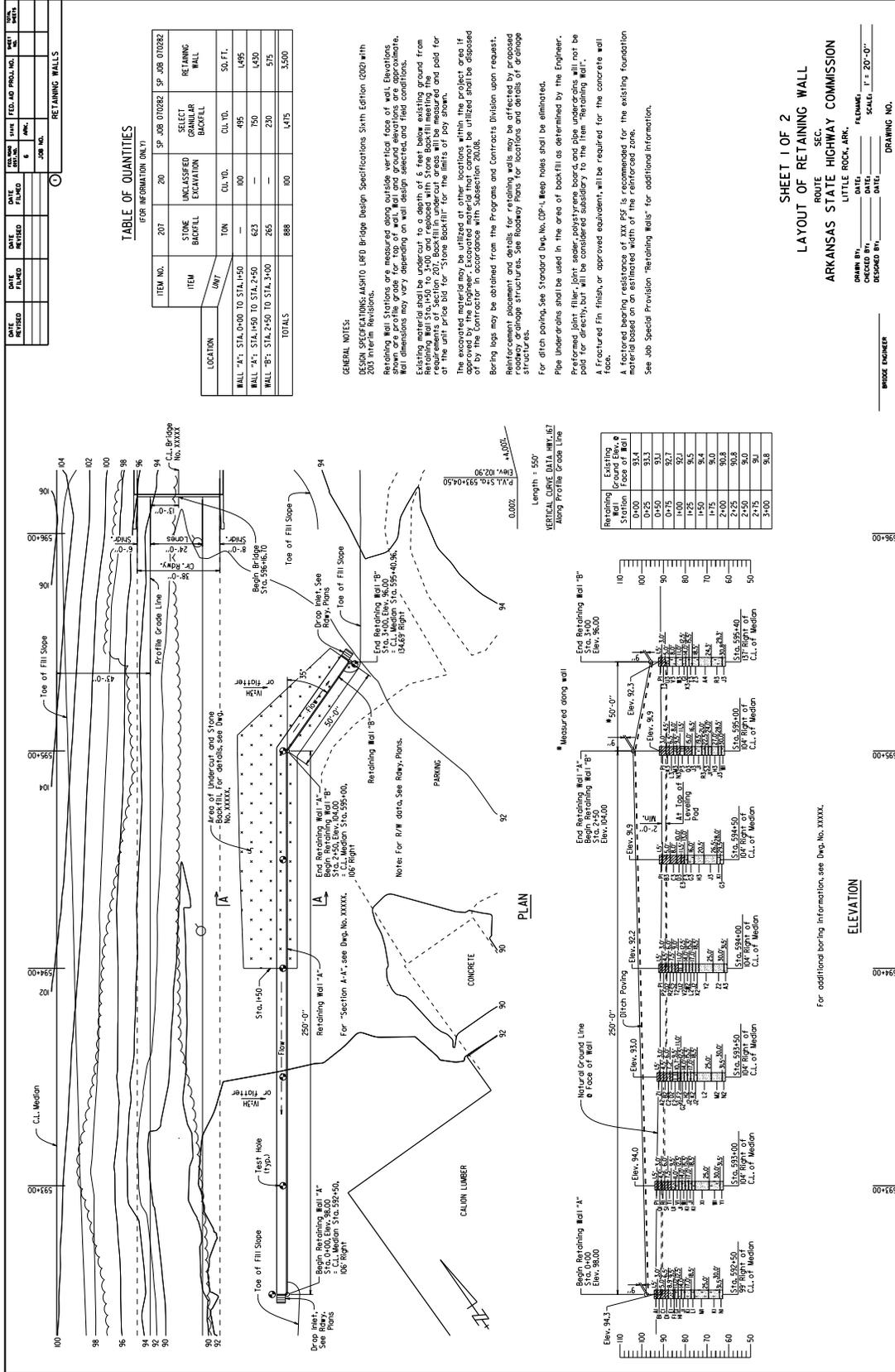
Seismic Analysis:

- Groundwater Elevation
- Slope Stability Analysis
- Liquefaction Potential
- Unified Soil Classification System Identifiers

Slope Stability at Bridge Ends: Recommendation on acceptability of slope for anticipated fill height and any measures or special embankment material required for slope stability.

- 1V:2H Slope (Anticipated Fill Height Approx. ___ Ft.)
- 1V:2.5H Slope (Anticipated Fill Height Approx. ___ Ft.)
- 1V:3H Slope (Anticipated Fill Height Approx. ___ Ft.)
- Settlement Analysis

A2.11 Layout of Retaining Wall



A2.12 Procedure for Assessing the Use of Accelerated Bridge Construction

Page 1 of 3

Guidance for Accelerated Bridge Construction Decision-Making

The following two step procedure will be used to provide guidance for the use of accelerated bridge construction (ABC) in lieu of conventional construction on bridge replacement projects. The first step is the calculation of an ABC Rating Score which will assess the applicability of ABC for the specific project. The ABC Rating Score acts as a filter by ranking the suitability of the bridge replacement as a candidate for ABC. The second step is the use of a Decision Flowchart. The ABC Rating Score will be used to enter the Decision Flowchart. The flowchart will provide guidance toward the final decision for the use of ABC and which ABC method(s) that is most appropriate for the project.

There will be certain levels of subjectivity in determining the ABC Rating Score and in the use of the Decision Flowchart. A viable candidate for ABC may be rejected due to scheduling issues or lack of funding. These tools are only intended to provide general guidance and are not intended to provide “black and white” answers.

Accelerated Bridge Construction Rating Score

This procedure will be used to calculate an Accelerated Bridge Construction (ABC) Rating Score. The values assigned to each of the five measures are multiplied by the corresponding weighted factor. The ABC Rating Score is then used to enter the ABC Decision Flowchart as part of the final decision toward a conclusion.

Accelerated Bridge Construction Decision Flowchart

The Accelerated Bridge Construction (ABC) Flowchart uses the ABC Rating Score and then yes/no factors that are considered prior to making the final decision on the construction approach. These factors include project schedule, environmental issues, total project cost, and impacts to stakeholders.

Accelerated Bridge Construction Rating Score

Accelerated Bridge Construction Measures

Five (5) measures of project conditions will be used as part of the Accelerated Bridge Construction (ABC) decision process. Each of the measures has a pre-determined value on a scale of 1 – 5.

1. Current Average Daily Traffic

A measure of the amount of current traffic traversing the bridge site that will be impacted. Use a value equal to the total number of vehicles on the bridge and on the roadway under the bridge (if applicable). A maximum score should be used for the interstate highway network.

Value = 4

2. Bridge Importance

A measure of the importance of the timely completion of the construction of a vital bridge. Higher scores should be used for vital bridges such as those on designated evacuation routes, critical routes that will be used after a catastrophic event such as an earthquake, near military installations and hospitals, etc.

Value = 5

3. Functional Classification

A measure of the character of traffic service that the route is intended to provide. Functional classification is primarily based on access and mobility.

Value = 3

4. Detour Length

A measure of the total additional travel for a vehicle which would result from construction of the bridge.

Value = 3

5. Safety

A measure of the safety of the traveling public and workers. Higher scores should be used for projects that will have complex maintenance of traffic schemes for extended periods of time.

Value = 3

Weighted Factors

Weighted factors will be used that are specific to the project. The values assigned to each of the five (5) measures are multiplied by the corresponding weighted factor.

Average Daily Traffic	0	No Traffic Impacts
	1	Less than 1000
	2	1000 to 5000
	3	More than 5000 to 10,000
	4	More than 10,000 to 20,000
	5	More than 20,000
Bridge Importance	1	Typical
	2	Essential
	3	Critical
Functional Class	1	City, County, or Local Route
	2	Major or Minor Collector
	3	Minor Arterial
	4	Principal Arterial
	5	Interstate
Detour Length	0	No Detour
	1	Less than 3 miles
	3	More than 3 miles to 10 miles
	5	More than 10 miles
Safety	0	Road Closed
	1	Short duration with simple MOT scheme
	2	Short duration with multiple traffic shifts
	3	Normal duration with traffic shifts
	4	Extended duration with traffic shifts
	5	Extended duration with complex MOT schemes/shifts

Accelerated Bridge Construction - Project Evaluation

Guidance for Accelerated Bridge Construction Decision-Making

The following two-stage process will be used to provide guidance for the use of Accelerated Bridge Construction (ABC) in lieu of conventional construction on bridge projects. The first stage is the calculation of an ABC Rating Score which assesses the applicability of ABC for a specific project. The ABC Rating Score acts as a filter by ranking the suitability of a bridge project for ABC. The second stage is the use of an ABC Decision Flowchart. The ABC Rating Score will be used to enter the Decision Flowchart. The flowchart will provide guidance toward the final decision for the use of ABC and which ABC method(s) is most appropriate. There will be certain levels of subjectivity in determining the ABC Rating Score and in the use of the Decision Flowchart. Viable candidates for ABC may be rejected due to scheduling issues or lack of funding. These tools are only intended to provide general guidance and are not intended to be prescriptive.

Accelerated Bridge Construction Rating Score

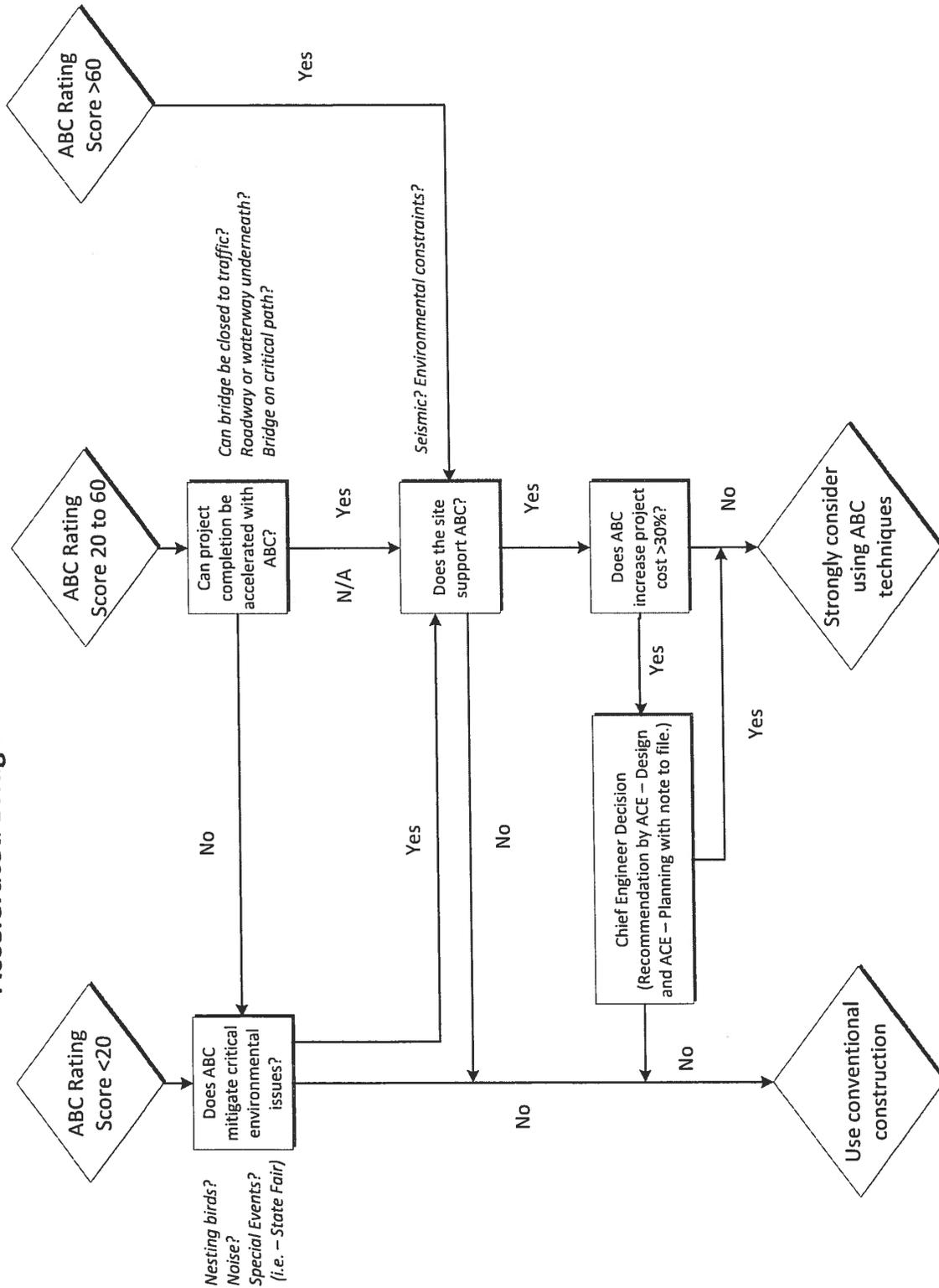
Click on the dropdown box in the lower right bottom corner of each Weighting Factor below and select the most appropriate item. Project Scores for each Measure will automatically tally as well as the Total Score below.

Measure	Value	Weighting Factors	Project Score
Current Average Daily Traffic Use a value equal to the total number of vehicles on the bridge and on the roadway under the bridge (if applicable).	4		0
Bridge Importance A measure of the importance of the timely completion of the construction of a vital bridge. Higher scores should be used for vital bridges such as those on designated evacuation routes, critical routes that will be used in emergencies, such as an earthquake, near military installations and hospitals, etc.	5		0
Functional Class A measure of the character of traffic service that the route is intended to provide. It is related to the route that the bridge is on - not routes under or over. Functional classification is primarily based on access and mobility.	3		0
Detour Length A measure of the total additional travel for a vehicle which would result from construction of the bridge. For example, closed road, accidents in construction zone, long delays/queue etc.	3		0
Safety A measure of the safety of the traveling public and workers. Higher scores should be used for projects that will have complex maintenance of traffic schemes for extended periods of time.	3		0
Total Score			0

Proceed to ABC Decision Flowchart

The ABC Bridge Construction Flowchart uses the ABC rating score determined above and then uses a Yes/No path to reach a recommendation to use either Accelerated Bridge Construction or Conventional Bridge Construction. This is a tool that can be used to justify project decisions. It does not require the use of ABC techniques and it does provide over ride opportunities at the Chief Engineer Decision point.

Accelerated Bridge Construction - Decision Flow Chart



A2.13 Bridge Environmental Form

Date Submitted to Environmental Division: Date

BRIDGE INFORMATION – PRELIMINARY

Job Number: _____ FAP Number: _____ County: County
 Job Name: _____
 Design Engineer: _____ Environmental Staff: _____

A. Description of Existing Bridge

1. Bridge Number: _____ over _____
2. Route: _____ Section: _____ Log Mile: _____
3. Length: _____ Ft. Br. Rdwy. Width: _____ Ft. Deck Width (Out-to-Out) _____ Ft.
4. Type Construction: _____
5. Deficiencies: _____
6. Are any Condition Component ratings at 3 or less? Y/N

B. Proposed Improvements

1. Length: _____ Ft. Br. Rdwy. Width: _____ Ft. Deck Width (Out-to-Out) _____ Ft.
2. Travel Lanes: _____
3. Shoulder Width: _____
4. Sidewalks? Y/N Location: _____ Width: _____ Ft.

C. Construction Information

1. Location in relation to existing bridge: _____
2. Superstructure Type: _____
3. Span Lengths: _____
4. Substructure Type: _____
5. Ordinary High Water Elev. (OHW): _____ No. of Bents inside OHW Contours: _____
6. Concrete below OHW: _____ yd³ Bent Excavation: _____ yd³ Backfill: _____ yd³
7. Channel Excavation below OHW? Y/N Surface Area: _____ ft² Volume: _____ yd³
8. Fill below OHW? Y/N Surface Area: _____ ft² Volume: _____ yd³
9. Riprap below OHW? Y/N Volume: _____ yd³

D. Work Road Information

1. Work Road(s) Required? Y/N Location: _____ Top Width: _____ ft
2. Fill below OHW? Y/N Surface Area: _____ ft² Volume: _____ ft³
3. Pipes Required for Backwater Criteria? Y/N Waterway Opening: _____ ft²

E. Detour Information

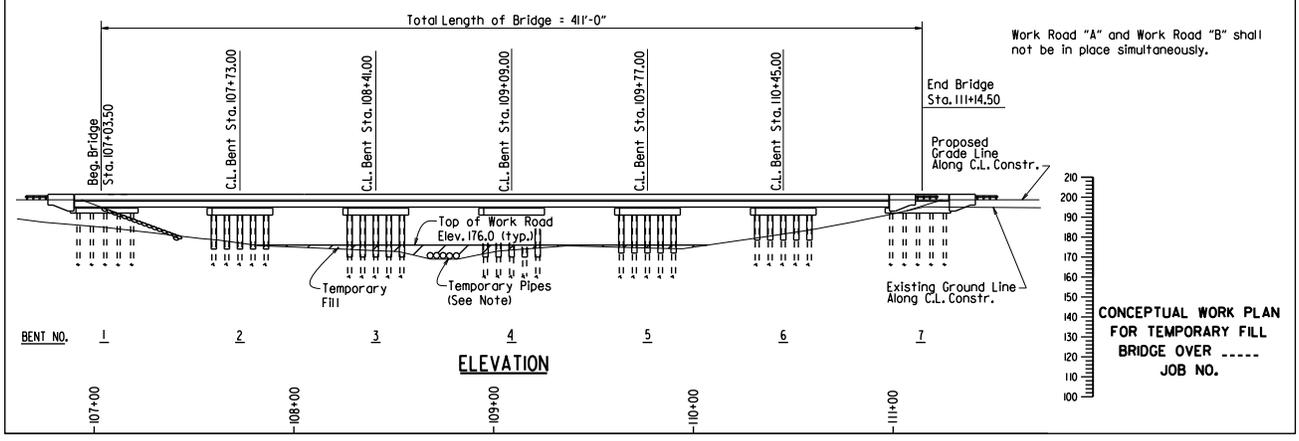
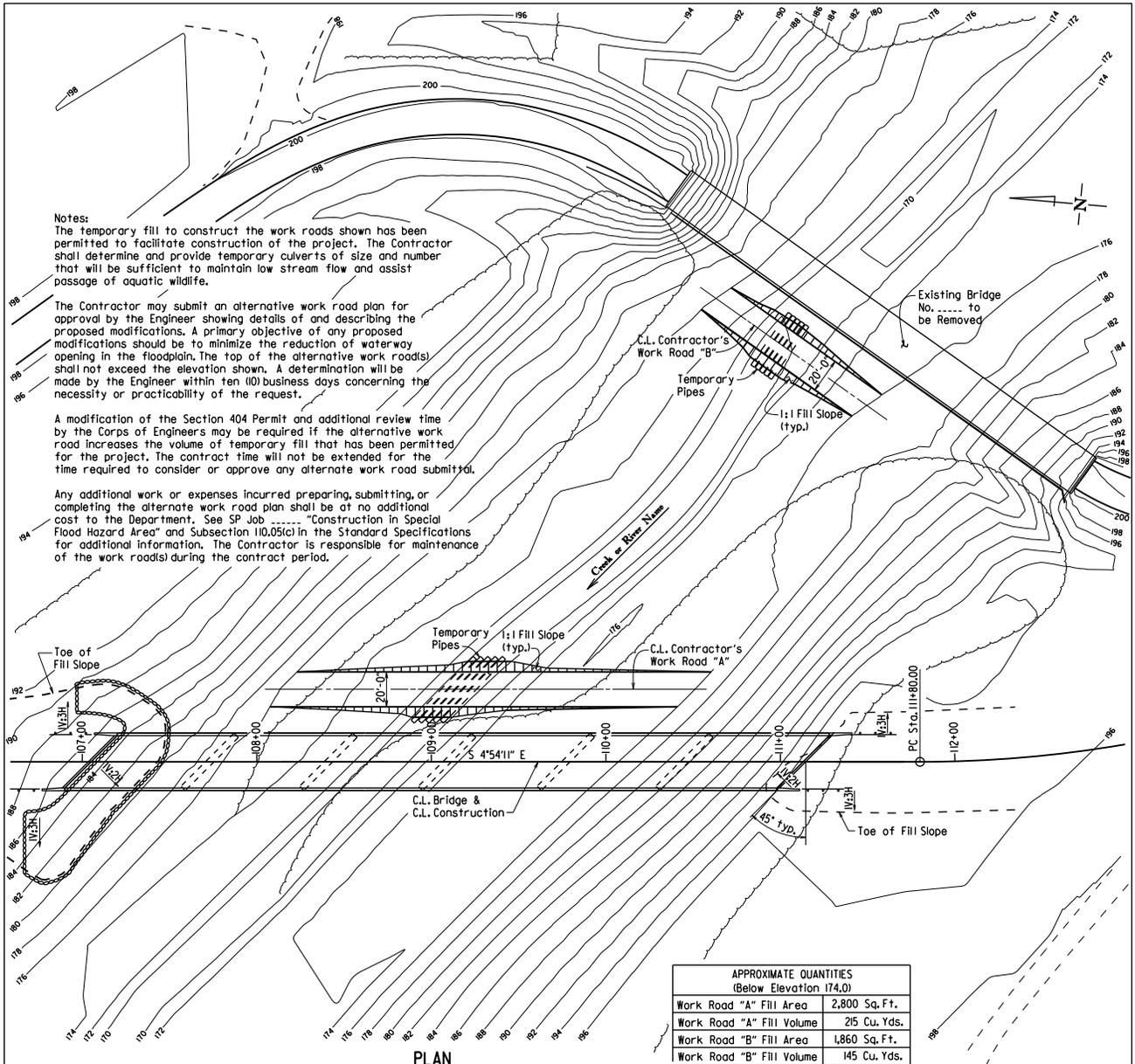
1. Detour Bridge? Y/N Location in relation to Existing Bridge: _____
2. Length: _____ ft Br. Rdwy. Width: _____ ft Deck Elevation: _____
3. Volume of Fill below OHW: _____ ft³ Surface Area: _____ ft²

F. Coordination with Outside Agencies

1. Has Bridge Division coordinated with any outside agencies? Y/N

Agency	Person Contacted	Date

A2.14 Example Conceptual Work Plan



A2.15 USCG Section 9 Arkansas Waterways

PERMITS REQUIRED:

<u>Waterway</u>	<u>Location</u>	<u>Lower Limit</u>	<u>Upper Limit</u>	<u>Date</u>
Arkansas Waterway			Entirety	
Arkansas Post Canal			Entirety	
Arkansas River (old channel)			Mile 37.7	(1943 survey)
Big Maumelle River			Maumelle Dam, Mile 4.6	
Black River			Mile 6.0	
Fourche Creek			Mile 0.5	02/29/88
Galla Creek			Mile 0.7	
Lee Creek (302.3 ARR)			Mile 3.45	
Little Massard Creek			Mile 0.65	
Little Maumelle River			Maumelle 3.8	05/16/85
Lower Mississippi River			Entirety	
Maddox Creek			Entirety	
Massard Creek			Mile 1.5	
McClellan-Kerr Ark River Navigation System			Entirety	
Norfolk Lake			Entirety	
North Fork White River			Entirety	
Ouachita River			Camden, AR, Mile 338.5	
Palarm Creek			Mile 0.1	
Piney Creek			Mile ?	
Poteau River			Mile 10	
Saline River		Mile 0.0	Mile 30.0	11/13/03 B.L.M.
White River			Batesville, AR Mile 299.8	

ADVANCE APPROVAL:

Waterway	Location	Lower Limit	Upper Limit	Date
Baker's Creek	ARR, Mile 209.0	Mouth	State Hwy 7 Bridge	
Bartholomew Bayou	OUA, Mile 205.0	La-Ark State Line	Baxter, AR	
Big Piney Creek	ARR			10/14/98 JF
Black River				09/13/89
Cabin Creek	ARR, Mile 226.8			03/28/14 RW
Cadron Creek	ARR, Mile 158.7	Mouth	Mile 2.0	
Canadian Reach	LMR, Mile 796.0	Mouth	Entirety	12/30/91
Fourche Creek	ARR, Mile 113.5	Mile 0.5	Mile 9.2	02/29/88
Fourche LaFave River	ARR, Mile 144.0	Mouth	Mile 27.0	
Illinois Bayou	Lake Dardanelle(ARR)	Mile 0.0	Mile 10.0	05/29/01, 07/09/04, 11/08/04 DAO
Jimerson Creek	ARR, Mile 172.2	Mile 0.0	Mile 0.04	02/06/91
LaGrue Bayou	WHT, Mile 19.0	Mouth	Mile 12.0	
L'Anguille River	STF, Mile 12.0	Mouth	Mile 8.8	
Little Maumelle	ARR, Mile 126.2	Mile 3.8	Mile 8.6	05/16/85, 05/13/02 DAO
Little Missouri River	OUA, Mile 377.0	Mouth	Mile 23.0	
Little Red River	WHT, Mile 180.0	Mouth	Mile 31.0	
Little Spadra Creek	ARR, Mile 230.5	Mile 0.0	Mile 3.0	10/03/97 JF
Maple Creek (aka Maple Slough)	CAC, Mile UNK	Mouth	Entirety	
Mill Creek	Lake Dardanelle(ARR)	Mile 0.0	Mile 4.5	05/25/01 DAO
Mulberry River	ARR	Mile 0.0	Mile 4.1	01/10/95 JF
Ouachita River	ARR, Mile 30.0	Mile 338.5	Mile 475.8	
Petit Jean River	ARR, Mile 183.5	Mouth	Mile 24.0	
Saline River	OUA, Mile 254.0	Mile 30.0	Headwaters	11/13/03 BLMB
Shilcotts Bayou	ARR, Mile 122.5			08/14/13 RW
Shiloh Creek	Lake Dardanelle(ARR)		Entirety	
St. Francis River	LMR, Mile 670.0	Mouth	Mile 13.0	03/22/89
White Oak Bayou	ARR, Mile 122.2	Mile 0.0	Mile 13.0	03/29/92
White River, Batesville, AR	LMR, Mile 599.0	Mile 299.8	HW of Table Rock Reservoir	05/18/10 PS

NOTES:

There are no available maps, online or printed, that specifically show these waterways.

For Permits Required: The process of obtaining a permit from USCG is required when the project is located between the upper and lower limits. An early informational letter is required so the USCG can start a file on the project. If the bridge location is above the upper limit, the same documentations may be required.

For Advance Approval: No permit is required. Early correspondence with USCG and as-built plans are required **only** for bridges located between the upper and lower limits.

CGAA:

Waterway	Location	Lower Limit	Upper Limit	Date
Brush Creek	Little Sugar Creek		Entirety	
Butler Creek	Little Sugar Creek		Entirety	
Cedar Creek	ARR			10/14/98 JF
Cossatot River	Millwood Lake		Entirety	01/06/94 JF
Current River	BLK, Mile 95.0	Mouth	AR/MO State Line	
Deer Creek	Butler Creek		Entirety	
Devil's Fork, Lit. Red Riv.	WHT, Mile unknown		Entirety	07/08/96 DS
East Fork	Little Sugar Creek		Entirety	
Eleven Point River	BLK, Mile 65.0	Mouth	AR/MO State Line	
Fourche Creek	ARR, Mile 113.5	Mile 9.2	Headwaters	02/29/88
Horse Creek	Butler Creek		Entirety	
Illinois Bayou	Lake Dardanelle (ARR)	Mile 10.0	Headwaters	05/25/01 DAO
Lake Hamilton on Ouachita River	OUA	Mile 417.0	Headwaters	01/22/02 DAO
Little Piney Creek	ARR			10/14/98 JF
Little River	Red River, Mile 464.0		Entirety	10/20/93 WR
Little Spadra Creek	ARR, Mile 230.5	Mile 3.0		10/03/97 JF
Little Sugar Creek	Elk River		Entirety	03/25/96
Midland Branch	Greers Ferry Reservoir, Mile 0.5		Entirety	09/16/2010 PJS
McKisic Creek	Little Sugar Creek		Entirety	
Mill Creek	Lake Dardanelle (ARR)	Mile 4.5	Headwaters	05/25/01 DAO, 01/28/14 RW
Mulberry River	ARR	Mile 4.1		01/10/95 JF
Ouachita River	Tributary of Black River, Mile 41.0	Mile 475.9	Headwaters	04/7/11 RW, 06/14/11 RW
North Fork River	Tributary of White River, Mile 374.4		Entirety	06/21/11, DAO
Red River	LMR, Mile 304.0	Mile 284.0	Mile 730.0 (Denison Dam)	11/15/90
River	WHT, Mile 261.0	Mile 6.0	AR/MO State Line	
Roc Roe Bayou	Whie River, Mile 92.5		Entirety	01/20/06 EAW
South Prong	Spavinaw Creek		Entirety	
Spanker Creek	Little Sugar Creek		Entirety	
Spavinaw Creek	Butler Creek		Entirety	
Spring Creek	WHT, Mile 404.7		Entirety	03/29/04 JF
Spring River	BLK, Mile 65.0	Mouth	Mile 8.0	
St. Francis Bayou	STF, Mile 90+		Entirety	06/19/96 DS
St. Francis River	LMR, Mile 672.3	Mile 2.0	Headwaters	07/18/01
Sunnymede Creek	ARR, Mile 308.8		Entirety	02/08/08 PJS
Table Rock Reservoir	LMR, Mile 299.8			06/14/05 DAO
Tanner Branch	Little Sugar Creek		Entirety	
Tanyard Creek	Little Sugar Creek		Entirety	
Unnamed Tributary of the Ouachita River	OUA, Mile 338.8		Mile 338.8	08/10/05 JF
White Oak Bayou	ARK, Mile 122.2	Mile 13.0		03/26/92
	OUA, Mile 417.0+	Mile 417.0+		06/20/96 DS

CGAA = Coast Guard Authorization Act. No documentation between USCG and ARDOT is necessary.

A2.16 USACE Section 10 Navigable Arkansas Waterways

Little Rock District

Arkansas River
Black River
Big Maumelle River
Buffalo River
Cadron Creek
Current River
Eleven Point River
Fourche Creek
Fourche LaFave River
Greers Ferry Lake
Illinois Bayou
Lake Langhofer
Lee Creek
Little Maumelle River
Little Red River
Little River
Mulberry River
Norfolk Lake
North Fork River
Petit Jean River
Spring River
White River

Memphis District

Bayou LaGrue
Blackfish Bayou
L' Anguille River
Little River
Mississippi River
Roc Roe Bayou
St. Francis Bayou
Tyronza River
White River

Vicksburg District

Arkansas River
Bayou Bartholomew
Black River
Little Missouri River
Ouachita River
Saline River
Sulphur River

A2.17 Bridge Layout Checklist

LAYOUT - PLAN				Job No. :	
Date Revised:				Staff Engineer:	
NO.	ITEM	SITE(S)			COMMENTS
		1	2	3	
GENERAL:					
P1.	Approach Gutters/Approach Slab Note				
P2.	Approach Roadway Width				
P3.	Bearing (DD MM SS) along CL Const. or CL Median				
P4.	Boring Test Hole Locations				
P5.	Bridge End Terminals when confirmed by Roadway				
P6.	Bridge Width - Clear and Out to Out				
P7.	CL Bridge, CL Construction, CL Median (and offsets)				
P8.	CL Lanes/Offset when different than CL Bridge				
P9.	Cut Slopes w/Top of Cut & Toe of Cut (Hatch or pattern)				
P10.	Deck Cross-Slope/Superelevation				
P11.	Existing Bridge Number (Outline/Pattern?)				
P12.	Existing Contours & Topography				
P13.	Fill Slopes (_V:_ H) and Toe of Fill				
P14.	Fill Slopes (Safety slopes on one-way bridges?)				
P15.	Guard Rail (Off ends of one-way bridges?)				
P16.	Horizontal Curve Data (PI Station, Delta, D, T, L)				
P17.	Horizontal Curve Notes (How structure constructed)				
P18.	Nearest Hwy. Intersection (Round to 0.1 Mile)				
P19.	North Arrow				
P20.	Pipe Underdrains @ Integral Bts./Special Fills (Pay Item?)				
P21.	Profile Grade Line/Offset when not located at CL Bridge				
P22.	Rail, Sidewalk, Bikeway Width				
P23.	Retaining Wall				
P24.	Riprap - Type/Limits/Top Elevation				
P25.	Roadway Ditches ?				
P26.	R/W Data, See Rdwy. Plans Note (Temp. Const. Easement?)				
P27.	Shoring/SP Reference				
P28.	Sight Distance Checked (Curved approaches & bridges)				
P29.	Skew Angle @ Bents/Jts.				
P30.	Special Fill Limits in Rock Fills to permit driving piles				
P31.	Stage Construction Dimensions				
P32.	Stations (XX+00)				
P33.	Structural Excavation at Bridge End Limits/Note				
P34.	Tangent Dist. from Bridge Ends (Unless PC, PI or PT shown)				
P35.	Temporary Bridge/Pipes				
P36.	Transitional Approach Railing (With sidewalks)				
P37.	Utilities				
HYDRAULIC STRUCTURES:					
P38.	Channel Excav. (Limits/Sta.-Offset/Slope/Toes/Qty. Note)				
P39.	Gages (Existing/Proposed)				
P40.	Waterway Name & Direction of Flow				
P41.	Q50 Bridge Length on Collector Routes Only				
OVERPASS STRUCTURES:					
P42.	Horizontal Clearances				
P43.	Name of Roadway Crossing/Railroad				
P44.	Pier Protection/Impact Attenuation Barrier				
P45.	Point of Minimum Vertical Clearance				
P46.	Station/Skew at Intersecting Roadway				

LAYOUT - ELEVATION				Job No. :	
Date Revised:				Staff Engineer:	
NO.	ITEM	SITE(S)			COMMENTS
		1	2	3	
GENERAL:					
E1.	Bent/Pier Heights (6" Increments preferred)				
E2.	Bent/Pier Numbers (Don't use a circle)				
E3.	Boring Logs, Legends, N-Values				
E4.	CL Deck to Low Seat of Cap @ Interior Bents				
E5.	CL Deck to Low Steel or Concrete				
E6.	Design Highwater Frequency & Elevation (X.X')				
E7.	Drilled Shaft Top & Bottom Elevations				
E8.	Elevation Scale - both sides preferable				
E9.	End of Beam (Integral Bridges)				
E10.	Excavation - Abutment/Channel/Existing Topography				
E11.	Existing Ground Line along . . .				
E12.	Fencing for RR Overpasses				
E13.	Fixity at Bents				
E14.	Footing Bottom Elevation				
E15.	Geosynthetic Reinforcement in Embankments Note				
E16.	Guard Rail (Off ends of one-way bridges?)				
E17.	Handrail for Bridges w/Sidewalks				
E18.	Joint Dimensions & Type				
E19.	Length of Bridge - Spans, Unit (Unit Nos.?), Total Bridge				
E20.	Light Poles				
E21.	Navigation Channel Information				
E22.	Pedestrian Rail for Bikeways/Combined Use				
E23.	Pier Protection (Crash Walls, Boats, etc.)				
E24.	Pile Encasement for Steel Shell Piles/H-Piles (Corrugated?)				
E25.	Pile Lengths				
E26.	Proposed Grade Line along . . .				
E27.	Railing Type				
E28.	Railroad Tracks				
E29.	Retaining Wall				
E30.	Riprap				
E31.	Slope Intercept Stations				
E32.	Special Fill in Embankments (Rock, . . .)				
E33.	Station/CL Deck Elevation @ Bridge Ends/Bents				
E34.	Stations (XX+00) - along lower drawing border				
E35.	Superstructure Type				
E36.	Vertical Clearance - to Highwater, RR Track, Pavement, etc.				
E37.	Vertical Curve Data				
E38.	Working Point Note for Crowned Decks				
Miscellaneous Details:					
E39.	ABC Consideration (Include checklist with submittal)				
E40.	Channel Relocation Detail				
E41.	Exhibit A Drawing for RR Overpasses				
E42.	Foundation Plan for Existing/New Pile Locations				
E43.	Foundation Protection Riprap Detail				
E44.	Hydraulic Data Table				
E45.	Special Fill Detail for Piling Driven in Rock Fills				
E46.	Stage Construction Details (Separate dwg. typically)				
E47.	Superelevation Details/Cross-Slope Transition Sketch				

A2.18 General Notes for Bridge Layouts

Page 1 of 9

GENERAL NOTES FOR BRIDGE LAYOUTS

General Notes are used to give the broad, overall information needed to construct the bridge. The enclosed example notes are not intended to be comprehensive, but include numerous variations of commonly used notes for layouts. Select the appropriate notes, modify as needed, and include them on the layout drawing in the order below.

Organization of General Notes for Layouts

1. Benchmark.
2. Construction Specifications.
3. Design Specifications.
4. Live Loading.
5. Method of Design. - Not applicable if LRFD design
6. Seismic Zone.
7. Materials and Strengths.
8. Boring Logs.
9. Piling.
10. Preboring.
11. Driving System.
12. Footings.
13. Drilled Shafts.
14. Bridge Deck Finish.
15. Protective Surface Treatment – Class 2 for Districts 4, 5, & 9, Class 1 Typical elsewhere.
16. Detail Drawings/Drawing Nos. - include end bent, intermediate bent, spans, bearings, piling, approach gutters and/or slabs, and other drawings relating to the structural details. Generally, do not include embankment construction, permanent deck forms, name plates, etc.
17. Existing Bridge – Include Bridge No., log mile, length, width and description of superstructure and substructure. If not located within the layout plan view, describe where it is located relative to the new bridge.
18. Remodeling of the Existing Bridge - if parts of the existing bridge are to be incorporated into the new work, give a description of what work is to be done.
19. Removal and Salvage.
20. Temporary Bridge.
21. Shoring.
22. Maintenance of Traffic.

EXAMPLE GENERAL NOTES FOR LAYOUTS

BENCHMARK: Vertical Control Data are shown on the Survey Control Data Sheets.

CONSTRUCTION SPECIFICATIONS: Arkansas State Highway and Transportation Department Standard Specifications for Highway Construction (2014 edition) with applicable Supplemental Specifications and Special Provisions. Section and Subsection refer to the Standard Construction Specifications unless otherwise noted in the Plans.

DESIGN SPECIFICATIONS: AASHTO LRFD Bridge Design Specifications, Eighth Edition (2017).

LIVE LOADING: HL-93

SEISMIC ZONE: X **S_{D1}:** X.XX **SITE CLASS:** X

SEISMIC OPERATIONAL CLASSIFICATION: (critical, essential, or other)

MATERIALS AND STRENGTHS: (*for steel beams and girders*)

Class S(AE) Concrete (superstructure)	$f'c = 4,000$ psi
Class S Concrete (substructure)	$f'c = 3,500$ psi
Reinforcing Steel (AASHTO M 31 or M 322, Type A)	$f_y = 60,000$ psi
Structural Steel (ASTM A709, Gr. 50)	$F_y = 50,000$ psi
Structural Steel (ASTM A709, Gr. 50W)	$F_y = 50,000$ psi
Structural Steel (ASTM A709, Gr. 36)	$F_y = 36,000$ psi

MATERIALS AND STRENGTHS: (*for prestressed concrete girders*)

Class S(AE) Concrete (superstructure)	$f'c = 4,000$ psi
Class S Concrete (prestressed concrete girders)	$f'c = 6,000$ psi
Prestressing Strands (AASHTO M 203, Gr. 270)	$f_{pu} = 270,000$ psi
Class S Concrete (substructure)	$f'c = 3,500$ psi
Reinforcing Steel (AASHTO M 31 or M 322, Type A)	$f_y = 60,000$ psi
Structural Steel (ASTM A709, Gr. 50)	$F_y = 50,000$ psi
Structural Steel (ASTM A709, Gr. 50W)	$F_y = 50,000$ psi
Structural Steel (ASTM A709, Gr. 36)	$F_y = 36,000$ psi

MATERIALS AND STRENGTHS: (*precast concrete spans*)

Class S(AE) Concrete (superstructure)	$f'c = 4,000$ psi
Class S Concrete (substructure)	$f'c = 3,500$ psi
Reinforcing Steel (AASHTO M 31 or M 322, Type A)	$f_y = 60,000$ psi

BORING LOGS: Boring logs may be obtained from the Construction Contract Procurement Section of the Program Management Division.

CONCRETE PILING: (*Method A Pile Driving*)

Piling in Bents ____ through ____ shall be XX" square precast concrete and shall be driven with an approved air, steam, or diesel hammer to a minimum safe bearing capacity of XX tons per pile. Piling in end bents shall be driven after embankment to bottom of cap is in place. Drive all piles to a minimum penetration of 20' below natural ground. Lengths of piling shown are assumed for estimating quantities only. Actual lengths are to be determined in the field. Drive one XX' test pile in Bent ____ and one XX' test pile in Bent ____.

CONCRETE PILING: *(Method B Pile Driving)*

Piling in Bents ____ through ____ shall be XX" square prestressed concrete and shall be driven with an approved air, steam, or diesel hammer to a minimum ultimate bearing capacity of XX tons per pile. Piling in end bents shall be driven after embankment to bottom of cap is in place. Drive all piles to a minimum penetration of 20' below natural ground. Lengths of piling shown are assumed for estimating quantities only. Actual lengths are to be determined in the field. Drive one XX' test pile in Bent ____ and one XX' test pile in Bent ____.

CONCRETE PILING: *(Method B Pile Driving, Misc. Pile Sizes, & Min. Tip Elevations)*

Piling in Bents ____ and ____ shall be XX" square prestressed concrete and shall be driven to an ultimate bearing capacity of XX tons per pile. Piling in Bents ____ through ____ shall be XX" square prestressed concrete and shall be driven to a minimum ultimate bearing capacity of XX tons per pile. All piling shall be driven with an approved air, steam, or diesel hammer to a minimum tip elevation of ____ or lower at Bents ____ and ____ and to a minimum tip elevation of ____ or lower at Bents ____ thru _____. Piling in end bents shall be driven after embankment to bottom of cap is in place. Lengths of piling shown are assumed for estimating quantities only. Actual lengths are to be determined in the field. Drive one XX' test pile in Bent _____, one XX' test pile in Bent _____, and one XX' test pile in Bent _____.

STEEL SHELL PILING: *(Method B Pile Driving, Misc. Pile Sizes, & Min. Tip Elevations)*

Piling in Bents ____ and ____ shall be XX" diameter concrete filled steel shell piles and shall be driven to a minimum ultimate bearing capacity of XX tons per pile. Piling in Bents ____ thru ____ shall be XX" diameter concrete filled steel shell piles and shall be driven to a minimum ultimate bearing capacity of XX tons per pile. All piling shall be driven with an approved air, steam, or diesel hammer to a minimum tip elevation of ____ or lower at Bents ____ and ____ and to a minimum tip elevation of ____ or lower at Bents ____ thru _____. Piling in end bents shall be driven after embankment to bottom of cap is in place. Lengths of piling shown are assumed for estimating quantities only. Actual lengths are to be determined in the field. No additional payment will be made for cut-off or build-up. Test piles are not required but may be driven for the Contractor's information in accordance with Subsection 805.08(g).

Water jetting or other methods as approved by the Engineer may be required to achieve minimum penetration. This work shall not be paid for directly, but shall be considered incidental to the item "Steel Shell Piling (____" Dia.)". *(Used when anticipate that preboring, jetting, etc. will most likely not be required to achieve minimum penetration. Specify and pay for Preboring when anticipate that piles cannot be driven to minimum penetration without preboring.)*

STEEL PILING: *(Method A Pile Driving with Minimal Embankment Construction)*

All piling shall be HP x (Grade 50) and shall be driven with an approved air, steam, or diesel hammer to a minimum safe bearing capacity of XX tons per pile and into the material designated as _____ on the boring legend. Minimum penetration shall be 10' below bottom of cap for all piles in Bents 1 and _____. Piling in end bents shall be driven after embankment to bottom of cap is in place. Lengths of piling shown are for estimating quantities and for use in determining payment for cut-off and build-up in accordance with Section 805. Actual pile lengths are to be determined in the field. The Contractor shall use QPL-approved steel H-Pile driving points on all piles.

STEEL PILING: *(Method A Pile Driving with Minimum Penetration & Embankment Construction)*

All piling shall be HP x (Grade 50) and shall be driven with an approved air, steam, or diesel hammer to a minimum safe bearing capacity of XX tons per pile and into the material designated as _____ on the boring legend. Minimum penetration shall be 10' below natural ground for all piles

in Bents 1 and ____, and 10' below bottom of footing for all piles in Bents 2 thru _____. Piling in end bents shall be driven after embankment to bottom of cap is in place. Lengths shown are for estimating quantities and for use in determining payment for cut-off and build-up in accordance with Section 805. The Contractor shall use QPL-approved steel H-Pile driving points on all piles.

STEEL PILING: *(Method A Pile Driving & Driving Points for Integral End Bents with shallow rock)*

All piling shall be HP ____x____ (Grade 50) and shall be driven with an approved air, steam, or diesel hammer to a minimum safe bearing capacity of XX tons per pile and into the material designated as _____ on the boring legend. Minimum penetration shall be 15' below bottom of cap. Piling in end bents shall be driven after embankment to bottom of cap is in place. Lengths shown are for estimating quantities and for use in determining payment for cut-off and build-up in accordance with Section 805. The Contractor shall use QPL-approved steel H-Pile driving points on all piles.

PREBORING: *(Friction piles when required to achieve minimum penetration)*

All piling in Bents ____ thru ____ shall be prebored to achieve minimum penetration. Quantities of preboring shown are for bidding purposes only. The actual size and depth of preboring shall be determined in the field by the Engineer. After the piles have been driven, the holes shall be backfilled in accordance with Subsection 805.08(a). The Contractor shall be responsible for keeping prebored holes free of debris prior to driving piles and backfilling which may require the use of temporary casings or other approved methods. Any related cost for backfilling and temporary casing will not be paid for directly, but shall be considered subsidiary to the item "Preboring".

PREBORING: *(Bearing H-piles when required to achieve minimum penetration)*

Preboring is required for all piles in Bents ____ and _____. The depth of preboring shall be to a depth sufficient to provide the specified minimum penetration and to a minimum 3' depth into material designated as _____ on the boring legend, whichever is lower. The actual size and depth of preboring shall be determined in the field by the Engineer. The Contractor shall be responsible for keeping prebored holes free of debris prior to driving piles and backfilling which may require the use of temporary casings or other approved methods. After driving is completed, the prebored hole shall be backfilled with Class S Concrete to the top of the rock and the remaining length backfilled in accordance with Subsection 805.08(a). Any related cost for backfilling and temporary casing will not be paid for directly, but shall be considered subsidiary to the item "Preboring".

PREBORING: *(Integral End Bents, Steel Shell Piles)*

Preboring is required for all piling at Bents 1 and _____. Prebored holes shall have a diameter 6" greater than the diameter of the pile for a depth of 10' below the bottom of the cap. The void space around the pile after completion of driving shall be backfilled with sand or pea gravel. The Contractor shall be responsible for keeping prebored holes free of debris prior to backfilling which may require the use of temporary casings or other approved methods. Any related cost for backfilling and temporary casing will not be paid for directly, but shall be considered subsidiary to the item "Preboring".

PREBORING: *(Integral End Bents, Steel H-Piles into shallow Rock)*

Preboring is required for all piling at Bents 1 and _____. Preboring shall be to a minimum depth of 5' into material designated as _____ on the boring legend or to a minimum depth of 15' below the bottom of the cap, whichever is lower. Prebored holes shall have a diameter 6" greater than the diagonal of the pile for a depth of 10' below the bottom of the cap. The size and depth of the remaining preboring shall be determined in the field by the Engineer. After driving is completed, the prebored holes shall be backfilled with Class S Concrete to within 10' of the bottom of the cap, and the remaining 10' shall be backfilled with sand or pea gravel. The Contractor shall be responsible for keeping prebored holes free

of debris prior to driving piles and backfilling which may require the use of temporary casings or other approved methods. Any related cost for backfilling and temporary casing will not be paid for directly, but shall be considered subsidiary to the item "Preboring".

DRIVING SYSTEM: *(Used with Method B or C Pile Driving, Method B Shown)*

The driving system approval and the ultimate bearing capacity determination for piling shall be based on the requirements of Subsection 805.09(b), "Method B – Wave Equation Analysis (WEAP)". It is estimated that the minimum rated hammer energy required to obtain the ultimate bearing capacity for all piles will be _____ foot pounds per blow.

PILE ENCASEMENT: *(Used at steel shell pile intermediate bents)*

Pile encasement for Bents ____ shall extend from bottom of cap to 3' below natural or finished ground. See Standard Drawing Number 55021 for additional information.

PILE CASINGS: *(Used with MSE walls to avoid damaging straps)*

Pile casings are required for piling within MSE walls at end bents. Casings shall be installed prior to or during the embankment construction and shall extend from top of leveling pad to bottom of cap. Pile casing material shall be of sufficient strength to retain its original form free from harmful distortions after compaction of the fill material surrounding it. The minimum inside diameter of the casing shall be at least 4" greater than the outside diameter of the steel shell pile. Piles shall be driven through the open casings after embankment to bottom of cap is in place. After driving is complete, the pile casings shall be filled with Class S Concrete, an approved non-shrink grout, mixture used for Portland Cement Concrete Pavement, or other approved material in a single continuous operation to completely fill voids. Pile casings and concrete will not be paid for directly but shall be considered subsidiary to the item "Steel Shell Piling (XX" Dia.)".

PILE FOOTINGS: The top of the footings at Bents ____ thru ____ shall be set a minimum of ____' below natural ground or at the elevations shown on the plans, whichever is lower. Foundations for footings shall be prepared in accordance with Subsection 801.04. Foundation piles shall not be driven until after the excavation to bottom of footing is complete. Excavations shall be backfilled and compacted to the level of the existing ground in accordance with Subsection 801.08.

SPREAD FOOTINGS: *(with Backfill of Excavations)*

Footings shall be set a minimum of ____' into material designated as _____ on the boring legend. The top of the footings at Bents ____ thru ____ shall be set a minimum 2' below the channel bottom as determined by the lowest channel elevation within the footprint of the footing. Foundations for footings shall be prepared in accordance with Subsection 801.04. Rock excavations shall be made to neat lines of the concrete footings. Care shall be exercised to avoid shattering of rock faces by excessive blasting. Concrete in footings shall be poured directly against excavated surfaces of rock. Excavations shall be backfilled and compacted to the level of the existing ground in accordance with Subsection 801.08.

SPREAD FOOTINGS: *(with Rock at Surface, No Backfill of Excavations)*

Footings shall be set a minimum of ____' into material designated as _____ on the boring legend. The top of the footings at Bents ____ thru ____ shall be set at or below the channel bottom as determined by the lowest channel elevation within the footprint of the footing. Foundations for footings shall be prepared in accordance with Subsection 801.04. Rock excavations shall be made to neat lines of the concrete footings. Care shall be exercised to avoid shattering of rock faces by excessive blasting. Concrete in footings shall be poured directly against excavated surfaces of rock.

DRILLED SHAFTS: Drilled shafts at Bents ___ thru ___ shall be constructed in accordance with Special Provision “Drilled Shaft Foundations”. Drilled shafts shall be socketed into material designated as _____ on the boring legend and to the minimum rock penetrations and tip elevations shown in the plans. No adjustment to plan tip elevations shall be made without prior approval from the Engineer. Temporary casing may be required.

NONDESTRUCTIVE TESTING: Crosshole Sonic Logging (CSL) and Thermal Integrity Profiling (TIP) shall be performed on each drilled shaft. Testing shall be performed in accordance with Special Provision “Nondestructive Testing of Drilled Shafts”.

NONDESTRUCTIVE TESTING: Crosshole Sonic Logging (CSL) shall be performed on each drilled shaft. Testing shall be performed in accordance with Special Provision “Nondestructive Testing of Drilled Shafts”.

NONDESTRUCTIVE TESTING: Crosshole Sonic Logging (CSL) and Thermal Integrity Profiling (TIP) shall be performed on the first drilled shaft constructed at each bent and any remaining drilled shafts as instructed by the Engineer. Testing shall be performed in accordance with Special Provision “Nondestructive Testing of Drilled Shafts”.

PAINTING: *(Ends of beams/girders only for weathering steel with jointed bridges, use five feet for W-beams and 2*D (up to ten feet max.) for plate girders)*

All Grade 50W structural steel, except galvanized members, surfaces in contact with concrete, and the expansion device, within five feet of bridge deck expansion joints shall be painted as specified in Subsection 807.75. The color of paint shall be Brown equal or close to Federal Std. 595B, Color Chip No. 30070 and as approved by the Engineer. The finish system may be applied in the shop. Any damage to the paint system occurring during transport or installation shall be corrected according to the manufacturer’s recommendations at no cost to the Department.

PAINTING: All Grade 50 structural steel, except galvanized members and surfaces in contact with concrete, shall be painted as specified in Subsection 807.75. The color of paint shall be _____ and shall match Federal Standard 595B, Color Chip No. _____.

POWDER COATING: *(When powder coating is required for bridge railing)*

All metal bridge railing shall receive a powder coating finish. The color of paint shall be _____ equal or close to Federal Std. 595B, Color Chip No. _____ and as approved by the Engineer. See Std. Dwg. No. 55014 for additional information.

TEXTURED COATING FINISH: Class 3 Textured Coating Finish shall be applied to bridge and retaining wall surfaces as specified in Special Provision “Textured Coating Finish” and in accordance with Subsection 802.19(b)(3). Textured Coating Finish shall not be applied on surfaces where Class _ Protective Surface Treatment is applied.

BRIDGE DECK: *(Without sidewalks)*

The concrete bridge deck shall be given a tined finish as specified for final finishing in Subsection 802.19 for Class 5 Tined Bridge Roadway Surface Finish.

BRIDGE DECK: *(With sidewalks)*

The concrete bridge deck, except sidewalks, shall be given a tined finish as specified for final finishing in Subsection 802.19 for Class 5 Tined Bridge Roadway Surface Finish. Sidewalks shall be given a Class 6 Broomed Finish.

PROTECTIVE SURFACE TREATMENT: *(Without Sidewalks)*

Class _ Protective Surface Treatment shall be applied to the roadway surface and to the roadway face and top of the concrete parapet rails in accordance with Section 803.

PROTECTIVE SURFACE TREATMENT: *(With Sidewalks)*

Class _ Protective Surface Treatment shall be applied to the roadway surface, sidewalk surface (including curbing), and to the roadway face and top of the concrete parapet rails in accordance with Section 803.

DETAIL DRAWINGS:

DRAWING NO(S).

Stage Construction	_____
End Bents	_____
Intermediate Bents	_____
Elastomeric Bearings	_____
_____' Continuous W-Beam Unit	_____
_____' Integral Continuous W-Beam Unit	_____
_____' Continuous Plate Girder Unit	_____
_____' Simple W-Beam Span	_____
_____' Simple Plate Girder Span	_____
_____' Prestressed Concrete Girder Unit	_____
_____' Integral Prestressed Concrete Girder Unit	_____
_____' Precast Concrete Spans	_____
General Notes For Steel Bridge Structures	55006
Details For Steel Bridge Structures	55007
Poured Silicone Joints	55008
Neoprene Strip Seal Joints	55009
Transitional Approach Railing	55013
Type H Railing	55014
Steel H-Piling	55020
Concrete Filled Steel Shell Piling	55021
Concrete Piling	55022

EXISTING BRIDGE: Existing Bridge No. _____ (Log Mile XXX.XX) is XX.X' wide (XX.X' clear roadway) and XXX.X' long and consists of steel I-beam spans (x spans total) supported by concrete columns on concrete pile footings. The existing bridge is located approximately XXX' upstream from the proposed new bridge. Plans of the existing structure, if available, may be obtained upon request to the Construction Contract Procurement Section of the Program Management Division.

(Note: Out to Out Bridge Deck Width should be used to define the existing bridge width).

REMODELING OF THE EXISTING BRIDGE: *(Used for Widening Bridges to describe scope of work)*

The proposed work consists of widening the existing bridge by modifying/extending the existing: substructure, concrete deck, dumped riprap, and joints and by adding beam lines as shown in the plans. For additional requirements of conducting the work, see Section 821. The cost associated with the

removal and disposal of portions of the existing bridge shall be included in the item "Modification of Existing Bridge Structure (Bridge No. _____)".

VERIFICATION: (Used for Widening Bridges)

Except as noted, components of the existing bridge are to be retained and joined to the proposed work. Information and dimensions shown are based on the existing bridge plans and available survey data. The Contractor is to adhere strictly to the requirements for verification of the geometry of the existing bridge and its relationship to the proposed work described in Subsection 821.02 and make necessary adjustments to fit the proposed work to the existing structure. Payment for this work shall be considered subsidiary to the pay item "Modification of Existing Bridge Structure (Bridge No. XXXXX)".

REMOVAL AND SALVAGE: (Traffic not maintained on exist. bridge, all salvage by Contractor)

After the detour alignment is open to traffic, the Contractor shall remove existing Bridge No. _____ in accordance with Section 205. All material from the existing bridge shall become the property of the Contractor.

REMOVAL AND SALVAGE: (Traffic maintained on exist. bridge, all salvage by Contractor)

After the new bridge is open to traffic, the Contractor shall remove existing Bridge No. _____ in accordance with Section 205. All material from the existing bridge shall become the property of the Contractor.

REMOVAL AND SALVAGE: (Stage construction of new bridge, all salvage by Contractor)

After Stage 1 construction is complete and open to traffic, the Contractor shall remove existing Bridge No. _____ in accordance with Section 205. All material from the existing bridge shall become the property of the Contractor.

REMOVAL AND SALVAGE: (Additional removal of pre-existing structures, concrete riprap)

After the new bridge is open to traffic, the Contractor shall remove existing Bridge No. _____ in accordance with Section 205. Existing concrete riprap and exposed timber piling from a previous structure shall also be removed. Timber piling shall be removed to a depth of 2' below subgrade or final ground surface. This work shall be considered subsidiary to the item "Removal of Existing Bridge Structure (Site No.)". All material from the existing bridge and previous structure shall become the property of the Contractor.

REMOVAL AND SALVAGE: (Traffic maintained on exist. bridge, some salvage by District)

After the new bridge is open to traffic, the Contractor shall remove existing Bridge No. _____ in accordance with Section 205. All material from the existing bridge shall become the property of the Contractor except the following which shall remain the property of the State:

Guard Rail Beams and Posts from Bridge Approaches
24" I-Beams in all Spans

The Contractor shall notify the Department prior to removal to determine the specific pieces deemed salvageable. The Contractor shall provide temporary storage and on-site loading onto ARDOT equipment for removal of salvage items from the site. This work shall be considered incidental to the item "Removal of Existing Bridge Structure (Site No.)".

REMOVAL AND SALVAGE: (Additional removal of pre-existing structure piles)

After the new bridge is open to traffic, the Contractor shall remove existing Bridge No. _____ in accordance with Section 205. Existing remnant timber piling from a previous structure shall also be removed to a depth of 2' below subgrade or final ground surface. This work will not be paid for directly but shall be considered subsidiary to the item "Removal of Existing Bridge Structure (Site No.)". All material from the existing bridge and previous structure shall become the property of the Contractor.

REMOVAL AND SALVAGE: *(Additional removal of dumped riprap)*

After the new bridge is open to traffic, the Contractor shall remove existing Bridge No. _____, including dumped riprap, in accordance with Section 205. Removal of dumped riprap will not be paid for directly but shall be considered subsidiary to the item "Removal of Existing Bridge Structure (Site No.)". All material from the existing bridge shall become the property of the Contractor.

REMOVAL AND SALVAGE: *(Additional removal of concrete riprap)*

After the new bridge is open to traffic, the Contractor shall remove existing Bridge No. _____, including concrete riprap, in accordance with Section 205. Removal of concrete riprap will not be paid for directly but shall be considered subsidiary to the item "Removal of Existing Bridge Structure (Site No.)". All material from the existing bridge shall become the property of the Contractor.

TEMPORARY BRIDGE: *(24' Width, No Timber Deck, No Untreated Timber Piling)*

Construct a minimum ____' long temporary bridge approximately XXX' upstream with a minimum deck elevation of XXX.XX. See Roadway Plans for actual detour grade and alignment. The temporary bridge shall have a minimum roadway width of 24' and a minimum live load capacity of H15 in accordance with AASHTO Standard Specifications for Highway Bridges, 2002 Edition. See Section 603 and Standard Drawing Nos. 55054-55056 for standard temporary bridge details. If timber piling and pine timber are used on this temporary bridge structure, the materials shall be treated with a preservative in accordance with the Standard Specifications. If an optional design is used by the Contractor, a timber deck will not be allowed.

TEMPORARY BRIDGE: *(20' Width, Precast or Timber Spans, Untreated Timber allowed)*

Construct a minimum ____' long temporary bridge approximately XXX' downstream with a minimum deck elevation of XXX.XX. See Roadway Plans for actual detour grade and alignment. The temporary bridge shall have a minimum roadway width of 20' and a minimum live load capacity of H15 in accordance with AASHTO Standard Specifications for Highway Bridges, 2002 Edition. See Section 603 and Standard Drawing Nos. 55050-55054 for standard temporary bridge details. Untreated timber piling and untreated pine timber may be used in the construction of the temporary bridge structure.

SHORING: Shoring may be required for Stage One *(or I, I, etc. as the case may be)* Construction. No direct payment will be made for shoring. See Special Provision "Shoring".

MAINTENANCE OF TRAFFIC: The road will be closed during the construction of this project.

MAINTENANCE OF TRAFFIC: See Roadway Plans.

A2.19 Example Letters & Interoffice Memorandums



ARKANSAS DEPARTMENT OF TRANSPORTATION

ArDOT.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director

BRIDGE DIVISION

10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2361 | Fax: 501.569.2623

Date

Mr. Angel Correa
Division Administrator
Federal Highway Administration
Room 3130 Federal Building
Little Rock, AR 72201

Arkansas Job No. ____

Job Title

Hwy. __, ____ County

FAP No. ____

Dear Mr. Correa:

Enclosed for your review and approval are two copies of the proposed bridge layouts on the subject project. We are also enclosing a copy of the job title sheet for your information.

Soil borings are not available to date; however the use of concrete filled steel shell piling is anticipated. This will be confirmed upon receipt of the soil borings, and the layouts resubmitted for your review should any changes be required.

Please furnish us with your approval or comments at your earliest opportunity.

Sincerely,

Charles R. Ellis, P.E.
Bridge Engineer

CRE:xxx

Enclosure

c: Assistant Chief Engineer - Design



ARKANSAS DEPARTMENT OF TRANSPORTATION

ARDOT.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director

10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2000

INTEROFFICE MEMORANDUM

Date

TO: Mr. Michael D. Fugett, Assistant Chief Engineer - Design

FROM: Rick Ellis, Bridge Engineer

SUBJECT: Bridge Layout; Job No. _____
Job Title
Choose a County
Route __, Section __

Attached for your review and approval is the proposed bridge layout for the subject project. We are also attaching a copy of the job title sheet for your information.

CRE:xxx

Attachments

Email: Environmental
Hydraulics Section
Materials
Right of Way
Roadway Design



ARKANSAS DEPARTMENT OF TRANSPORTATION

AR^{DOT}.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director

10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2000

INTEROFFICE MEMORANDUM

Date

TO: Mr. _____, District _ Engineer

FROM: Rick Ellis, Bridge Engineer

SUBJECT: Bridge Layout; Job No. _____
Job Title
Choose a County
Route __, Section __

Attached for your review and comments is the proposed bridge layout for the subject project. We are also attaching a copy of the job title sheet for your information. In addition, attached is all required information for the beams/girders qualifying for the ARDOT Salvaged Bridge Material Program.

If you desire a joint bridge site inspection with this office, please advise and we will schedule one at your convenience. Please send us a list of any material you wish to salvage from the existing structure or if any county wishes to enter a Memorandum of Agreement with the Department for utilizing the available beams/girders at another location.

Your prompt response would be greatly appreciated so that we can proceed with the development of the plans.

CRE:xxx

Attachments

c & attachments: Association of Arkansas Counties

Email: Heavy Bridge



ARKANSAS DEPARTMENT OF TRANSPORTATION

ArDOT.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director

BRIDGE DIVISION

10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2361 | Fax: 501.569.2623

Date

The Honorable _____
_____ County Judge
P.O. Box _____
City, AR Zip Code

Arkansas Job No. ____
Job Title
_____ County
County Road ____

Dear Judge _____:

A print of the proposed bridge layout for the referenced project is enclosed for your review and comments. We are also enclosing a copy of the job title sheet for your information.

If you feel that a joint site inspection with Bridge Division personnel is needed, please let us know.

We will include in the contract a pay item for the removal of the existing bridge by the Contractor. Please let us know whether you want (1) all materials, (2) none of the materials, or (3) certain items from the existing bridge to remain the property of the County. Any steel deemed salvageable by ARDOT that does not remain the property of _____ County will be offered to other counties as part of ARDOT's Salvaged Steel Program. All materials not salvaged will become the property of the Contractor.

Should you need additional information, please contact Staff Engineer of this office at 501-569-Ext.

Sincerely,

Charles R. Ellis, P.E.
Bridge Engineer

CRE:xxx
Enclosures
c: Assistant Chief Engineer - Design
State Aid

Appendix A3

Bridge Hydraulics

A3.1	HEC-RAS Cross Sections	A3-1
A3.2	Example Hydraulic Certification Request	A3-2

A3.1 HEC-RAS Cross Sections

CREATING NEW CROSS SECTIONS IN HEC-RAS

The following steps provide guidance for creating a new cross section in HEC-RAS using In-Roads:

1. Copy the h“Job Number”. dgn file from the EDM and Open
2. Open the s“Job Number”.dtm file in the .dgn file
3. Open the h“Job Number”.alg file in the .dgn file
4. Add necessary cross sections perpendicular to centerline stream by creating a line. Verify cross sections do not overlap each other and that they are on a zero Z-plane (the third coordinate for each end of the line needs to be set to 0). Select all cross section to be added to the HEC-RAS model.
5. Verify that the “Hydrology & Hydraulics” add-in under the “Evaluation” tab is available. If it is not available, go to “Tools/Application Add-ins” and turn on the “Hydrology and Hydraulics” add-in. It should now be visible under “Evaluation”. Please note that not all versions of In-Roads (i.e. “Bridge”) have this add-in available. Once this feature is available then go to the “Generate Water Surface Data” feature. A similar input box shown below should appear. Once all the required data fields are correct, the designer shall hit “Apply” and save the file as “filename”.geo.
6. The created file can now be entered into HEC-RAS. Open the project file that the newly created cross section data will be imported into. Under the “Edit/enter geometric data” tab, go to “File/Import Geometry Data/GIS Format”. Choose the “filename”.geo file. Follow the on screen prompts for the user preferences and click the “Finished-Import Data” button.

Generate Water Surface Data

Cross Sections Job Control

Surface: Imported Surface Filter...

Alignment: Stream C.L. Help

Create: Section Data

Section Format: HEC-RAS

Maximum Points: 200

Alignment Direction: Upstream

Cross Section Begin Station: 0.0000

Stream ID: Stream

Reach ID: Reach

Station Units: Feet

Banks

Left Bank: LB

Left Overbank: LOB

Right Bank: RB

Right Overbank: ROB

Source

Selection Set

Level: Default

Alignment

Interval: 100.0000

Offsets

Left: -100.0000

Right: 100.0000

Station

Start: 0+00.00

Stop: 7+17.99

Display Section Lines

Apply Close

A3.2 Example Hydraulic Certification Request



ARKANSAS DEPARTMENT OF TRANSPORTATION
 ARDOT.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director
 10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2000

INTEROFFICE MEMORANDUM

Date

TO: Mr. Trinity Smith, Roadway Design Engineer
 Attn: Mark Earl

FROM: Rick Ellis, Bridge Engineer

SUBJECT: Design & Floodplain Certification
 Bridge Layout Submittal
 Job No. _____
Job Title
 _____ County
 Route __, Section __

Attached is a copy of the proposed bridge layout for your use in reviewing the hydraulic design and in evaluating compliance with floodplain regulations and department design criteria.

Pertinent bridge design information may be found as indicated below:

Location	Bridge Layout Filename ¹	Hydraulics Geometry Filename ²
Crossing	filename.dgn (River Station XXX.XX used for reported elevations in Table)	filename.g0x

If additional information is required, please contact Staff Engineer at extension Phone Number.

CRE:xxx
 Attachment(s)
 Email: Roadway Staff Engineer

¹ Layout files are located on EDM

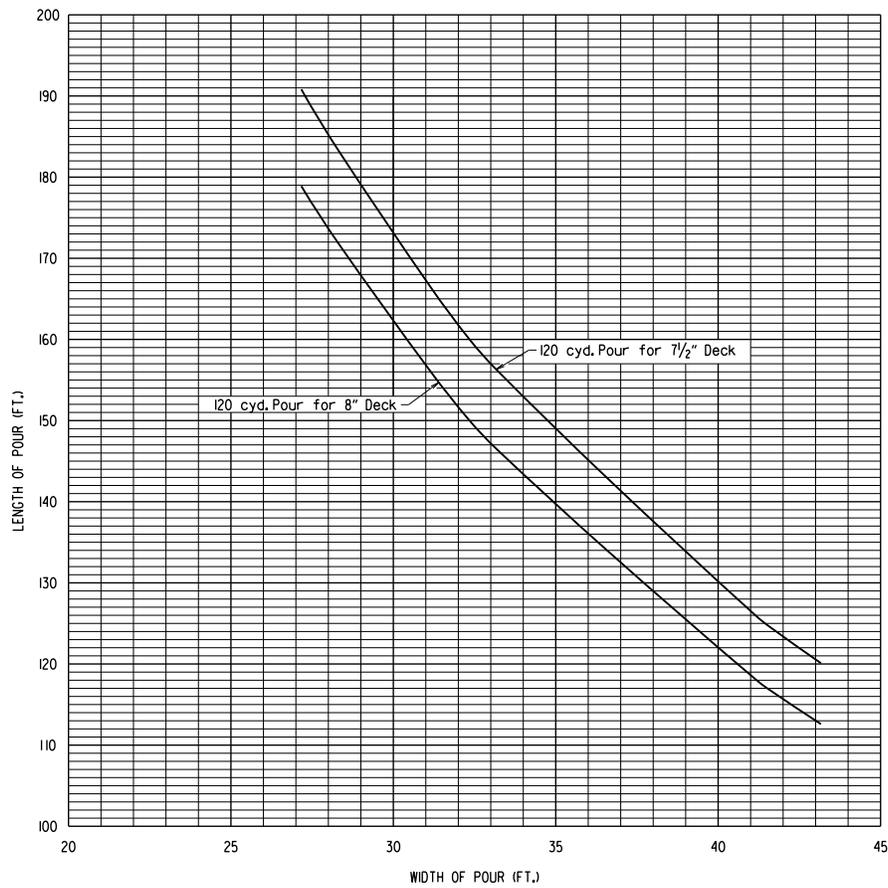
² Geometry files are located at \\CSD4\BRIDGE DIVISION INFO\HEC-RAS_Brg\XXXXX\

Appendix A4

Superstructure

A4.1	Guide for Short Unit Pours	A4-1
A4.2	Example W-Beam Details	A4-2
A4.3	Example Plate Girder Details	A4-3
A4.4	Prestressed Girder and Bulb-Tee Shapes	A4-4
A4.5	Example Prestressed Girder and Bulb-Tee Details	A4-5
A4.6	Example Preformed Silicone Joint Details	A4-6
A4.7	Example Finger Joint Details	A4-7
A4.8	Example Preformed Compression Joint Seal Details	A4-8
A4.9	Example Inverted Tee Cap with Poured Silicone Joint Details	A4-9
A4.10	New Jersey Railing Details	A4-10
A4.11	Single Slope Railing Details	A4-12

A4.1 Guide for Short Unit Pours



EXAMPLE: 3-SPAN UNIT

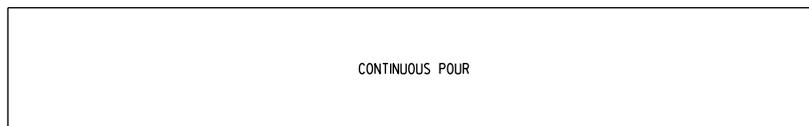
Normal Sequence for Long Units



Alternate A

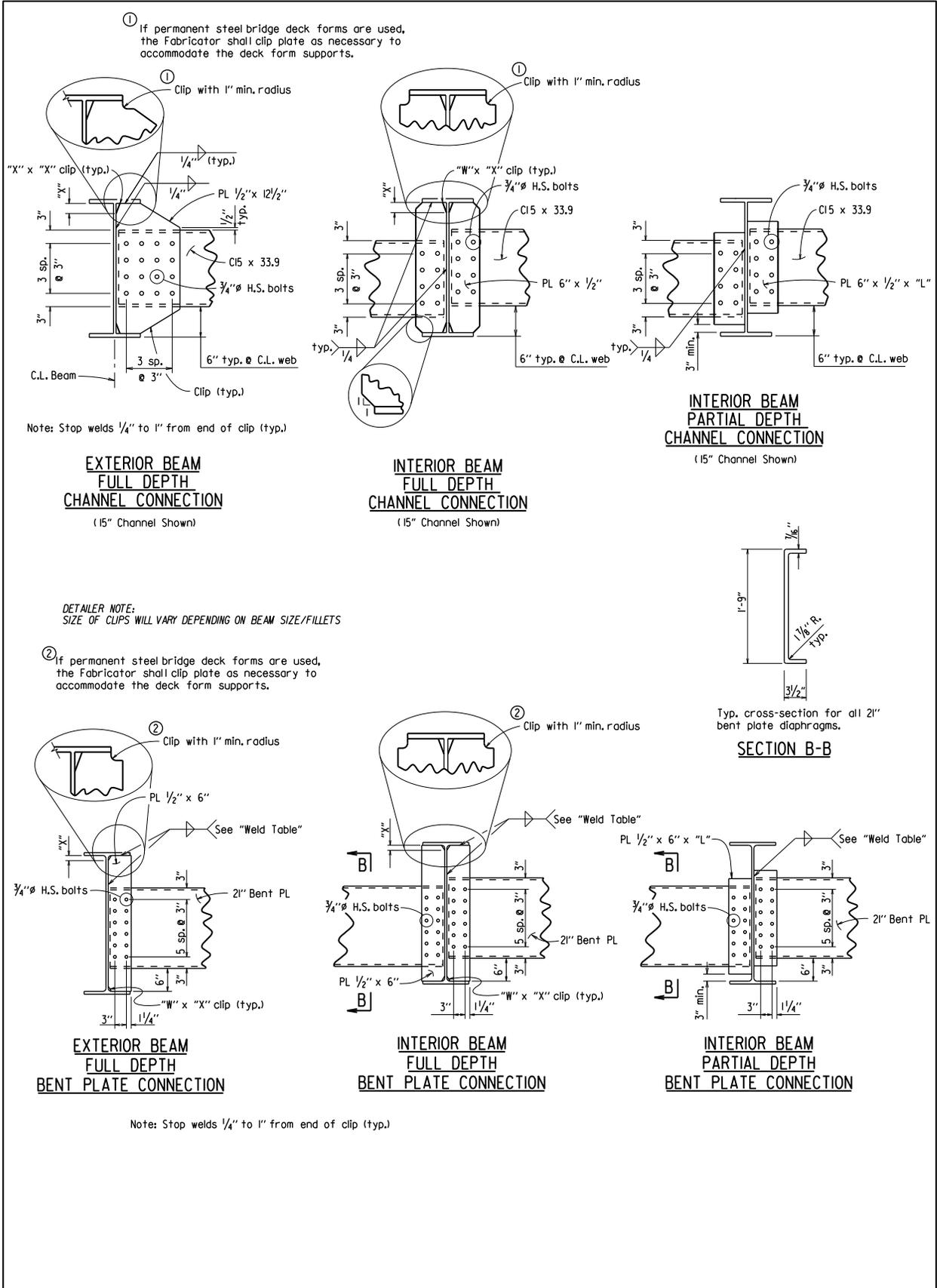


Alternate B

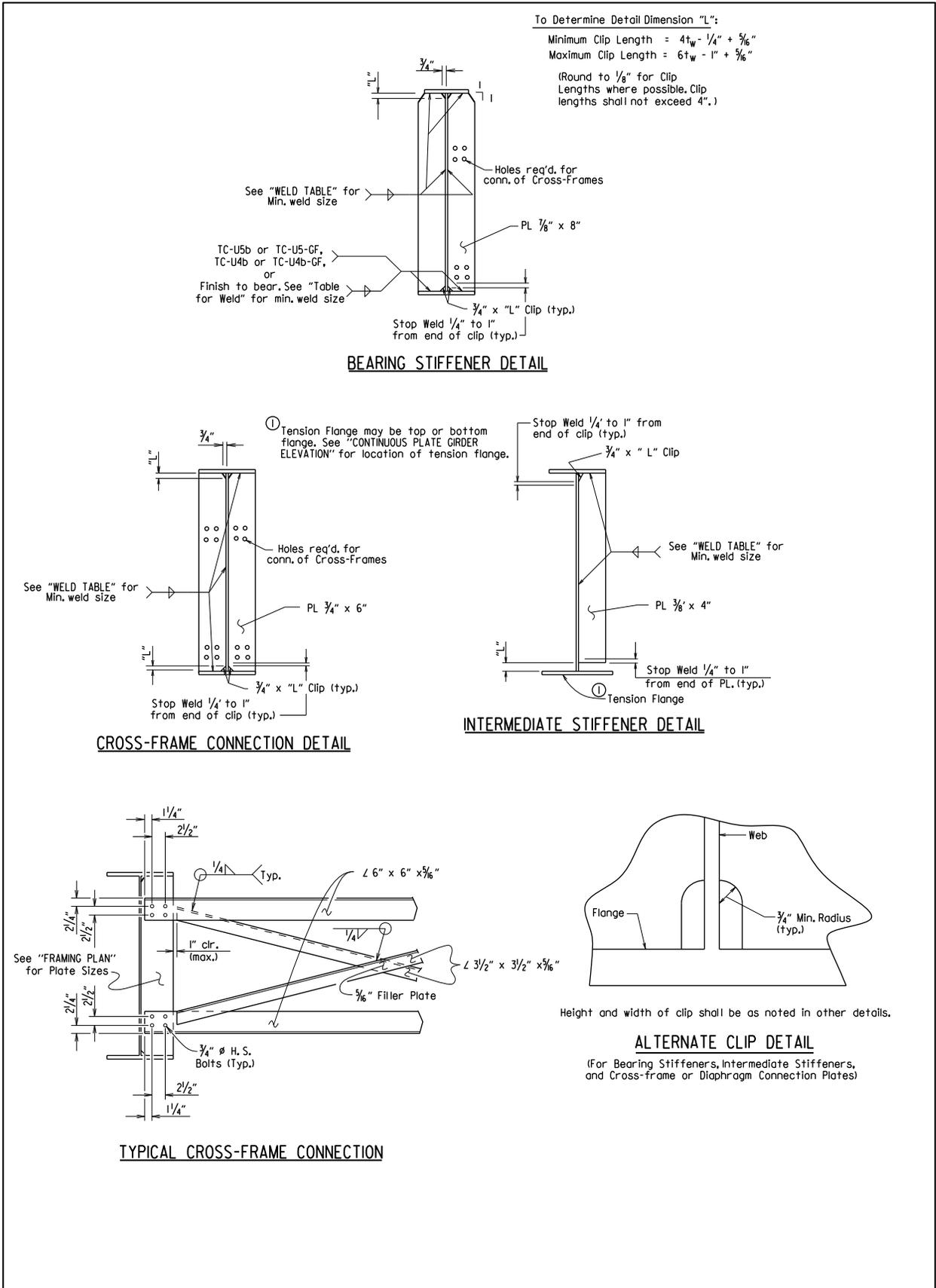


Note: Show Alternates A and B on the plans for Short Units.

A4.2 Example W-Beam Details



A4.3 Example Plate Girder Details



A4.4 Prestressed Girder and Bulb-Tee Shapes

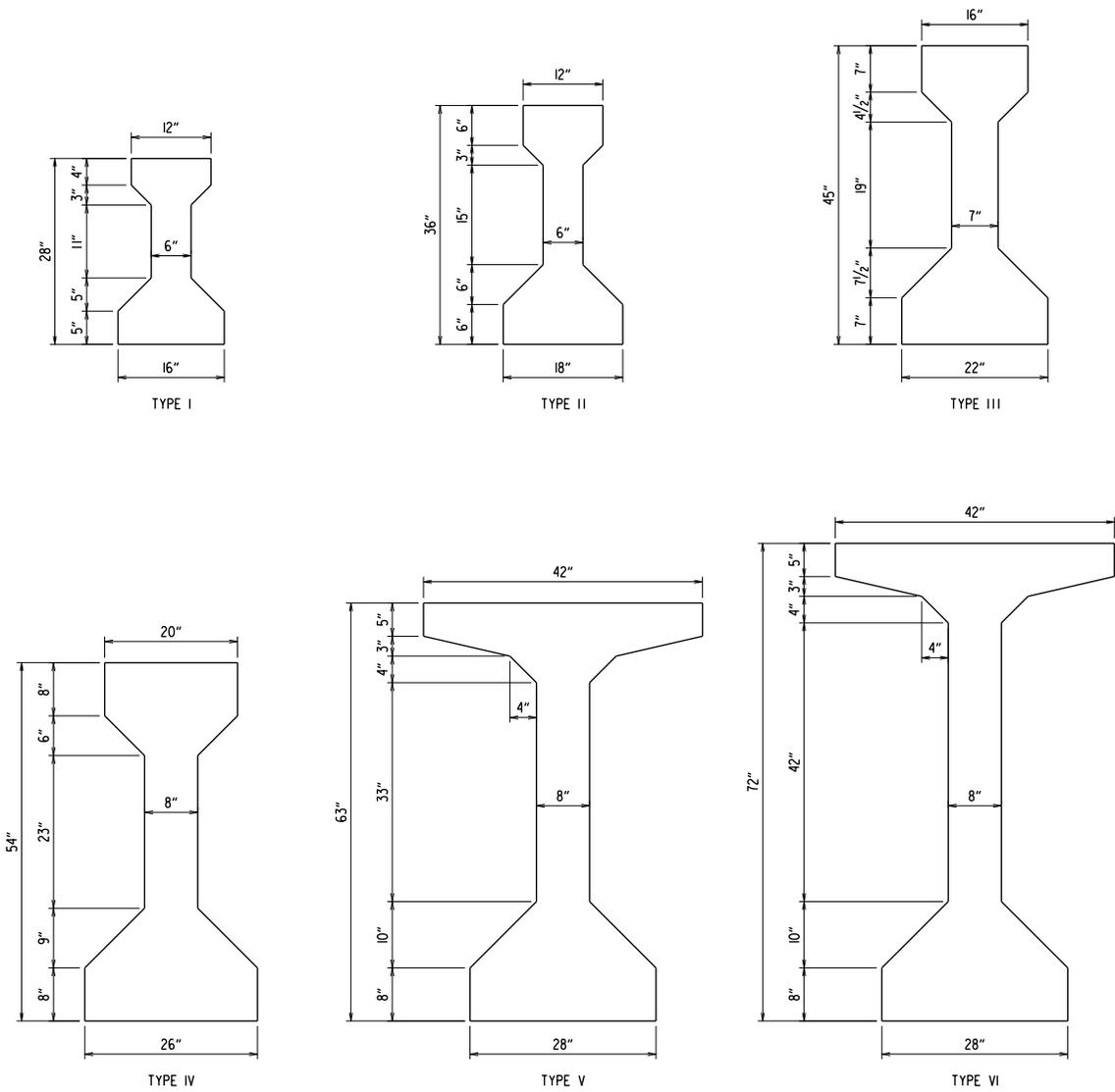
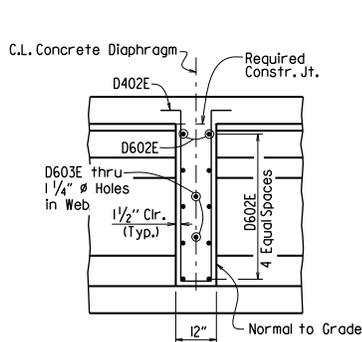


Table of Properties

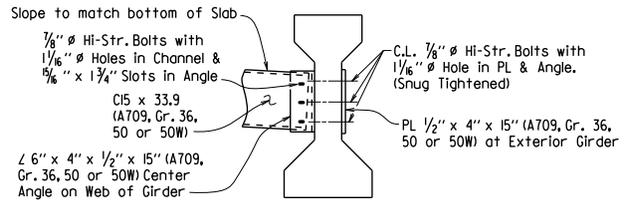
Girder Type	Area, in. ²	I, in. ⁴	c _b , in.	Recommended Span Limits, ft
I	276	22,750	12.59	30 - 45
II	369	50,980	15.83	40 - 60
III	560	125,390	20.27	55 - 80
IV	789	260,730	24.73	70 - 100
V	1013	521,180	31.96	90 - 120
VI	1085	733,320	36.38	110 - 140

Standard AASHTO-PCI prestressed concrete I-beams for highway bridges.

A4.5 Example Prestressed Girder and Bulb-Tee Details



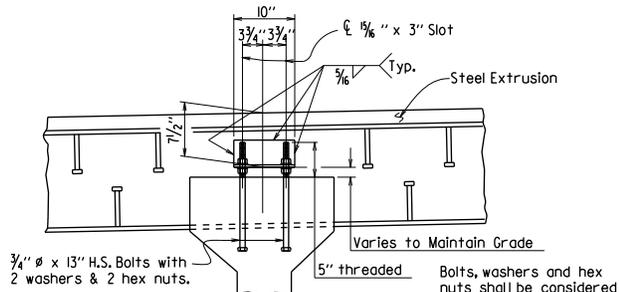
MIDSPAN CONCRETE DIAPHRAGM
(Type IV Girder Shown)



A standard washer shall be supplied under both the nut and the head of the 7/8" H.S. bolts. An additional plate washer shall cover the angle slots.

DETAILS OF ALTERNATE MID-SPAN DIAPHRAGM

Note: Galvanized Steel Diaphragms may be used in place of Concrete at Mid-Span Diaphragms only. All components of the Alternate Steel Diaphragms shall be Galvanized. Payment will be based on concrete diaphragms.



CONNECTION ADJUSTMENT AT EXPANSION DEVICE

Bolts, washers and hex nuts shall be considered subsidiary to the item "Prestressed Concrete Girders".

A4.6 Example Preformed Silicone Joint Details

DETAILS FOR BLOCKING EXPANSION JOINT DEVICE

The Contractor may elect to install the expansion device using one of the following two alternatives:

- 1) The concrete span pair adjacent to joint shall be placed before the end bent is erected. The blocked expansion device shall be installed and adjusted for grade. All connection bolts shall be fully tightened prior to placing the deck concrete. The blocking shall be removed and the opening adjusted for temperature and grade.
- 2) The blocking shall be poured to the exterior construction joint after beams are erected. The blocked expansion device shall be installed and adjusted for grade. All connection bolts shall be fully tightened prior to placing the deck concrete. The blocking shall be removed and the opening adjusted for temperature and grade.

EXPANSION DEVICE INSTALLATION AT END BENTS:

1) The concrete span pair adjacent to joint shall be placed before the end bent is erected. The blocked expansion device shall be installed and adjusted for grade. All connection bolts shall be fully tightened prior to placing the deck concrete. The blocking shall be removed and the opening adjusted for temperature and grade.

2) The blocking shall be poured to the exterior construction joint after beams are erected. The blocked expansion device shall be installed and adjusted for grade. All connection bolts shall be fully tightened prior to placing the deck concrete. The blocking shall be removed and the opening adjusted for temperature and grade.

EXPANSION DEVICE INSTALLATION AT INTERIOR BENTS:

After all beams on each side of the joint are erected the blocked expansion device shall be installed and adjusted for grade. Block concrete shall be placed on the other side is placed. Connection bolts for the first side to move deck concrete placed shall be completely tightened. Bolts on the other side shall be tightened during concrete placement on the first side.

Connection bolts on the second side shall remain loose until the concrete pour adjacent to the joint is to be placed. Immediately prior to pouring the span concrete on the second side, the blocking shall be removed. The joint adjusted for temperature and grade, and the connection bolts tightened.

CHANNEL CONNECTION DETAIL

PREFORMED SILICONE JOINT SEAL DATA

Joint Width Perpendicular to Joint at 24 Hour Average Temperature (°F)	Perpendicular to Joint at 60°F	
	40°F	80°F
1"	1 1/2"	2"
1 1/2"	2"	2 1/2"
2"	2 1/2"	3"

○ The temperature used to set the joint opening shall be the approximate average air temperature during the 24 hour period immediately preceding the joint opening. Interpolation of the table may be necessary.

○ The temperature limitations recommended by the joint seal manufacturer shall be followed. The minimum joint opening shall only when the ambient air temperature is a minimum of 40°F and rising.

SECTION THRU JOINT AT INTERMEDIATE BENT

Note: Section taken perpendicular to C.L. Joint

DETAIL OF PREFORMED SILICONE JOINT SEAL

Designer: Notes Detail shown is applicable to R.J. Bolton SP400 Joint Seal with 3" maximum opening.

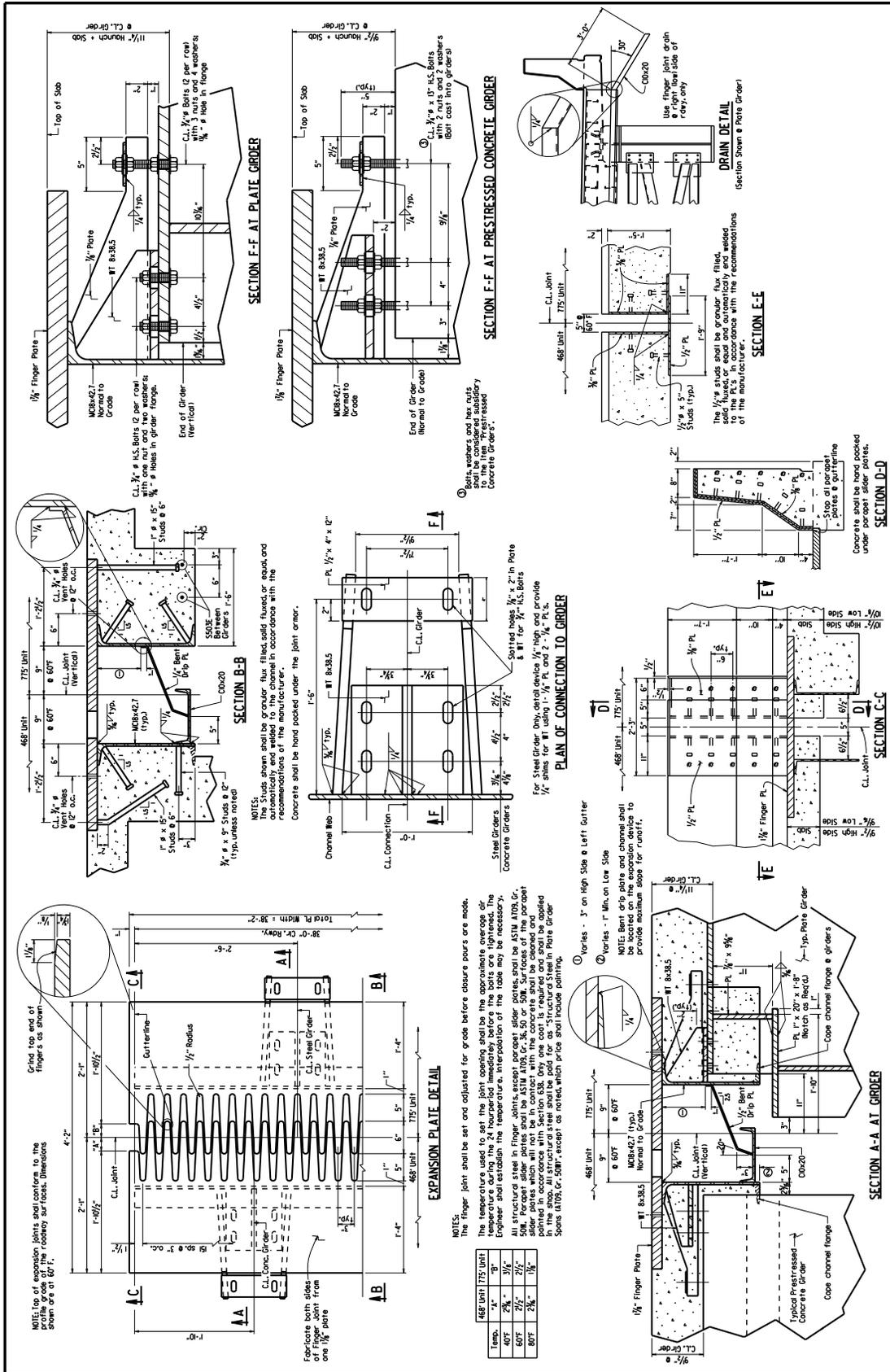
SECTION THRU JOINT AT END BENT

Note: Section taken perpendicular to C.L. Joint

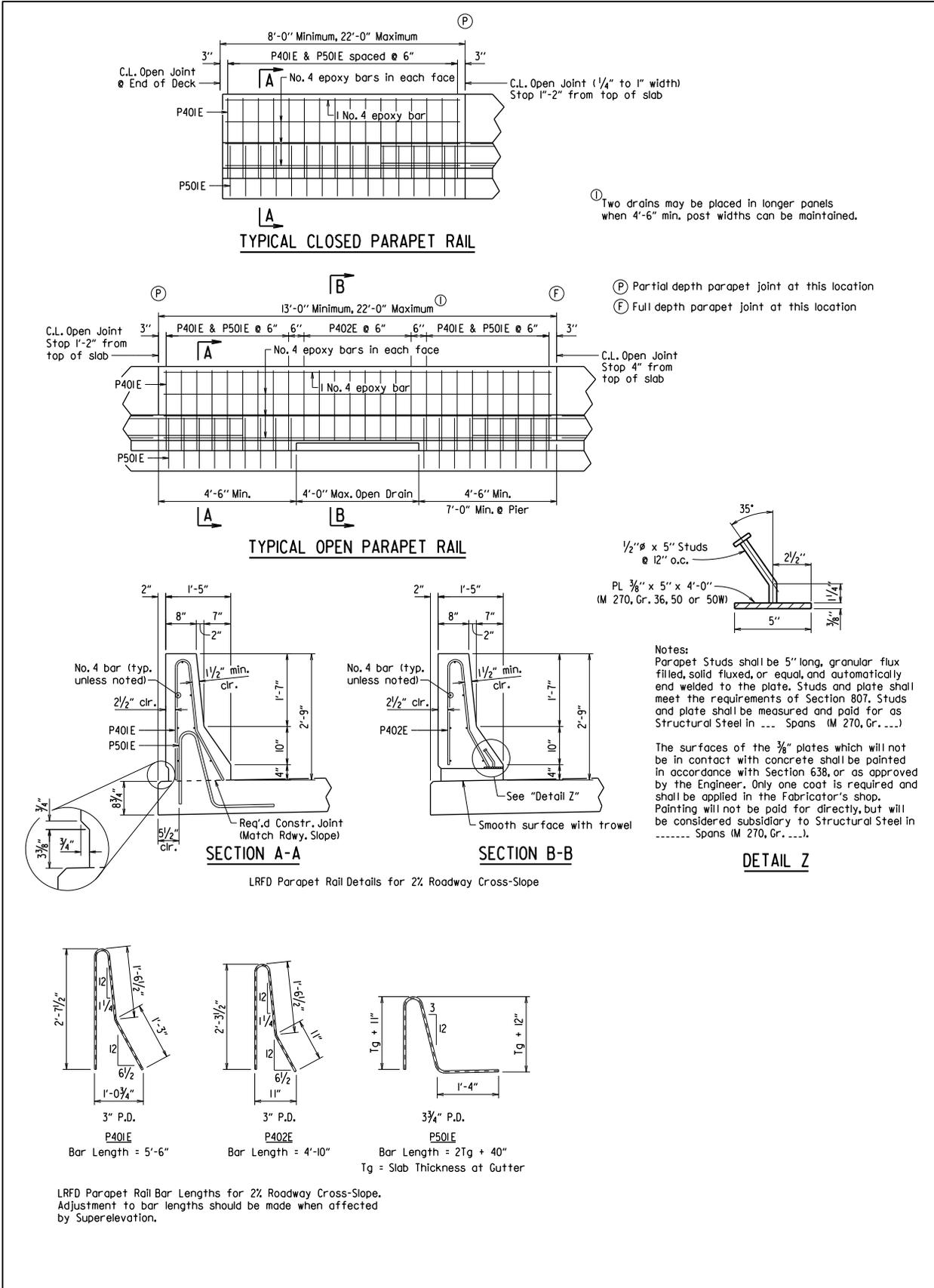
DETAIL OF PREFORMED SILICONE JOINT SEAL

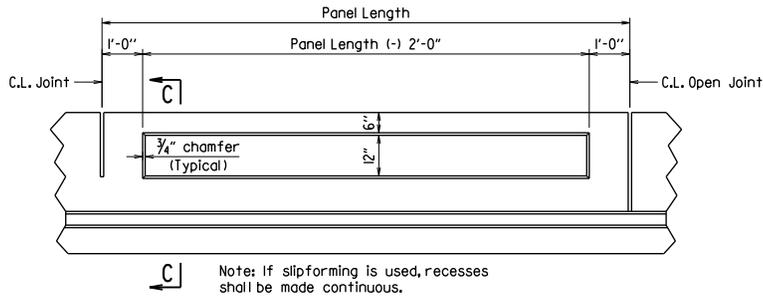
Designer: Notes Detail shown is applicable to R.J. Bolton SP400 Joint Seal with 3" maximum opening.

A4.7 Example Finger Joint Details



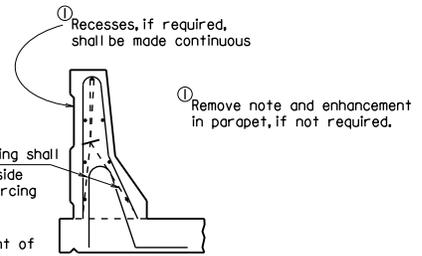
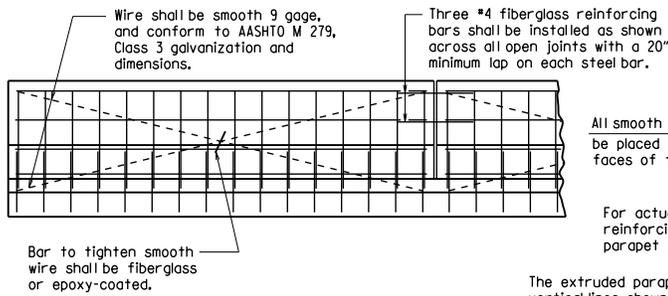
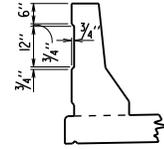
A4.10 New Jersey Railing Details





DETAILS OF PARAPET ENHANCEMENT

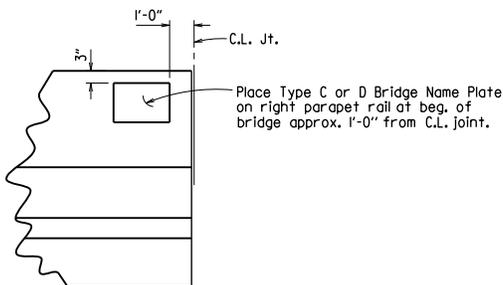
(Picture-Frame Shown)



All panels shall be braced as required to prevent racking. All open joints shall be sawed as soon as practical to a minimum width of 1/4". To control cracking before sawing, all joints must be grooved before the concrete is set. Sawing of the joints must be controlled so it will follow the grooved joint.

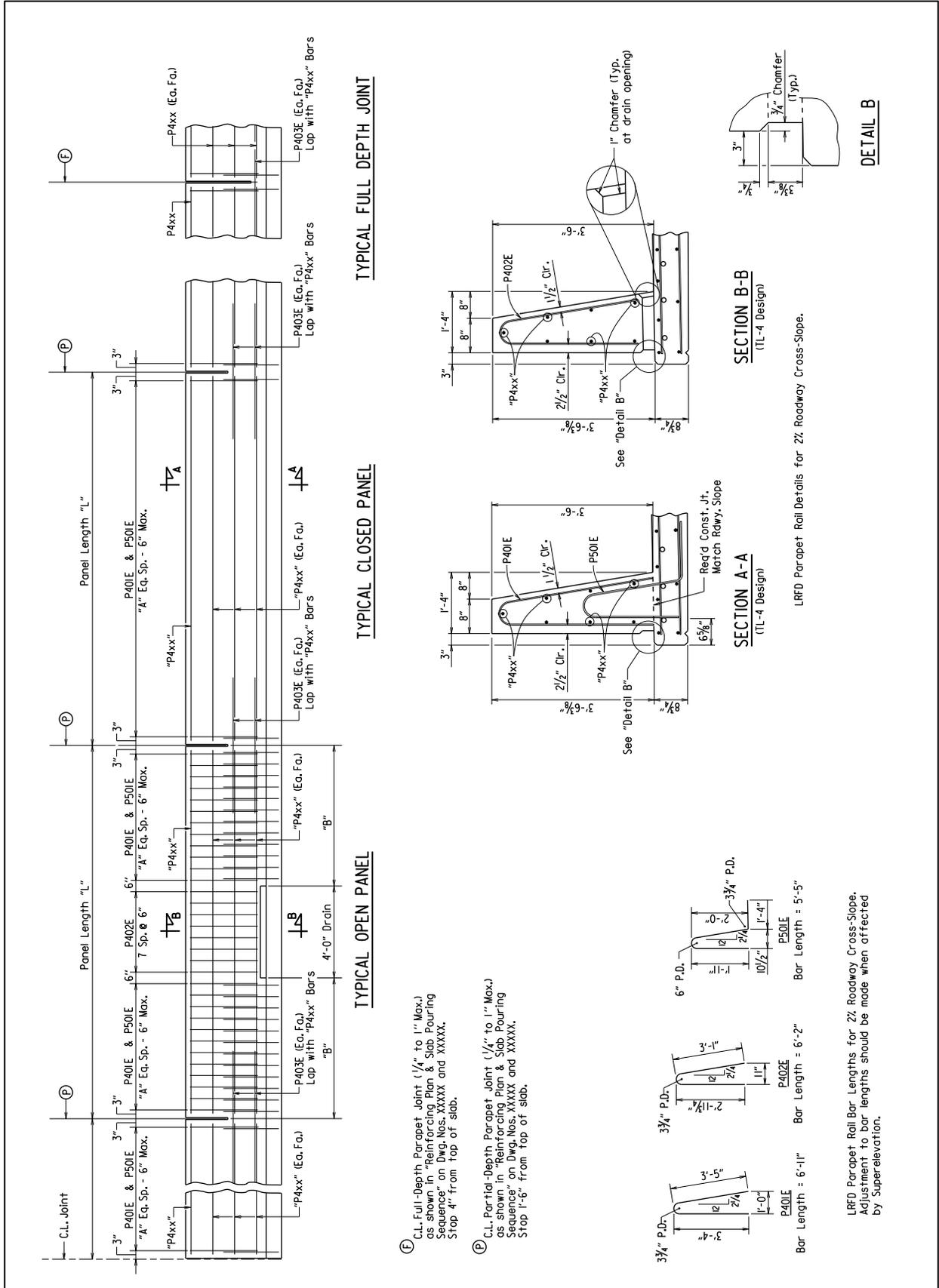
The extruded parapet shall conform to the horizontal and vertical lines shown on the plans or as directed by the Engineer and shall present a smooth, uniform appearance and texture. Unless otherwise noted, exposed surfaces may be given a light brush finish or a Class 3, Textured Coating Finish, in place of the Class 2, Rubbed Finish.

DETAILS OF OPTIONAL SLIPFORMING OF CONCRETE PARAPET RAIL



VIEW SHOWING LOCATION OF NAME PLATE

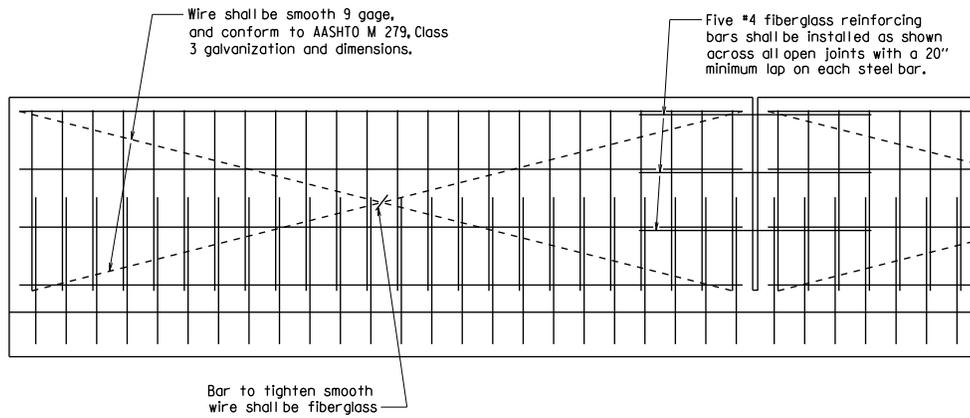
A4.11 Single Slope Railing Details



Ⓒ C.L. Full-Depth Parapet Joint (1/2" to 1" Max.) as shown in "Reinforcing Plan & Slab Pouring Sequence" on Dwg. Nos. XXXX and XXXX. Stop 4" from top of slab.

Ⓓ C.L. Partial-Depth Parapet Joint (1/4" to 1" Max.) as shown in "Reinforcing Plan & Slab Pouring Sequence" on Dwg. Nos. XXXX and XXXX. Stop 1'-6" from top of slab.

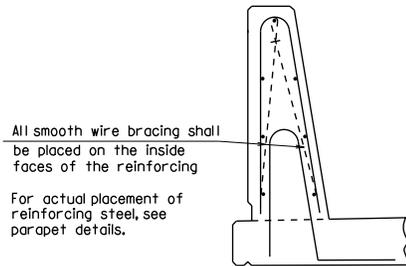
LRFD Parapet Rail Bar Lengths for 2: Roadway Cross-Slope. Adjustment to bar lengths should be made when affected by Super-elevation.



All panels shall be braced as required to prevent racking. All open joints shall be sawed as soon as practical to a minimum width of 1/4". To control cracking before sawing, all joints must be grooved before the concrete is set. Sawing of the joints must be controlled so it will follow the grooved joint.

The extruded parapet shall conform to the horizontal and vertical lines shown on the plans or as directed by the Engineer and shall present a smooth, uniform appearance and texture. Unless otherwise noted, exposed surfaces may be given a light brush finish or a Class 3, Textured Coating Finish, in place of the Class 2, Rubbed Finish.

DETAILS OF OPTIONAL SLIP FORMING OF CONCRETE PARAPET RAIL



Appendix A5

Bearings

A5.1	Elastomeric Bearing Design Guidelines	A5-1
A5.2	Tables of Design Variables	A5-2
A5.3	Example Details of Elastomeric Bearings	A5-3
A5.4	Example Details of Bearings with Masonry Plates	A5-4
A5.5	Example Details of Bearings with Pintles	A5-5
A5.6	Example Details of Steel Rocker Bearings	A5-6
A5.7	Example Details of Isolation Bearings	A5-7

A5.1 Elastomeric Bearing Design Guidelines

ARDOT-BRIDGE DIVISION ELASTOMERIC BEARING DESIGN GUIDELINES

Design Specifications: AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS - SEVENTH EDITION, 2014

Design Load Cases:

CASE A (Maximum Reaction): Reaction = PDLmax + PLLmax w/ Rotation = ROTct + ROTLL
CASE B (Maximum Rotation): Reaction = PDLmin + PLLfor max rot w/ Rotation = ROTct + ROTLLmax rot

Use Service I Limit State Loads without Dynamic Load Allowance where,

PDLmax = Maximum Dead Load Reaction with Deck Form Weight and Future Wearing Surface
 PDLmin = Minimum Dead Load Reaction with Deck Form Weight, but without Future Wearing Surface
 PDLbeam = Dead Load reaction for Construction Condition (Beam & Diaphragm Dead Load only)
 PLLmax = Maximum Live Load Reaction
 PLLfor max. rot = Live Load Reaction occurring simultaneously with Maximum Live Load Rotation. (Use 60% of PLLmax if refined analysis is not available.)

ROTct * = **0.007 radians minimum** for construction/fabrication tolerances or **0.000 radians for pintle bearings**
 * If Req'd., Include additional dead load rotation due to use of unbeveled plates or other design issues
 ROTDLbeam = Dead Load Rotation occurring simultaneously with PDLbeam due to camber of beam prior to pouring concrete deck. (Use linear calculation at maximum camber minus beam + diaphragm self weight)
 ROTLLmax = Live Load Rotation occurring simultaneously with PLLmax. (Use 0.0 radians if refined analysis is not available.)
 ROTLLmax. rot = Live Load Rotation occurring simultaneously with PLLfor max. rot. (Use linear calculation at maximum live load deflection if refined analysis is not available.)

- ▶ Dead Load Rotation is eliminated through the use of tapered external load plates where applicable.
- ▶ Design may be based on interior girder loads if the exterior girder dead load is at least 75% of the interior girder dead load (both without future wearing surface). Curved bridges and bridges with sidewalks, trapezoidal spans, or atypical cantilevers may require independent bearing designs for all girders.

Division Guidelines:

- ▶ Use 50-durometer hardness (Std. Specifications for Hwy. Construction Subsection 808.02)
- ▶ Minimum Interior Layer Thickness (hri) = 1/2" preferred (7/16" may be used if necessary)
- ▶ Minimum Exterior Layer Thickness (hre) = 1/4" (Shall not exceed 70% of interior layer thickness)
- ▶ Total Elastomer Thickness (hrt) = N * hre + 2 * hri **The minimum number of interior layers shall be 2.**
- ▶ Minimum Steel Laminae Thickness = 12 Gauge (0.1046 inches)
- ▶ Δ FTH = constant amplitude threshold for Category A (ksi). Refer to Table 6.6.1.2.5-1.
- ▶ No. of interior layers may be increased by 1/2 for each exterior layer whose thickness ≥ 50% of the interior layer.
- ▶ Pad Length L (parallel to CL Bridge) shall be less than or equal to Pad Width W.
- ▶ Pad Width W (perpendicular to CL Bridge) shall not be less than girder flange width; preferably not more than 4" + flange width.

Design Expansion Length for Pad & Slot Length for External Load Plate (Steel Girders):

(3.12.2.1) Temperature Range = 0 degrees F to 120 degrees F EL = Expansion Length (inches)
 (3.12.2.3) $\Delta T = (.0000065)(EL)(T_{maxdesign} - T_{mindesign})$ Bolt Location Tolerance = 0.5 inches
 (Table 3.4.1-1) Load Factor = 1.2 SL = Slot Length (inches)
 SD = Outside Pipe Sleeve Diameter

Values Based on Installation Temperature Range of 40° F to 80° F:

(14.7.6.3.4) $\Delta S = 0.65(.0000065)EL(120)(1.2) = 0.000608(EL)$
 SL (for Expansion Bearings) = 2(DeltaS) + SD + 0.5 = 0.00122(EL) + SD + 0.5

Anchor Bolts: Maximum Anchor Bolt size is 2.75 inches. Grade 36 or Grade 55 may be used.
 100% of the bolts shall be considered effective for all seismic zones.
 Anchor bolt resistance shall be adequate for strength limit state and extreme limit state load combinations. Minimum requirements for the extreme event limit state are shown below:

- Zone 1:** Design force as determined from Article 3.10.9
- Zone 2:** Design force shall be the greater of 25% of the tributary vertical loads (dead + applicable live load) OR the sum of tributary dead load, tributary live load and seismic force effects.
- Zones 3 & 4:** A restraint system shall be used to resist seismic forces, but the design force should not be less than 25% of the tributary vertical loads (dead + applicable live load)

A5.2 Tables of Design Variables

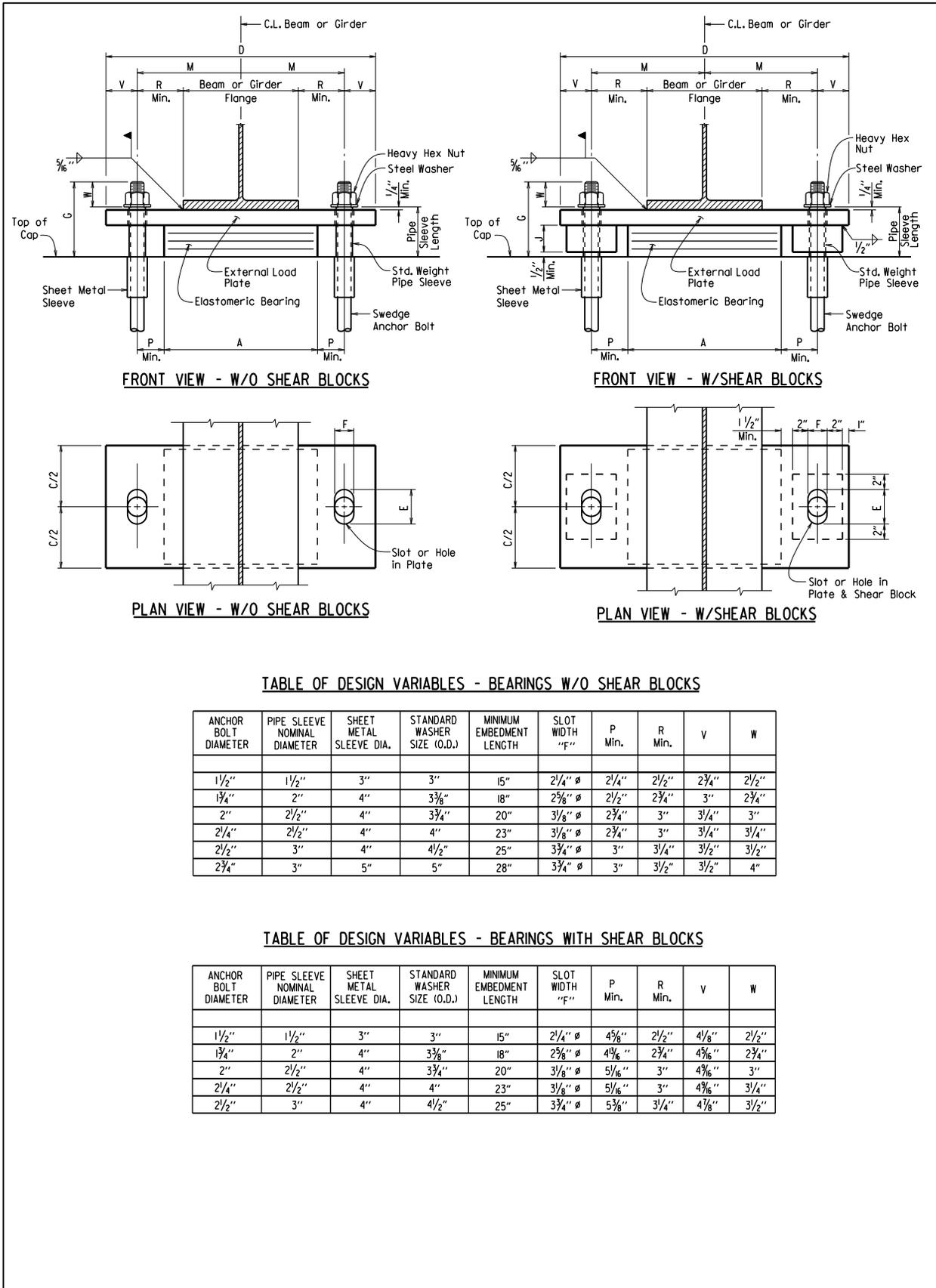


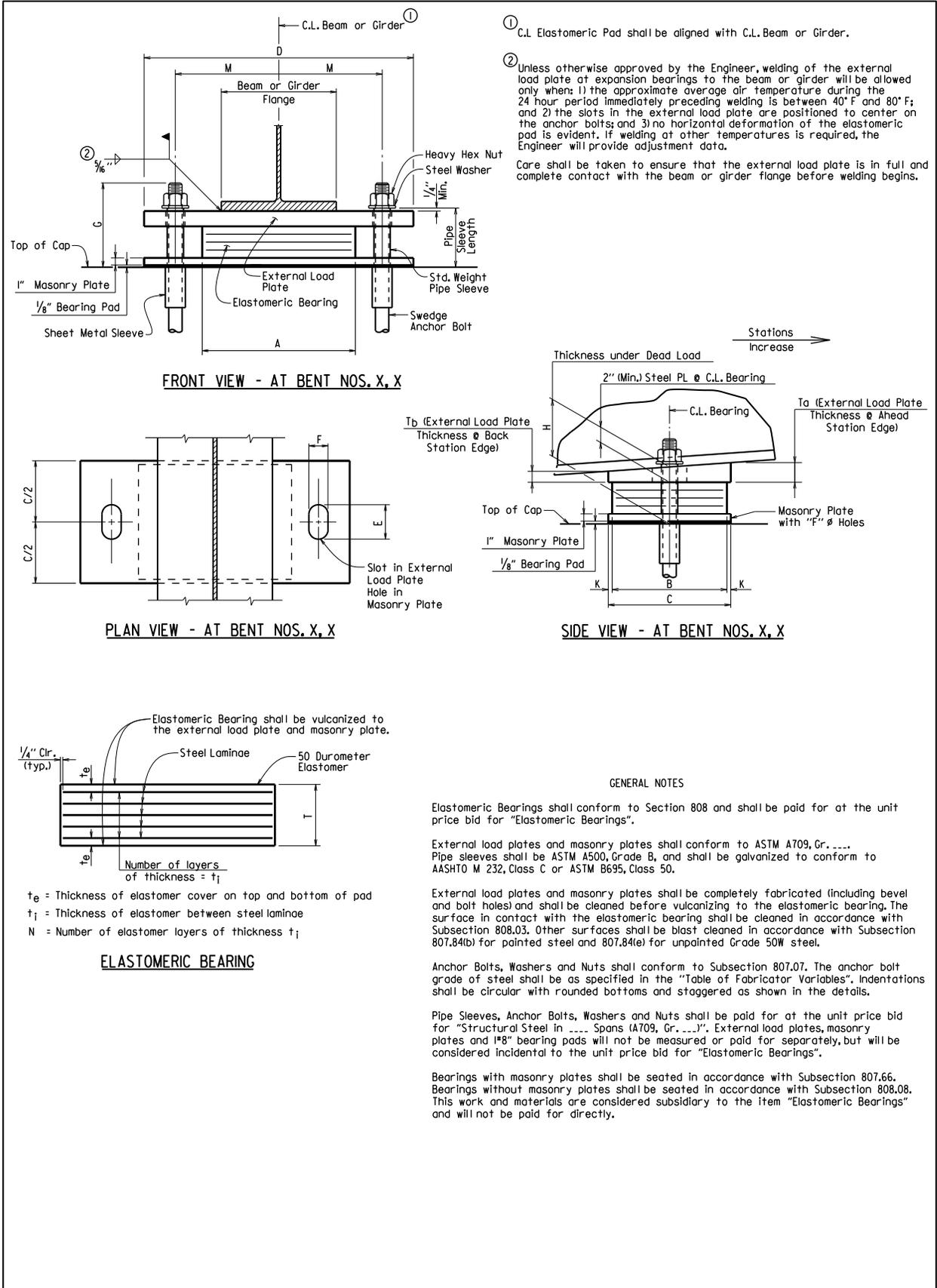
TABLE OF DESIGN VARIABLES - BEARINGS W/O SHEAR BLOCKS

ANCHOR BOLT DIAMETER	PIPE SLEEVE NOMINAL DIAMETER	SHEET METAL SLEEVE DIA.	STANDARD WASHER SIZE (O.D.)	MINIMUM EMBEDMENT LENGTH	SLOT WIDTH "F"	P Min.	R Min.	v	w
1 1/2"	1 1/2"	3"	3"	15"	2 1/4" ø	2 1/4"	2 1/2"	2 3/4"	2 1/2"
1 3/4"	2"	4"	3 3/8"	18"	2 5/8" ø	2 1/2"	2 3/4"	3"	2 3/4"
2"	2 1/2"	4"	3 3/4"	20"	3 1/8" ø	2 3/4"	3"	3 1/4"	3"
2 1/4"	2 1/2"	4"	4"	23"	3 1/8" ø	2 3/4"	3"	3 1/4"	3 1/4"
2 1/2"	3"	4"	4 1/2"	25"	3 3/4" ø	3"	3 1/4"	3 1/2"	3 1/2"
2 3/4"	3"	5"	5"	28"	3 3/4" ø	3"	3 1/2"	3 1/2"	4"

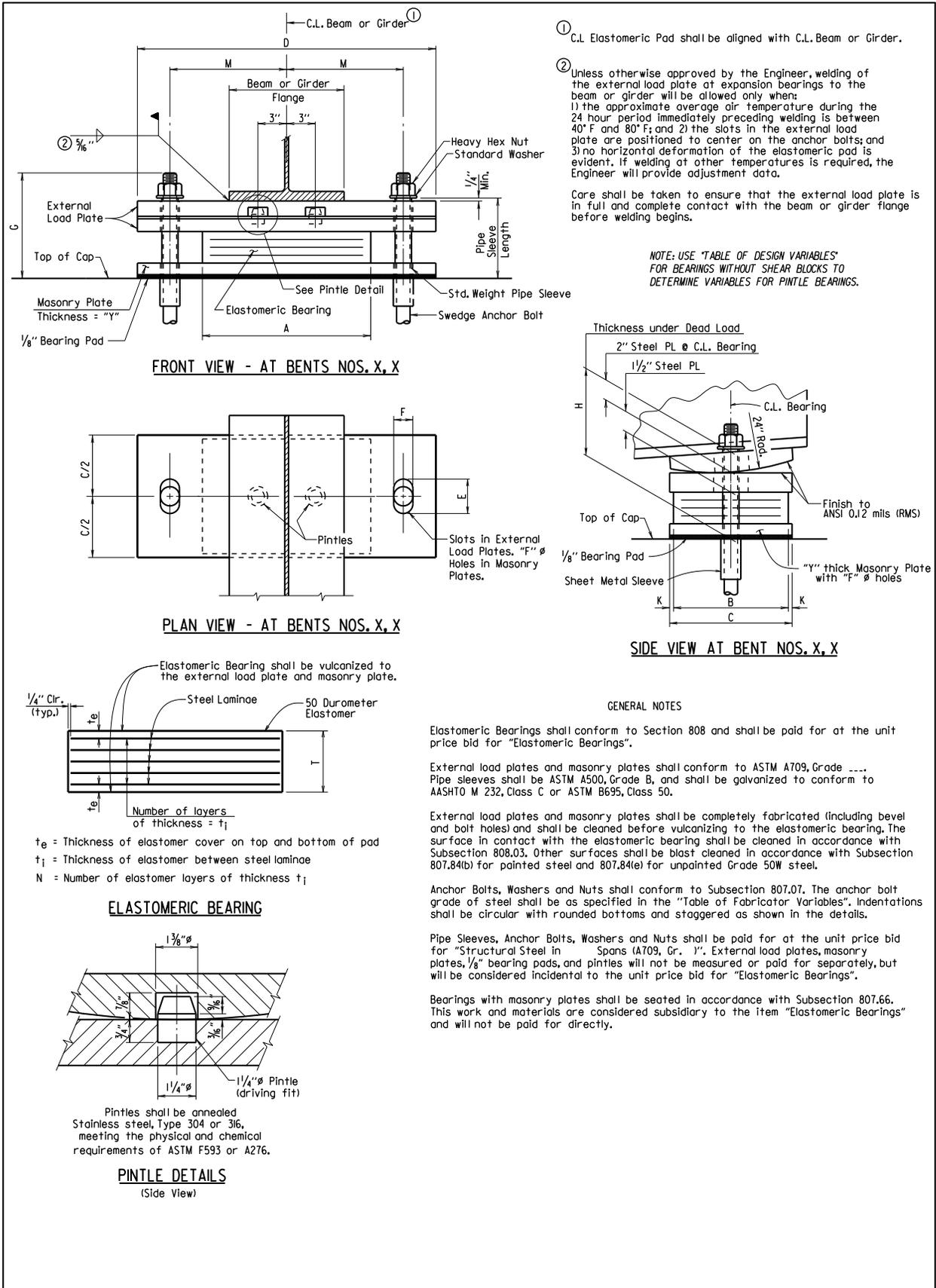
TABLE OF DESIGN VARIABLES - BEARINGS WITH SHEAR BLOCKS

ANCHOR BOLT DIAMETER	PIPE SLEEVE NOMINAL DIAMETER	SHEET METAL SLEEVE DIA.	STANDARD WASHER SIZE (O.D.)	MINIMUM EMBEDMENT LENGTH	SLOT WIDTH "F"	P Min.	R Min.	v	w
1 1/2"	1 1/2"	3"	3"	15"	2 1/4" ø	4 5/8"	2 1/2"	4 1/8"	2 1/2"
1 3/4"	2"	4"	3 3/8"	18"	2 5/8" ø	4 9/8"	2 3/4"	4 5/8"	2 3/4"
2"	2 1/2"	4"	3 3/4"	20"	3 1/8" ø	5 1/16"	3"	4 9/16"	3"
2 1/4"	2 1/2"	4"	4"	23"	3 1/8" ø	5 1/16"	3"	4 9/16"	3 1/4"
2 1/2"	3"	4"	4 1/2"	25"	3 3/4" ø	5 3/8"	3 1/4"	4 7/8"	3 1/2"

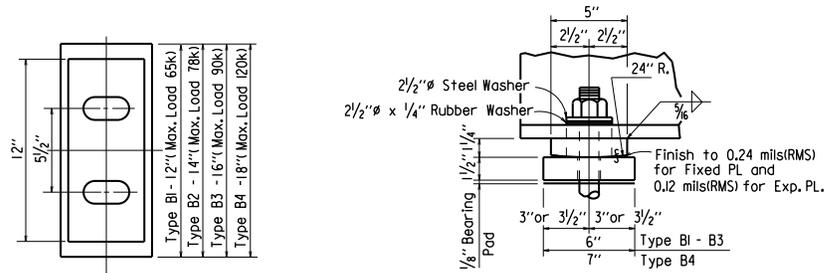
A5.4 Example Details of Bearings with Masonry Plates



A5.5 Example Details of Bearings with Pintles



A5.6 Example Details of Steel Rocker Bearings

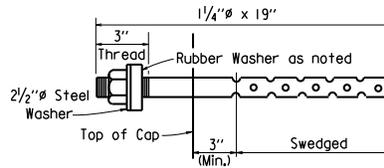


FIXED BEARING: 1/2" ϕ Holes in Sole Plate, Masonry Plate & Beam Flange.
 EXPANSION BEARING: 3" x 1/2" Slot in Sole Plate & Beam Flange; 1/2" ϕ Holes in Masonry Plate.

TYPE "B" FIXED OR EXP. ROCKER BEARING

Maximum Expansion Length = 60 feet unless otherwise noted.

NOTE: Plates for Type "B" Bearings must be A709, Gr. 50W if W-Beams are A709, Gr. 50W. Bearing Plates may be Grade 36, 50, or 50W for other applications. Bearing Plates shall be painted when used with painted W-Beams.



ANCHOR BOLT DETAIL

N.T.S.

Note:
 Anchor Bolt, Nut and Washer to be according to Subsection 807.07. Indentations shall be circular with rounded bottoms and staggered as shown above. Rubber washer shall be closed cell expanded rubber, meeting the requirements of ASTM D1056 - 85 2B2 E2, and shall be considered subsidiary to the item of Structural Steel.

Appendix A6

Substructure

A6.1	LRFD Backwall Steel	A6-1
A6.2	Example Details of Rail Transitions	A6-2
A6.3	Example Memo for Pile Driving System Approval	A6-3
A6.4	Example Memo for Test Pile Approval	A6-5

A6.1 LRFD Backwall Steel

LRFD Backwall Steel (with LL surcharge)

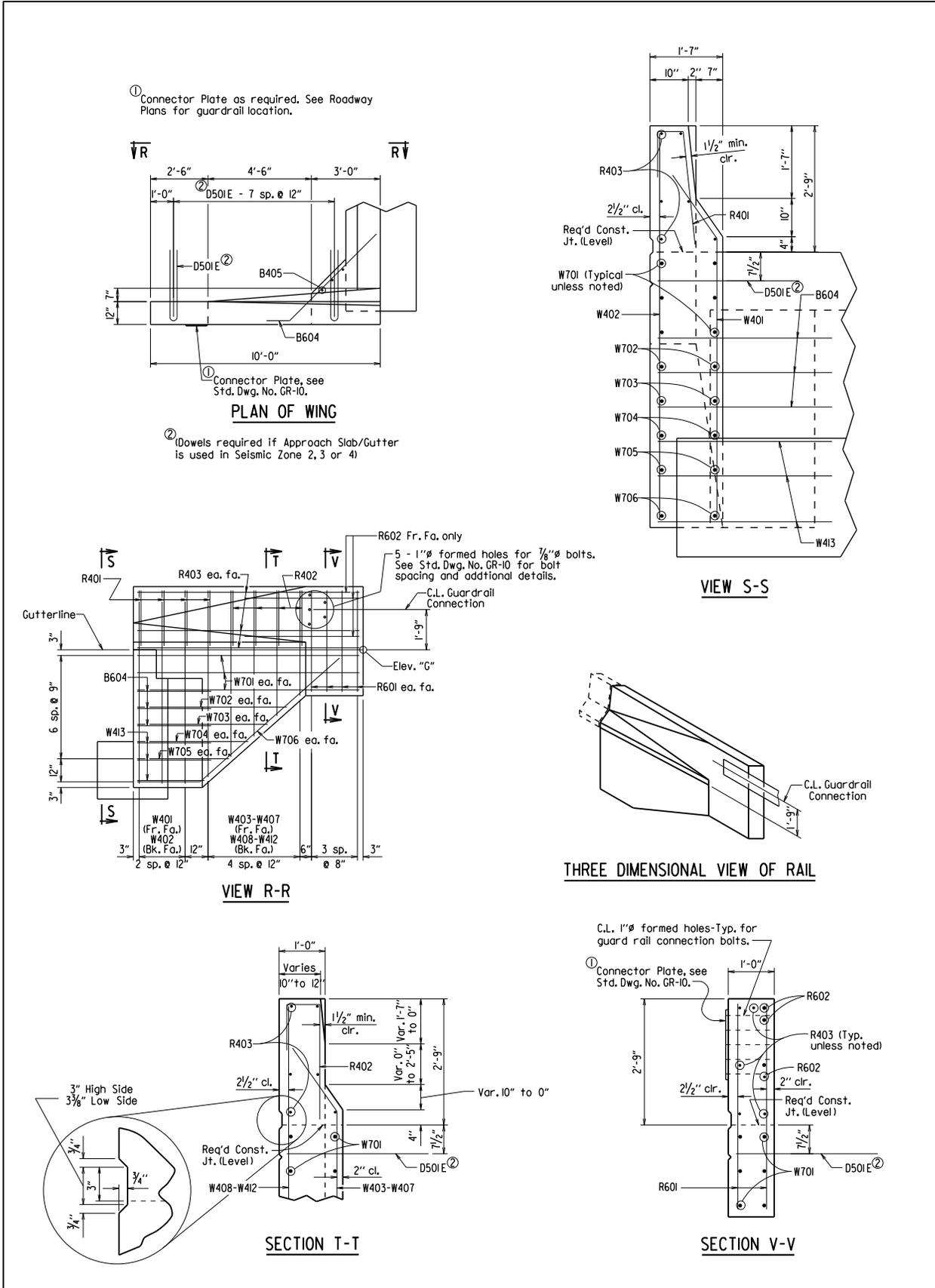
H (ft.)	h (ft.)	Moment (k*ft.)	18" Backwall				12" Backwall			
			d (inches)	As (in ² /ft.)	4/3*As	As Min.	d (inches)	As (in ² /ft.)	4/3 As	As Min.
3	4	5.79	15.75	0.082	0.109	0.109	9.75	0.133	0.178	0.178
3.25	4	6.88	15.75	0.098	0.130	0.130	9.75	0.159	0.212	0.212
3.5	4	8.09	15.75	0.115	0.153	0.153	9.75	0.187	0.250	0.250
3.75	4	9.41	15.75	0.134	0.178	0.178	9.6875	0.220	0.293	0.273
4	4	10.84	15.75	0.154	0.206	0.206	9.6875	0.254	0.339	0.273
4.25	4	12.40	15.75	0.177	0.235	0.235	9.6875	0.292	0.389	0.292
4.5	4	14.07	15.6875	0.202	0.269	0.269	9.625	0.335	0.446	0.335
4.75	4	15.87	15.6875	0.228	0.304	0.304	9.625	0.379	0.505	0.379
5	4	17.81	15.6875	0.256	0.341	0.341	9.625	0.427	0.569	0.427
5.25	3.95	19.68	15.6875	0.283	0.378	0.377	9.625	0.474	0.632	0.474
5.5	3.9	21.66	15.625	0.313	0.418	0.377	9.625	0.524	0.699	0.524
5.75	3.85	23.74	15.625	0.344	0.459	0.377	9.625	0.577	0.770	0.577
6	3.8	25.92	15.625	0.376	0.502	0.377	9.625	0.633	0.845	0.633
6.25	3.75	28.20	15.625	0.410	0.547	0.410	9.625	0.693	0.924	0.693
6.5	3.7	30.58	15.625	0.446	0.594	0.446	9.625	0.756	1.008	0.756
6.75	3.65	33.07	15.625	0.483	0.644	0.483	9.625	0.822	1.097	0.822
7	3.6	35.65	15.625	0.522	0.696	0.522	9.625	0.893	1.190	0.893
7.25	3.55	38.35	15.625	0.562	0.750	0.562	9.625	0.967	1.289	0.967
7.5	3.5	41.15	15.625	0.605	0.807	0.605	9.625	1.045	1.394	1.045
7.75	3.45	44.05	15.625	0.649	0.866	0.649	9.625	1.128	1.504	1.128
8	3.4	47.06	15.625	0.695	0.927	0.695	9.625	1.216	1.621	1.216

Interpolation used for "h" found in LRFD Table 3.11.6.4-1.

LRFD Backwall Steel (without LL surcharge)

H (ft.)	Moment (k*ft.)	18" Backwall				12" Backwall			
		d (inches)	As (in ² /ft.)	4/3*As	As Min.	d (inches)	As (in ² /ft.)	4/3 As	As Min.
3	0.94	15.75	0.013	0.018	0.018	9.75	0.021	0.028	0.028
3.25	1.19	15.75	0.017	0.022	0.022	9.75	0.027	0.036	0.036
3.5	1.49	15.75	0.021	0.028	0.028	9.75	0.034	0.045	0.045
3.75	1.83	15.75	0.026	0.034	0.034	9.75	0.042	0.056	0.056
4	2.22	15.75	0.031	0.042	0.042	9.75	0.051	0.068	0.068
4.25	2.66	15.75	0.038	0.050	0.050	9.75	0.061	0.081	0.081
4.5	3.16	15.75	0.045	0.060	0.060	9.75	0.072	0.097	0.097
4.75	3.71	15.75	0.053	0.070	0.070	9.75	0.085	0.114	0.114
5	4.33	15.75	0.061	0.082	0.082	9.75	0.100	0.133	0.133
5.25	5.01	15.75	0.071	0.095	0.095	9.75	0.115	0.154	0.154
5.5	5.76	15.75	0.082	0.109	0.109	9.75	0.133	0.177	0.177
5.75	6.59	15.75	0.093	0.125	0.125	9.75	0.152	0.203	0.203
6	7.48	15.75	0.106	0.142	0.142	9.75	0.173	0.231	0.231
6.25	8.46	15.75	0.120	0.160	0.160	9.75	0.196	0.261	0.261
6.5	9.52	15.75	0.135	0.180	0.180	9.6875	0.223	0.297	0.273
6.75	10.66	15.75	0.152	0.202	0.202	9.6875	0.250	0.333	0.273
7	11.88	15.6875	0.170	0.227	0.227	9.6875	0.279	0.373	0.279
7.25	13.20	15.6875	0.189	0.252	0.252	9.625	0.313	0.418	0.313
7.5	14.62	15.6875	0.209	0.279	0.279	9.625	0.348	0.464	0.348
7.75	16.13	15.6875	0.231	0.308	0.308	9.625	0.385	0.514	0.385
8	17.74	15.625	0.256	0.341	0.341	9.625	0.425	0.567	0.425

A6.2 Example Details of Rail Transitions



A6.3 Example Memo for Pile Driving System Approval



ARKANSAS DEPARTMENT OF TRANSPORTATION
ArDOT.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director
10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2000

INTEROFFICE MEMORANDUM

Date

TO: Mr. David Henning, State Construction Engineer

FROM: Rick Ellis, Bridge Engineer

SUBJECT: Proposed Driving System at Bents _____
Job No. _____; Bridge No. _____
Job Title
Route __, Section __

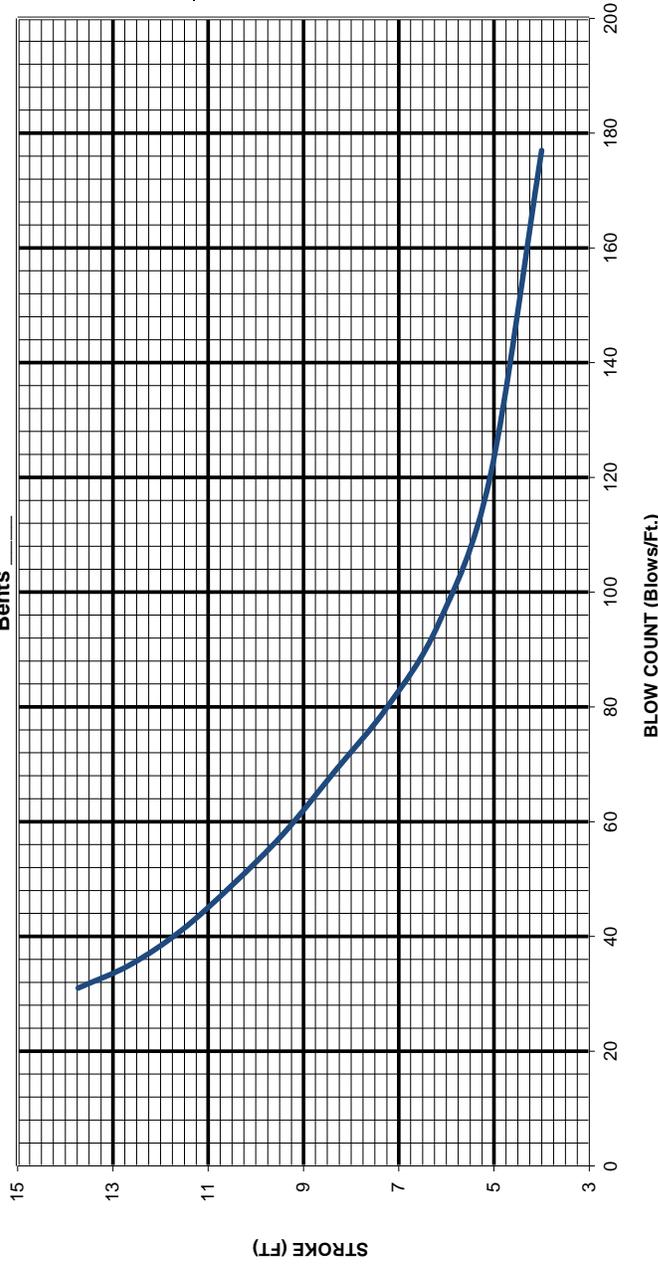
As requested by your office via Doc Express, we have reviewed the attached Contractor's proposed driving system to determine its acceptability based on the criteria specified in Subsection 805.07(h) of the Standard Specifications. The Contractor proposes to drive the 18" square prestressed concrete test piles at the subject bents using an APE D30-32 pile driving hammer.

Based on the wave equation analyses and the driving system data submitted by the Contractor, we have determined the pile driving hammer is **acceptable** for driving the 18" square prestressed concrete test piles while operating at its **maximum** pump setting.

The attached bearing graph or table of stroke vs. blow count relationships shall be used to evaluate the ultimate bearing capacity during end of driving of the test piles only at the bents specified and while operating at the hammer's pump setting specified above. The test piles shall be driven in accordance with Subsection 805.09(b)(1) of the Standard Specifications.

CRE:xxx
Attachments

Job _____
 Bridge No. _____
STROKE vs. BLOW COUNT
18" Sq. Prestressed Concrete Test Piles
 Bents _____



Hammer: APE D30-32
 Maximum Pump Setting

BLOW COUNT (BPF)	STROKE (Kip-ft)
177	4.0
120	5.1
95	6.2
80	7.2
69	8.3
58	9.4
49	10.5
41	11.6
35	12.7
31	13.7

A6.4 Example Memo for Test Pile Approval



ARKANSAS DEPARTMENT OF TRANSPORTATION
 ArDOT.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director
 10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2000

INTEROFFICE MEMORANDUM

Date

TO: Mr. David Henning, State Construction Engineer

FROM: Rick Ellis, Bridge Engineer

SUBJECT: Bent ___ Production Pile Lengths
 Job No. _____; Bridge No. _____
Job Title
Choose a County
 Route __, Section __

The Contractor has driven a successful test pile at Bent __. The test pile meets the ultimate bearing capacity and minimum tip elevation requirements. The approved production pile lengths are as follows:

<u>Bent No(s)</u>	<u>Length</u>
—	—'

The driving system used for the production piles shall be **identical** to the driving system used for the successful test pile, with the exception that a follower will be used. The production piles shall be driven to plan grade. Bearing graphs are not required for production piles at locations where long piles were driven to establish tip elevations for ultimate bearing capacity.

CRE:xxx
 Attachments

Appendix A7

Seismic



Appendix A8

Plans, Specifications, and Quantities

A8.1	Reinforcing Bar Bends	A8-1
A8.2	Drawing Scales	A8-3
A8.3	Standard Element Attributes	A8-4
A8.4	Bridge Drawing Naming Convention	A8-5
A8.5	Arkansas Counties	A8-6
A8.6	Standard Bridge Drawings	A8-7
A8.7	Standard Drawing Detailing Aids	A8-9
A8.8	Standard Weights and Measurements	A8-11
A8.9	Example - Schedule of Bridge Quantities	A8-14
A8.10	Standard Rounding for Bridge Quantities	A8-15
A8.11	Job Submission Form	A8-16
A8.12	Example - Drawing List	A8-17
A8.13	List of Bridge Supplemental Specifications	A8-18
A8.14	Special Provision Guide	A8-20
A8.15	Example - Cost Estimate	A8-22
A8.16	Scour Form 113	A8-23

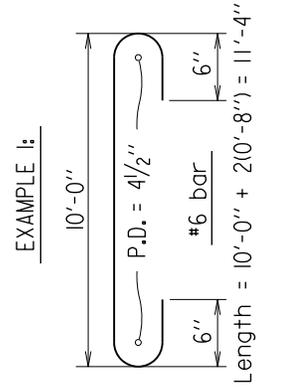
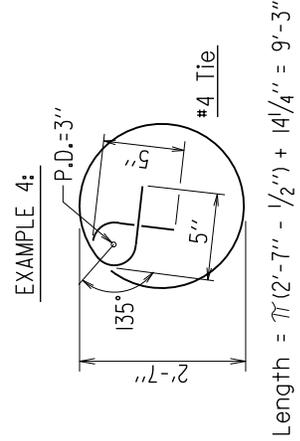
A8.1 Reinforcing Bar Bends

STANDARD REINFORCING BAR BENDS AASHTO M 31 OR M 322, GRADE 60

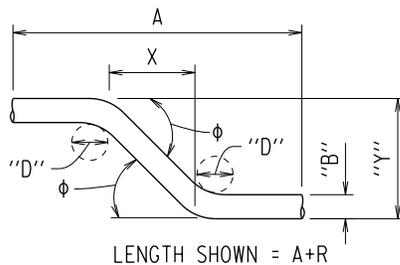
Bar Size	Pin Dia.	K	Stirrups	
			Add for Bends	Deduct for Bend
3	1 1/2"	3 1/2"	3"	3/4"
4	2"	4 1/2"	4"	1"
5	2 1/2"	6"	6"	1 1/4"
6	4 1/2"	12"	14"	2"
7	5 1/4"	14"	17"	2 1/4"

Bar Size	Pin Dia.	Hooked End		90° Bend		Column Ties	
		Add for Bend	K	K	Deduct for Bend	K	Add for Bends
3	2 1/4"	4"	6"	1"	4 1/2"	12 1/4"	
4	3"	4 1/2"	8"	1 1/4"	5"	14 1/4"	
5	3 3/4"	5"	10"	1 1/2"	6 1/4"	18"	
6	4 1/2"	6"	12"	1 3/4"	7 1/2"	10"	
7	5 1/4"	7"	14"	2 1/4"		21 1/2"	
8	6"	8"	16"	2 1/2"			
9	9"	10"	19 1/4"	3 1/4"			
10	10"	11 1/2"	21 1/2"	3 3/4"			
11	11 1/4"	12 1/2"	24"	4 1/4"			
14	18 1/4"	18"	32"	6"			

Note: 45° bends are not Std. hooks. The required extension is a full development length. No deduction for bend is required for bar sizes 3 thru 8; deduct 1 1/4" for bars 9, 10, & 11.



STANDARD REINFORCING BAR BENDS AASHTO M 31 OR M 322, GRADE 60

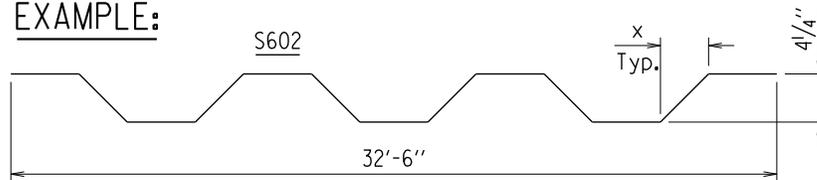


"X" & "R" VALUES FOR TRUSSED BARS

BAR SIZE	PIN DIA.	"Y"											
		3"	3 1/4"	3 1/2"	3 3/4"	4"	4 1/4"	4 1/2"	4 3/4"	5"	5 1/4"	5 1/2"	
5	3"	" ϕ "	41°	41.3°	41.6°	41.9°	42.1°	42.2°	42.4°	42.6°	42.7°	42.8°	42.9°
		"X"	2 1/2"	2 3/4"	3"	3 1/4"	3 1/2"	3 3/4"	4"	4 1/4"	4 1/2"	4 3/4"	5"
		"R"	3/4"	3/4"	1"	1"	1 1/4"	1 1/4"	1 1/4"	1 1/2"	1 1/2"	1 3/4"	1 3/4"
6	4 1/2"	" ϕ "	34.8°	35.6°	36.3°	36.9°	37.4°	37.8°	38.2°	38.6°	38.9°	39.2°	39.5°
		"X"	3"	3 1/4"	3 1/2"	3 3/4"	4"	4 1/4"	4 1/2"	4 3/4"	5"	5 1/4"	5 1/2"
		"R"	1/2"	3/4"	3/4"	1"	1"	1"	1 1/4"	1 1/4"	1 1/4"	1 1/2"	1 1/2"

EQUATIONS: $X = (Y-B) (\text{Cot. } \phi) - B(\text{Tan. } \frac{\phi}{2})$
 $R = (Y-B) (\text{Csc. } \phi - \text{Cot. } \phi) + (B+D) (\frac{\phi \pi}{180} - 2\text{Tan. } \frac{\phi}{2})$

EXAMPLE:



X = 4 1/4", R = 1" from TABLE
 LENGTH = (32'-6") + 6(0'-1") = 33'-0"

A8.2 Drawing Scales

Dominate Detail Scale															Alternate Detail Scale															Drawing Title			Detail Title		Detail Lettering Dimensions & General Notes		
																														TX	TH	TW	TH	TW	TH	TW	
3	1.000	0.500	1.1/2	1	3/4	1/2	3/8	1/4	3/16	1/8	3/32	1/16	Border	Plot Scale	0.067	0.067	0.053	0.042	0.033	0.067	0.067	0.053	0.042	0.033													
10	2.000	1.000	1.000	0.667	0.500	0.333	0.250	0.167	0.125	0.083	0.063	0.042	8	2:3	0.133	0.133	0.107	0.083	0.067	0.133	0.133	0.107	0.083	0.067													
1	3.000	1.500	2.000	1.000	0.750	0.500	0.375	0.250	0.188	0.125	0.094	0.063	12	1:1	0.200	0.200	0.160	0.125	0.100	0.200	0.200	0.160	0.125	0.100													
3/4	4.000	2.000	3.000	1.333	1.000	0.667	0.500	0.333	0.250	0.167	0.125	0.083	16	4:3	0.267	0.267	0.213	0.167	0.133	0.267	0.267	0.213	0.167	0.133													
1/2	6.000	3.000	4.000	2.000	1.500	1.000	0.750	0.500	0.375	0.250	0.188	0.125	24	2:1	0.400	0.400	0.320	0.250	0.200	0.400	0.400	0.320	0.250	0.200													
3/8	8.000	4.000	6.000	2.667	2.000	1.333	1.000	0.667	0.500	0.333	0.250	0.167	32	8:3	0.533	0.533	0.427	0.333	0.267	0.533	0.533	0.427	0.333	0.267													
1/4	12.000	6.000	8.000	4.000	3.000	2.000	1.500	1.000	0.750	0.500	0.375	0.250	48	4:1	0.800	0.800	0.640	0.500	0.400	0.800	0.800	0.640	0.500	0.400													
3/16	16.000	8.000	12.000	5.333	4.000	2.667	2.000	1.333	1.000	0.667	0.500	0.333	64	16:3	1.067	1.067	0.853	0.667	0.533	1.067	1.067	0.853	0.667	0.533													
1/8	24.000	12.000	16.000	8.000	6.000	4.000	3.000	2.000	1.500	1.000	0.750	0.500	96	8:1	1.600	1.600	1.280	1.000	0.800	1.600	1.600	1.280	1.000	0.800													
3/32	32.000	16.000	24.000	10.667	8.000	5.333	4.000	2.667	2.000	1.333	1.000	0.667	128	32:3	2.133	2.133	1.707	1.333	1.067	2.133	2.133	1.707	1.333	1.067													
1/16	48.000	24.000	32.000	16.000	12.000	8.000	6.000	4.000	3.000	2.000	1.500	1.000	192	16:1	3.200	3.200	2.560	2.000	1.600	3.200	3.200	2.560	2.000	1.600													
10	1.000	0.500	0.500	0.333	0.250	0.200	0.100						10	10:1	2.000	2.000	1.600	1.250	1.000	2.000	2.000	1.600	1.250	1.000													
20	2.000	1.000	1.000	0.667	0.500	0.400	0.200						20	20:1	4.000	4.000	3.200	2.500	2.000	4.000	4.000	3.200	2.500	2.000													
30	3.000	1.500	1.500	1.000	0.750	0.600	0.300						30	30:1	6.000	6.000	4.800	3.750	3.000	6.000	6.000	4.800	3.750	3.000													
40	4.000	2.000	2.000	1.333	1.000	0.800	0.400						40	40:1	8.000	8.000	6.400	5.000	4.000	8.000	8.000	6.400	5.000	4.000													
50	5.000	2.500	2.500	1.667	1.250	1.000	0.500						50	50:1	10.000	10.000	8.000	6.250	5.000	10.000	10.000	8.000	6.250	5.000													
100	10.000	5.000	5.000	3.333	2.500	2.000	1.000						100	100:1	20.000	20.000	16.000	12.500	10.000	20.000	20.000	16.000	12.500	10.000													

A8.3 Standard Element Attributes

- I. Drawing Titles
 - a. TX = see chart
 - b. Line Weight: WT = 3
 - c. Font: FT = 1

- II. Detail Titles
 - a. TH & TW = see chart
 - b. Line Weight: WT = 2
 - c. Font: FT = 1

- III. Object Lines
 - a. Line Weight: WT = 1

- IV. Dimension Lines and Projection Lines
 - a. Line Weight: WT = 0

- V. Reinforcing Bars
 - a. Line Weight: WT = 0

- VI. Detail Lettering and Dimensions
 - a. TH & TW = see chart
 - b. Line Weight: WT = 1
 - c. Font: FT = 1
 - d. Use lower case lettering

- VII. General Notes
 - a. TX = see chart
 - b. Line Spacing: LS = 0.67(TX)
 - c. Line Weight: WT = 1
 - d. Font: FT = 1
 - e. Use lower case lettering (Title to be all capitals)

A8.4 Bridge Drawing Naming Convention

NUMBERS									A	B	C	D	E	F	G	H	I	J, ...
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19, ...

- Column 1: b (to represent Bridge Division)
- Columns 2-7: Project Number (Contract Job Number)
- Column 8: a or b (for twin bridge a or b)
1 or 2 (for Alternate 1 or Alternate 2)
m for multiple bridges a and b
q for Alternate 1, Bridge a
r for Alternate 1, Bridge b
s for Alternate 2, Bridge a
t for Alternate 2, Bridge b
- Column 9: 1 for Site Number 1
2 for Site Number 2, etc.

Columns 8 & 9 will remain blank if there is only one bridge in job.

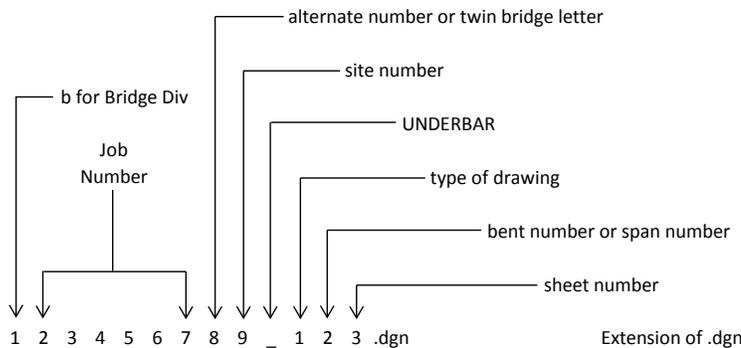
After the underbar in the filename:

Column 11 represents the type of drawing:

- l = Layout
- b = Bent
- s = Span
- a = Abutment
- w = Wing
- r = Rail
- p = Parapet
- q = Quantity Sheet
- g = gutters
- e = elasto bearings
- d = Deck forms
- c = Steel Shell Piles
- t = Sign Structures

Column 2 represents the Bent Number or Span Number

Column 3 represents the Shet number (if more than one sheet per bent, etc.)



Ex:	<u>b</u> <u>3</u> <u>0</u> <u>0</u> <u>0</u> <u>2</u> <u>4</u> <u>x</u> <u>1</u> <u>_</u> <u>l</u> <u>1</u> .dgn	Job 300024, Site 1, Layout	(b300024x1_l1.dgn)
	<u>b</u> <u>b</u> <u>r</u> <u>0</u> <u>4</u> <u>0</u> <u>3</u> <u>_</u> <u>_</u> <u>_</u> <u>s</u> <u>1</u> <u>1</u> .dgn	Job BR-4-3, Span 1, Sheet 1	(bbr0403_s11.dgn)
	<u>b</u> <u>b</u> <u>r</u> <u>0</u> <u>4</u> <u>0</u> <u>3</u> <u>_</u> <u>_</u> <u>_</u> <u>s</u> <u>1</u> <u>2</u> .dgn	Job BR-4-3, Span 1, Sheet 2	(bbr0403_s12.dgn)
	<u>b</u> <u>r</u> <u>3</u> <u>0</u> <u>0</u> <u>2</u> <u>9</u> <u>x</u> <u>1</u> <u>_</u> <u>l</u> <u>1</u> .dgn	Job R30029, Site 1, Layout	(br30029x1_l1.dgn)
	<u>b</u> <u>r</u> <u>3</u> <u>0</u> <u>0</u> <u>2</u> <u>9</u> <u>x</u> <u>2</u> <u>_</u> <u>l</u> <u>1</u> .dgn	Job R30029, Site 2, Layout	(br30029x2_l1.dgn)
	<u>b</u> <u>r</u> <u>3</u> <u>0</u> <u>0</u> <u>7</u> <u>5</u> <u>a</u> <u>1</u> <u>_</u> <u>b</u> <u>1</u> .dgn	Job R30075, Twin Bridge A, Bent 1	(br30075a1_b1.dgn)
	<u>b</u> <u>r</u> <u>3</u> <u>0</u> <u>0</u> <u>7</u> <u>5</u> <u>b</u> <u>1</u> <u>_</u> <u>b</u> <u>1</u> .dgn	Job R30075, Twin Bridge B, Bent 2	(br30075b1_b1.dgn)
	<u>b</u> <u>4</u> <u>9</u> <u>1</u> <u>4</u> <u>_</u> <u>_</u> <u>_</u> <u>_</u> <u>_</u> <u>b</u> <u>c</u> <u>_</u> .dgn	Job 4914, Bent Number 12	(b4914bc.dgn)

Note: Use an "x" to fill columns if columns need to be filled.
Columns that do not need to be filled can be left out.
Job numbers that have dashes, such as br-4-3, should have zeros in the filename.
Example: br-4-3 should be bbr0403.

A8.5 Arkansas Counties

COUNTY NO.	COUNTY NAME	DISTRICT NO.
01	Arkansas	02
02	Ashley	02
03	Baxter	09
04	Benton	09
05	Boone	09
06	Bradley	07
07	Calhoun	07
08	Carroll	09
09	Chicot	02
10	Clark	07
11	Clay	10
12	Cleburne	05
13	Cleveland	07
14	Columbia	07
15	Conway	08
16	Craighead	10
17	Crawford	04
18	Crittenden	01
19	Cross	01
20	Dallas	07
21	Desha	02
22	Drew	02
23	Faulkner	08
24	Franklin	04
25	Fulton	05
26	Garland	06
27	Grant	02
28	Greene	10
29	Hempstead	03
30	Hot Spring	06
31	Howard	03
32	Independence	05
33	Izard	05
34	Jackson	05
35	Jefferson	02
36	Johnson	08
37	Lafayette	03
38	Lawrence	10

COUNTY NO.	COUNTY NAME	DISTRICT NO.
39	Lee	01
40	Lincoln	02
41	Little River	03
42	Logan	04
43	Lonoke	06
44	Madison	09
45	Marion	09
46	Miller	03
47	Mississippi	10
48	Monroe	01
49	Montgomery	08
50	Nevada	03
51	Newton	09
52	Ouachita	07
53	Perry	08
54	Phillips	01
55	Pike	03
56	Poinsett	10
57	Polk	04
58	Pope	08
59	Prairie	06
60	Pulaski	06
61	Randolph	10
62	Saline	06
63	Scott	04
64	Searcy	09
65	Sebastian	04
66	Sevier	03
67	Sharp	05
68	St. Francis	01
69	Stone	05
70	Union	07
71	Van Buren	08
72	Washington	04
73	White	05
74	Woodruff	01
75	Yell	08

A8.6 Standard Bridge Drawings

Eff. 05-24-2017

Rev. 03-24-2020

(Revisions are shown in bold)

(Based on AHTD 2014 Construction Specifications)

<u>DWG.</u>	<u>DATE</u>	<u>TITLE</u>
55000	02-27-2014	STANDARD DETAILS FOR EMBANKMENT CONSTRUCTION AND BACKFILL AT BRIDGE ENDS
55001	02-27-2014	STANDARD DETAILS FOR DUMPED RIPRAP AND FILTER BLANKET AND COMPUTING EXCAVATION FOR STRUCTURES
55002	02-27-2014	STANDARD DETAILS FOR CONCRETE RIPRAP
55005	03-24-2016	STANDARD DETAILS FOR PERMANENT STEEL BRIDGE DECK FORMS FOR STEEL & CONCRETE GIRDER SPANS
55006	09-02-2015	STANDARD GENERAL NOTES FOR STEEL BRIDGE STRUCTURES
55007	02-11-2016	STANDARD DETAILS FOR STEEL BRIDGE STRUCTURES
55008	02-11-2016	STANDARD DETAILS FOR POURED SILICONE JOINTS
55009	02-11-2016	STANDARD DETAILS FOR NEOPRENE STRIP SEAL JOINTS
55010	03-24-2020	STANDARD DETAILS FOR TYPE D BRIDGE NAME PLATE
55011	02-27-2020	STANDARD DETAILS FOR TYPE C BRIDGE NAME PLATES
55013	02-11-2016	STANDARD DETAILS FOR TRANSITIONAL APPROACH RAILING
55014	02-11-2016	STANDARD DETAILS FOR TYPE H RAILING
55018	02-11-2016	STANDARD DETAILS FOR CHAIN LINK FENCE
55020	03-24-2016	STANDARD DETAILS FOR STEEL H-PILES AND PILE ENCASEMENTS
55021	03-24-2016	STANDARD DETAILS FOR CONCRETE FILLED STEEL SHELL PILES AND PILE ENCASEMENTS
55022	03-24-2016	STANDARD DETAILS FOR CONCRETE PILES
55024	02-27-2014	STANDARD DETAILS FOR CONCRETE PILES (LOAD FACTOR DESIGN)
55025	02-27-2014	STANDARD DETAILS FOR CONCRETE PILES SEISMIC REGION B (LOAD FACTOR DESIGN)
55030A	09-02-2015	STANDARD DETAILS FOR TYPE A APPROACH GUTTERS
55030B	09-02-2015	STANDARD DETAILS FOR TYPE B APPROACH GUTTERS
55030C	02-27-2014	STANDARD DETAILS FOR TYPE C APPROACH GUTTERS
55030D	02-27-2014	STANDARD DETAILS FOR TYPE D APPROACH GUTTERS
55030E	02-27-2014	STANDARD DETAILS FOR TYPE E APPROACH GUTTERS
55035	11-07-2019	STANDARD DETAILS FOR TYPE 'PT' APPROACH GUTTERS (BRIDGES WITH CONCRETE PARAPET RAILING)
55036	11-07-2019	STANDARD DETAILS FOR TYPE 'AT' APPROACH GUTTERS (BRIDGES WITH 6" CURBS & TYPE A, B, C, D OR E RAILING)
55037	11-07-2019	STANDARD DETAILS FOR TYPE 'PT2' APPROACH GUTTERS (BRIDGES WITH CONCRETE PARAPET RAILING)
55038	11-07-2019	STANDARD DETAILS FOR TYPE 'AT2' APPROACH GUTTERS (BRIDGES WITH CURBS & TYPE A, B, C, D, OR E RAILING)
55039	11-07-2019	STANDARD DETAILS FOR TYPE 'CT' APPROACH GUTTERS (BRIDGES WITH CURB)
55040A	02-27-2014	STANDARD DETAILS FOR TYPE A APPROACH SLAB
55040B	02-27-2014	STANDARD DETAILS FOR TYPE B APPROACH SLAB
55040C1	02-27-2014	STANDARD DETAILS FOR TYPE C1 APPROACH SLAB
55040C2	02-27-2014	STANDARD DETAILS FOR TYPE C2 APPROACH SLAB
55040D	02-27-2014	STANDARD DETAILS FOR TYPE D APPROACH SLAB
55040E	02-27-2014	STANDARD DETAILS FOR TYPE E APPROACH SLAB
55045	02-27-2014	STANDARD DETAILS FOR APPROACH SLAB (EXISTING BRIDGE MODIFICATION)
55050	04-17-2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE TIMBER SPANS 20' ROADWAY WIDTH (SHEET 1 OF 2)
55051	04-17-2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE TIMBER SPANS 20' ROADWAY WIDTH (SHEET 2 OF 2)
55052	04-17-2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE PRECAST CONCRETE SPANS 20' ROADWAY WIDTH (SHEET 1 OF 2)
55053	04-17-2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE PRECAST CONCRETE SPANS 20' ROADWAY WIDTH (SHEET 2 OF 2)
55054	04-17-2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE BRIDGE END PROTECTION SYSTEM
55055	04-17-2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE PRECAST CONCRETE SPANS 24' ROADWAY WIDTH (SHEET 1 OF 2)
55056	04-17-2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE PRECAST CONCRETE SPANS 24' ROADWAY WIDTH (SHEET 2 OF 2)
55057	04-17-2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE TIMBER SPANS 24' ROADWAY WIDTH (SHEET 1 OF 2)
55058	04-17-2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE TIMBER SPANS 24' ROADWAY WIDTH (SHEET 2 OF 2)
55060	01-09-2020	STANDARD DETAILS FOR HYDRODEMOLITION AND LMC OVERLAY SLAB ON BEAM/GIRDER BRIDGES
55061	01-09-2020	STANDARD DETAILS FOR HYDRODEMOLITION AND LMC OVERLAY SLAB ON BEAM/GIRDER BRIDGES WITH GRADE RAISE
55062	01-09-2020	STANDARD DETAILS FOR HYDRODEMOLITION AND LMC OVERLAY REINFORCED CONCRETE SLAB STRUCTURES
55063	01-09-2020	STANDARD DETAILS FOR HYDRODEMOLITION AND LMC OVERLAY VOIDED CONCRETE SLAB STRUCTURES
55064	11-07-2019	STANDARD DETAILS FOR JOINT REPAIRS & MODIFICATION
55065	11-07-2019	STANDARD DETAILS FOR BACKWALL REPAIRS

<u>DWG.</u>	<u>DATE</u>	<u>TITLE</u>
55080	05-24-2017	STANDARD DETAILS FOR 19'-0" PRECAST CONCRETE SPANS 28'-0" AND 24'-6" CLEAR ROADWAYS
55081	05-24-2017	STANDARD DETAILS FOR 25'-0" PRECAST CONCRETE SPANS 28'-0" AND 24'-6" CLEAR ROADWAYS
55082	05-24-2017	STANDARD DETAILS FOR 31'-0" PRECAST CONCRETE SPANS 28'-0" AND 24'-6" CLEAR ROADWAYS
55083	02-11-2016	STANDARD DETAILS FOR PRECAST PARAPET RAILS FOR 19'-0", 25'-0", AND 31'-0" PRECAST END SPANS

A8.7 Standard Drawing Detailing Aids

Standard Dwg. No.	Detailing Aids
<p style="text-align: center;">55006 “Standard General Notes for Steel Bridge Structures”</p>	<ul style="list-style-type: none"> • Typically for use with: Simple W-Beam or Plate Girder Spans Continuous W-Beam or Plate Girder Units Tangent or Curved Beams or Girders With or without Sidewalks or Median Barriers • Reference Std. Dwg. 55006 in the General Notes on the bridge layout and in the plan details where appropriate. • All pouring sequence notes for deck construction, concrete diaphragms (seismic), integral bents, etc. must be addressed in the plan details. • Refer to “X” or “K” frames as Cross-Frames in the plan details. • Specify grade of steel and method of payment in the plan details. Framing Plan/Beam Elevation sheet preferred. • Specify grade and payment on end bent details requiring armoring. • Address any additional or job specific notes that may be required on the applicable substructure or superstructure plan details.
<p style="text-align: center;">55007 “Standard Details for Steel Bridge Structures”</p>	<ul style="list-style-type: none"> • Typically for use with: W-Beam or Plate Girder Simple Spans or Continuous Units • Reference Std. Dwg. 55007 in the General Notes on the bridge layout and in the plan details where appropriate. • Modify “Adjustment for Slab Thickness Tolerance” in plans to revise the maximum haunch dimension, when required. • Modify “Rounding Detail” in plans to accommodate superelevation transitions on bridge decks, when required. • Show location of drip plates, if required, on Framing Plan. • If special welds are required, show in plan details.
<p style="text-align: center;">55008 “Standard Details for Poured Silicone Joints”</p>	<ul style="list-style-type: none"> • Show 8”x4”x1/2” for Connection Angle in plans. • Show Roadway Channel size in plans. • Include “Table of Silicone Joint Data” in plan details, preferably on the sheet including the roadway details at joint, and reference this standard drawing. • Maximum width is 2 1/2” perpendicular to joint. • When required by design, a note shall be added to the end bent details that no backfill shall be placed behind the backwall until the deck concrete on the adjacent spans has been placed.

Standard Dwg. No.	Detailing Aids
<p align="center">55009 “Standard Details for Neoprene Strip Seal Joints”</p>	<ul style="list-style-type: none"> • Show Split C15x33.9 for Connection Angle in plans. • Show Roadway Channel size in plans. • Include “Table of Strip Seal Joint Data” in plan details, preferably on the sheet including the roadway details at joint and reference this standard drawing. • When required by design, a note shall be added to the end bent details that no backfill shall be placed behind the backwall until the deck concrete on the adjacent spans has been placed. • When alternate painting of slider plates and joint armoring is required, show in the plan details.
<p align="center">55010 & 55011 “Standard Details for Type D Bridge Name Plate” & “Standard Details for Type C Bridge Name Plate”</p>	<p>Unless otherwise approved by the Bridge Engineer, the bridge name plate drawing version for use on a bridge project shall be as follows:</p> <ul style="list-style-type: none"> • Type D name plates, Std. Dwg. 55010, shall be used for state bridges. • Type C name plates, Std. Dwg. 55011, shall be used for city and county bridges. • For typical projects to be let, the Standard Drawing used shall have the most recent revision date prior to the project Date of Letting. • For Alternative Delivery type projects like Design Build (DB) or Construction Manager/General Contractor (CMGC), the Standard Drawing used shall have the most recent revision date at the time of selection of the CMGC or execution of the DB Agreement.
<p align="center">55013 “Standard Details for Transitional Approach Railing”</p>	<ul style="list-style-type: none"> • Use to transition ends of N.J. parapet rails on sidewalks. • Show locations on the bridge layout. • When alternate architectural finishes are required, show on the plan details.
<p align="center">55014 “Standard Details for Type H Railing”</p>	<ul style="list-style-type: none"> • Use for pedestrian handrail mounted to parapet railing adjacent to sidewalks. • When powder coating finish is required, specify in the plan details, including color. • When used in conjunction with chain link fence, do not specify a powder coating finish. • Show and reference “Detail X” (concrete terminal) on parapet details. • Include reinforcing and bending diagrams for “Detail X” in the bar list on the superstructure details.
<p align="center">55018 “Standard Details for Chain Link Fence”</p>	<ul style="list-style-type: none"> • Typically used on railroad overpasses. • Show fence location/stationing in the plan details preferably on the “Reinforcing Plan”. Reference standard drawing and include the following: Begin Fence Sta. XXX+XX End Fence Sta. XXX+XX “L” = ____ feet “H” = X'-0”

A8.8 Standard Weights and Measurements

Anchor Bolt and Component Weights

Anchor Bolt Dia. (in.)	Bolt Weight (lb/ft)	Washer Weight (lb)	Nut Weight (lb)	Pipe Sleeve Dia. (in.)	Sleeve Weight (lb/ft)
1.25	4.176	0.172	0.786	1.25	2.27
1.50	6.013	0.251	1.310	1.50	2.72
1.75	8.185	0.329	2.040	2.00	3.65
2.00	10.690	0.398	2.990	2.50	5.79
2.25	13.530	0.576	4.190	2.50	5.79
2.50	16.703	0.743	5.640	3.00	7.58
2.75	20.195	0.931	7.380	3.00	7.58
3.00	24.033	1.140	9.500	3.50	9.11
3.25	28.210	1.369	11.940	3.50	9.11
3.50	32.710	1.619	15.260	4.00	10.79
3.75	37.550	1.891	18.120	4.00	10.79

Notes: Type B shoes only use 1.25 in. diameter bolts.

Typically, maximum anchor bolt diameter is 2.5" and 2.75" for bearings with and without shear blocks, respectively.

Shear Stud Connector Weight (lb)

Stud Dia. (in.)	Length (in.)					
	3	4	5	6	7	8
1/2	0.210	0.270	0.330	0.390	0.450	0.510
5/8	0.336	0.432	0.528	0.624	0.720	0.816
3/4	0.490	0.615	0.740	0.865	0.990	1.115
7/8	0.640	0.810	0.980	1.150	1.320	1.490
1	0.894	1.133	1.383	1.600	1.737	2.050

Connection Bolt Weight

Bolt Diameter (in.)	Weights (lb)
1/2	0.197
5/8	0.317
3/4	0.524
7/8	0.804
1	1.167
1 1/8	1.651
1 1/4	2.120
1 3/8	2.800
1 1/2	3.400

Note: Includes nut and washer weight

Plate Weight

Plate Thickness (in.)	Weights (psf)
3/8	15.3125
7/16	17.8646
1/2	20.4167
9/16	22.9688
5/8	25.5208
11/16	28.0729
3/4	30.6250
13/16	33.1771
7/8	35.7292

Rebar Properties

Rebar Designation	Weight (lb/ft)	Diameter (in.)	Area (in ²)	Perimeter (in.)
3	0.376	0.375	0.11	1.178
4	0.668	0.500	0.20	1.571
5	1.043	0.625	0.31	1.963
6	1.502	0.750	0.44	2.356
7	2.044	0.875	0.60	2.749
8	2.670	1.000	0.79	3.142
9	3.400	1.128	1.00	3.544
10	4.303	1.270	1.27	3.990
11	5.313	1.410	1.56	4.430
14	7.650	1.693	2.25	5.320
18	13.600	2.257	4.00	7.090

Item 803 Class 1 Protective Surface Treatment

Basis of Estimate: $[1/40 + 1/67] / 2(9) = .002218$ Gallons/SF

Note: Divided by 2 because only 1/2 of the mixture is boiled linseed oil.

Item 816 Foundation Protection Riprap

Specific Gravity of Foundation Protection Riprap, $G_s = 2.65$. $\gamma_w = 62.4$ pcf

$62.4 \text{ pcf} * (2.65) = 165.36 \text{ pcf}$

Assume in-situ void ratio, $e = 0.6$

$\gamma_{\text{in-situ}} = 165.36 \text{ pcf} * (1 / (1 + 0.6)) = 103.35 \text{ pcf}$

Tons per cyd = $103.35 \text{ pcf} * 27 \text{ ft}^3/\text{cyd} * 1 \text{ ton} / 2,000 \text{ lbs.} = 1.40 \text{ Tons} / \text{cyd}$

Specified Weights, lb/ft ²	Permissible Variation in Average Weight of Lots for Widths Given in Inches, Expressed in Percentage of the Specified Weights per Square Foot.										
	48 and under	Over 48 to 60, excl	60 to 72, excl	72 to 84, excl	84 to 96, excl	96 to 108, excl	108 to 120, excl	120 to 132, excl	132 to 144, excl	144 to 168, excl	168 and over
To 10, excl	4.0	4.5	5.0	5.5	6.0	7.5	9.0	11.0	13.0
10 to 12.5, excl	4.0	4.5	4.5	5.0	5.5	6.5	7.0	8.0	9.0	12.0	...
12.5 to 15.0, excl	4.0	4.0	4.5	4.5	5.0	5.5	6.0	7.5	8.0	11.0	...
15 to 17.5, excl	3.5	3.5	4.0	4.5	4.5	5.0	5.5	6.0	7.0	9.0	10.0
17.5 to 20, excl	3.5	3.5	3.5	4.0	4.5	4.5	5.0	5.5	6.0	8.0	9.0
20 to 25, excl	3.5	3.5	3.5	3.5	4.0	4.0	4.5	5.0	5.5	7.0	8.0
25 to 30, excl	3.0	3.5	3.5	3.5	3.5	3.5	4.0	4.5	5.0	6.5	7.0
30 to 40, excl	3.0	3.0	3.0	3.0	3.5	3.5	3.5	4.0	4.5	6.0	6.5
40 to 81.7, excl	2.5	3.0	3.0	3.0	3.5	3.5	3.5	3.5	4.0	5.5	6.0
81.7 to 122.6, excl	2.5	3.0	3.0	3.0	3.5	3.5	3.5	3.5	3.5	4.0	4.5
122.6 to 163.4, excl	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3.0	3.5
163.4 to 245.1, excl	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3.0	3.5
245.1 to 409.0, excl	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3.0
409.0 to 490.1, excl	2.0	2.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
490.1 to 613.0, excl	2.0	2.0	2.0	2.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5

Adaptation of Table 2 from ASTM A6 – Contains over tolerance values

From AHTD Subsection 807.89(a)(2)

To the nominal weights of plates more than 36" (900 mm) in width, there will be added one-half of the allowed percentage of overrun in weight given in ASTM A6.

Example Calculation:

$$\text{plate width} = 36 \text{ in.}$$

$$\text{plate thickness} = \frac{7}{8} \text{ in.}$$

$$\text{weight per square foot} = \left(\frac{7}{8} \text{ in.}\right) * \left(490 \frac{\text{lb}}{\text{ft}^3}\right) * \left(\frac{1 \text{ ft}}{12 \text{ in.}}\right) = 35.7292 \frac{\text{lb}}{\text{ft}^2}$$

$$\text{overrun percentage} = 3.0 \% \text{ (from table)}$$

$$\text{overrun weight per square foot} = \left(35.7292 \frac{\text{lb}}{\text{ft}^2}\right) * \left[1 + \left(\frac{3.0 \%}{2}\right) * \left(\frac{1}{100 \%}\right)\right] = 36.2651 \frac{\text{lb}}{\text{ft}^2}$$

A8.10 Standard Rounding for Bridge Quantities

ITEM NO.	*ITEM	PAY UNIT	SHOW IN MULTIPLES OF:	
			BENT OR SPAN	BRIDGE OR JOB
205	Removal of Existing Bridge Structure (Site No. ___)	Lump Sum	N/A	1
603	Temporary Bridge Structure (___' Roadway Width)	Linear Foot	N/A	1
801	Unclassified Excavation for Structures-Bridge	Cubic Yard	1	1
801	Common Excavation for Structures-Bridge	Cubic Yard	1	1
801	Rock Excavation for Structures-Bridge	Cubic Yard	1	1
802	Class B Concrete-Bridge	Cubic Yard	0.01	0.10
802	Class B(AE) Concrete-Bridge	Cubic Yard	0.01	0.10
802	Class S Concrete-Bridge	Cubic Yard	0.01	0.10
802	Class S(AE) Concrete-Bridge	Cubic Yard	0.01	0.10
802	Seal Concrete-Bridge	Cubic Yard	0.01	0.10
802	Grooving	Square Yard	0.1	1.0
802	___' Precast Concrete Curb Units	Each		
802	___' Precast Concrete Interior Units	Each		
802	___' Precast Concrete Rail Units	Each		
802	___' Precast Concrete Parapet Rail Units	Each		
802	Prestressed Concrete Girders (Type___)	Linear Foot	0.1	0.1
803	Class 1 Protective Surface Treatment	Gallon	0.1	0.1
803	Class 2 Protective Surface Treatment	Square Yard	0.1	0.1
803	Class 3 Protective Surface Treatment	Linear Foot	1	1
804	Reinforcing Steel-Bridge (Grade ___)	Pound	1	10
804	Epoxy Coated Reinforcing Steel (Grade ___)	Pound	1	10
805	Steel Piling (___)	Linear Foot	1	1
805	Steel Shell Piling (___ " Dia.)	Linear Foot	1	1
805	Concrete Piling (___ ")	Linear Foot	1	1
805	Test Pile (___ ")	Linear Foot	1	1
805	Pile Encasement	Linear Foot	1	1
805	Dynamic Pile Load Test	Each	1	1
805	Preboring	Linear Foot	1	1
806	Metal Bridge Railing (Type___)	Linear Foot	1	1
806	Transitional Approach Railing	Each	1	1
807	Structural Steel in Beam Spans (___)	Pound	1	10
807	Structural Steel in Plate Girder Spans (___)	Pound	1	10
807	Painting Structural Steel	Ton	0.1	0.1
808	Elastomeric Bearings	Cubic Inch	0.1	1.0
809	Armored Joint with Neoprene Strip Seal	Linear Foot	1	1
809	Preformed Joint Seal	Linear Foot	1	1
809	Silicone Joint Seal	Linear Foot	1	1
811	Sheet Piles (___)	Linear Foot	1	1
812	Bridge Name Plate (Type___)	Each	1	1
813	Damproofing	Square Foot	1	10
815	Membrane Waterproofing (Type _____)	Square Foot	1	10
816	Filter Blanket	Square Yard	1	1
816	Dumped Riprap	Cubic Yard	1	1
816	Concrete Riprap	Cubic Yard	1	1
816	Foundation Protection Riprap	Ton	1	1
817	Untreated Timber for Bridges	MFBM		
817	Treated Timber for Bridges	MFBM		
818	Untreated Timber Piling	Linear Foot	1	1
818	Treated Timber Piling	Linear Foot	1	1
818	Timber Test Piles	Linear Foot	1	1
820	Cleaning and Painting Existing Structural Steel (Type___)	Ton	0.1	0.1
821	Modification of Existing Bridge Structure (Bridge No. _____)	Lump Sum	1	1
822	Bridge Deck Repair	Square Yard	0.1	0.1
822	Bridge Deck Overlay	Square Yard	0.1	0.1

* pay items per 2014 specifications

A8.11 Job Submission Form

**BRIDGE DIVISION
FINAL PLAN SUBMISSION**

Squad: _____
Submit Date: _____
Let Date: _____

JOB NO. _____

COORDINATION STATUS (YES/NO):

Action	Requested	Approved	Completed
Hydraulics Certification(s)			
Conceptual Work Plan(s) & Qtys.			
LARS Model(s) on W:drive			
RR Coordination			
Coast Guard Coordination			
Corps of Engineers/Levee Board			
Franks Book Entry			
Sign Structures Log Entry			

For your review and comments. Please note the following:

- 1)

A8.12 Example - Drawing List

LIST OF BRIDGE DRAWINGS

JOB NO. _____ By: _____ Date: _____
 Ck: _____ Date: _____

DRAWING NUMBER	DRAWING TITLE	BRIDGE NUMBER
_____	SCHEDULE OF BRIDGE QUANTITIES	_____
_____	LAYOUT OF BRIDGE OVER DOGWOOD DR. & MONTE NE BRANCH (SHEET 1 OF 3)	_____
_____	LAYOUT OF BRIDGE OVER DOGWOOD DR. & MONTE NE BRANCH (SHEET 2 OF 3)	_____
_____	LAYOUT OF BRIDGE OVER DOGWOOD DR. & MONTE NE BRANCH (SHEET 3 OF 3)	_____
_____	DETAILS OF END BENT 1 (SHEET 1 OF 2)	_____
_____	DETAILS OF END BENT 1 (SHEET 2 OF 2)	_____
_____	DETAILS OF BENT 2	_____
_____	DETAILS OF BENT 3	_____
_____	DETAILS OF BENT 4	_____
_____	DETAILS OF BENT 5	_____
_____	COMMON DETAILS OF INTERMEDIATE BENTS	_____
_____	DETAILS OF END BENT 6 (SHEET 1 OF 2)	_____
_____	DETAILS OF END BENT 6 (SHEET 2 OF 2)	_____
_____	DETAILS OF TRANSITIONAL APPROACH RAILING	_____
_____	DETAILS OF ELASTOMERIC BEARINGS	_____
_____	DETAILS OF 220'-0" CONTINUOUS PLATE GIRDER UNIT (SHEET 1 OF 4)	_____
_____	DETAILS OF 220'-0" CONTINUOUS PLATE GIRDER UNIT (SHEET 2 OF 4)	_____
_____	DETAILS OF 220'-0" CONTINUOUS PLATE GIRDER UNIT (SHEET 3 OF 4)	_____
_____	DETAILS OF 220'-0" CONTINUOUS PLATE GIRDER UNIT (SHEET 4 OF 4)	_____
_____	DETAILS OF 450'-0" CONTINUOUS PLATE GIRDER UNIT (SHEET 1 OF 6)	_____
_____	DETAILS OF 450'-0" CONTINUOUS PLATE GIRDER UNIT (SHEET 2 OF 6)	_____
_____	DETAILS OF 450'-0" CONTINUOUS PLATE GIRDER UNIT (SHEET 3 OF 6)	_____
_____	DETAILS OF 450'-0" CONTINUOUS PLATE GIRDER UNIT (SHEET 4 OF 6)	_____
_____	DETAILS OF 450'-0" CONTINUOUS PLATE GIRDER UNIT (SHEET 5 OF 6)	_____
_____	DETAILS OF 450'-0" CONTINUOUS PLATE GIRDER UNIT (SHEET 6 OF 6)	_____
_____	COMMON DETAILS OF PLATE GIRDER UNITS (SHEET 1 OF 3)	_____
_____	COMMON DETAILS OF PLATE GIRDER UNITS (SHEET 2 OF 3)	_____
_____	COMMON DETAILS OF PLATE GIRDER UNITS (SHEET 3 OF 3)	_____
_____	DETAILS OF DECK DRAINS (SHEET 1 OF 2)	_____
_____	DETAILS OF DECK DRAINS (SHEET 2 OF 2)	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

A8.13 List of Bridge Supplemental Specifications

JOB NO. _____ Eff. 12/13/2018 (Revised 3/24/2020)

LIST OF BRIDGE SUPPLEMENTAL SPECIFICATIONS

<u>S.S. NO.</u>	<u>TITLE</u>
SS-800-1	STRUCTURES
SS-802-3	CONCRETE FOR STRUCTURES
SS-804-2	REINFORCING STEEL FOR STRUCTURES
SS-807-2	STEEL STRUCTURES
SS-808-1	INSTALLATION OF ELASTOMERIC BEARINGS
SS-808-2	ELASTOMERIC BEARINGS

LIST OF BRIDGE SPECIAL PROVISIONS

JOB _____	ARCHITECTURAL FINISH
JOB _____	BRIDGE DECK REPAIR
JOB _____	BRIDGE DECK REPAIR FOR LATEX MODIFIED CONCRETE OVERLAYS
JOB _____	BRIDGE DECK REPAIR FOR POLYMER OVERLAYS
JOB _____	CLASS C FLY ASH IN PORTLAND CEMENT CONCRETE PAVEMENT AND CLASS S(AE) CONCRETE (<i>PROVIDED BY ROADWAY</i>)
JOB _____	UNPAINTED WEATHERING STRUCTURAL STEEL
JOB _____	CONSTRUCTION IN SPECIAL FLOOD HAZARD AREAS
JOB _____	DETAILS FOR BOATER SAFETY (<i>PROVIDED BY ENVIRONMENTAL</i>)
JOB _____	DIRECT TENSION INDICATORS FOR HIGH STRENGTH BOLT ASSEMBLIES
JOB _____	DRILLED SHAFT FOUNDATIONS
JOB _____	HEADED STEEL BARS FOR CONCRETE REINFORCEMENT
JOB _____	JOINT REHABILITATION FOR BRIDGE DECKS
JOB _____	HYDRODEMOLITION - CLASS 1
JOB _____	HYDRODEMOLITION - CLASS 2
JOB _____	LATEX MODIFIED CONCRETE OVERLAY
JOB _____	MANAGEMENT OF HYDRODEMOLITION WASTEWATER (<i>PROVIDED BY ENVIRONMENTAL</i>)
JOB _____	NONDESTRUCTIVE TESTING OF DRILLED SHAFTS
JOB _____	POLYMER OVERLAY
JOB _____	RETAINING WALLS
JOB _____	SELECT GRANULAR BACKFILL (<i>PROVIDED BY MATERIALS</i>)
JOB _____	SHORING
JOB _____	SPECIAL SAFETY REQUIREMENTS FOR BRIDGES
JOB _____	SPECIAL SAFETY REQUIREMENTS FOR OVERHEAD SIGNS (<i>PROVIDED BY MAINTENANCE</i>)
JOB _____	TEMPORARY RETAINING WALLS (<i>PROVIDED BY MATERIALS</i>)
JOB _____	TEXTURED COATING FINISH
JOB _____	STEEL SIGN STRUCTURES
JOB _____	VERY EARLY STRENGTH LATEX MODIFIED CONCRETE OVERLAY

LIST OF BRIDGE STANDARD DRAWINGS (revisions are shown in bold)

<u>DWG. NO.</u>	<u>DATE</u>	<u>TITLE</u>
55000	2/27/2014	STANDARD DETAILS FOR EMBANKMENT CONSTRUCTION AND BACKFILL AT BRIDGE ENDS
55001	2/27/2014	STANDARD DETAILS FOR DUMPED RIPRAP AND FILTER BLANKET AND COMPUTING EXCAVATION FOR STRUCTURES
55002	2/27/2014	STANDARD DETAILS FOR CONCRETE RIPRAP
55005	3/24/2016	STANDARD DETAILS FOR PERMANENT STEEL BRIDGE DECK FORMS FOR STEEL & CONCRETE GIRDER SPANS
55006	9/2/2015	STANDARD GENERAL NOTES FOR STEEL BRIDGE STRUCTURES
55007	2/11/2016	STANDARD DETAILS FOR STEEL BRIDGE STRUCTURES
55008	2/11/2016	STANDARD DETAILS FOR POURED SILICONE JOINTS
55009	2/11/2016	STANDARD DETAILS FOR NEOPRENE STRIP SEAL JOINTS
55010	3/24/2020	STANDARD DETAILS FOR TYPE D BRIDGE NAME PLATE
55011	2/27/2020	STANDARD DETAILS FOR TYPE C BRIDGE NAME PLATES
55013	2/11/2016	STANDARD DETAILS FOR TRANSITIONAL APPROACH RAILING
55014	2/11/2016	STANDARD DETAILS FOR TYPE H RAILING
55018	2/11/2016	STANDARD DETAILS FOR CHAIN LINK FENCE
55020	3/24/2016	STANDARD DETAILS FOR STEEL H-PILES AND PILE ENCASEMENTS
55021	3/24/2016	STANDARD DETAILS FOR CONCRETE FILLED STEEL SHELL PILES AND PILE ENCASEMENTS
55022	3/24/2016	STANDARD DETAILS FOR CONCRETE PILES
55024	2/27/2014	STANDARD DETAILS FOR CONCRETE PILES (LOAD FACTOR DESIGN)
55025	2/27/2014	STANDARD DETAILS FOR CONCRETE PILES SEISMIC REGION B (LOAD FACTOR DESIGN)
55030A	9/2/2015	STANDARD DETAILS FOR TYPE A APPROACH GUTTERS
55030B	9/2/2015	STANDARD DETAILS FOR TYPE B APPROACH GUTTERS
55030C	2/27/2014	STANDARD DETAILS FOR TYPE C APPROACH GUTTERS
55030D	2/27/2014	STANDARD DETAILS FOR TYPE D APPROACH GUTTERS
55030E	2/27/2014	STANDARD DETAILS FOR TYPE E APPROACH GUTTERS
55035	11/7/2019	STANDARD DETAILS FOR TYPE 'PT' APPROACH GUTTERS (BRIDGES WITH CONCRETE PARAPET RAILING)
55036	11/7/2019	STANDARD DETAILS FOR TYPE 'AT' APPROACH GUTTERS (BRIDGES WITH 6" CURBS & TYPE A, B, C, D OR E RAILING)
55037	11/7/2019	STANDARD DETAILS FOR TYPE 'PT2' APPROACH GUTTERS (BRIDGES WITH CONCRETE PARAPET RAILING)
55038	11/7/2019	STANDARD DETAILS FOR TYPE 'AT2' APPROACH GUTTERS (BRIDGES WITH CURBS & TYPE A, B, C, D, OR E RAILING)

55039	11/7/2019	STANDARD DETAILS FOR TYPE 'CT' APPROACH GUTTERS (BRIDGES WITH CURB)
55040A	2/27/2014	STANDARD DETAILS FOR TYPE A APPROACH SLAB
55040B	2/27/2014	STANDARD DETAILS FOR TYPE B APPROACH SLAB
55040C1	2/27/2014	STANDARD DETAILS FOR TYPE C1 APPROACH SLAB
55040C2	2/27/2014	STANDARD DETAILS FOR TYPE C2 APPROACH SLAB
55040D	2/27/2014	STANDARD DETAILS FOR TYPE D APPROACH SLAB
55040E	2/27/2014	STANDARD DETAILS FOR TYPE E APPROACH SLAB
55045	2/27/2014	STANDARD DETAILS FOR APPROACH SLAB (EXISTING BRIDGE MODIFICATION)
55050	4/17/2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE TIMBER SPANS 20' ROADWAY WIDTH (SHEET 1 OF 2)
55051	4/17/2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE TIMBER SPANS 20' ROADWAY WIDTH (SHEET 2 OF 2)
55052	4/17/2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE PRECAST CONCRETE SPANS 20' ROADWAY WIDTH (SHEET 1 OF 2)
55053	4/17/2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE PRECAST CONCRETE SPANS 20' ROADWAY WIDTH (SHEET 2 OF 2)
55054	4/17/2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE BRIDGE END PROTECTION SYSTEM
55055	4/17/2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE PRECAST CONCRETE SPANS 24' ROADWAY WIDTH (SHEET 1 OF 2)
55056	4/17/2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE PRECAST CONCRETE SPANS 24' ROADWAY WIDTH (SHEET 2 OF 2)
55057	4/17/2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE TIMBER SPANS 24' ROADWAY WIDTH (SHEET 1 OF 2)
55058	4/17/2014	STANDARD DETAILS FOR TEMPORARY BRIDGE STRUCTURE TIMBER SPANS 24' ROADWAY WIDTH (SHEET 2 OF 2)
55060	1/9/2020	STANDARD DETAILS FOR HYDRODEMOLITION AND LMC OVERLAY SLAB ON BEAM/GIRDER BRIDGES
55061	1/9/2020	STANDARD DETAILS FOR HYDRODEMOLITION AND LMC OVERLAY SLAB ON BEAM/GIRDER BRIDGES WITH GRADE RAISE
55062	1/9/2020	STANDARD DETAILS FOR HYDRODEMOLITION AND LMC OVERLAY REINFORCED CONCRETE SLAB STRUCTURES
55063	1/9/2020	STANDARD DETAILS FOR HYDRODEMOLITION AND LMC OVERLAY VOIDED CONCRETE SLAB SPANS
55064	11/7/2019	STANDARD DETAILS FOR JOINT REPAIRS & MODIFICATIONS
55065	11/7/2019	STANDARD DETAILS FOR BACKWALL REPAIRS
55080	5/24/2017	STANDARD DETAILS FOR 19'-0" PRECAST CONCRETE SPANS 28'-0" AND 24'-6" CLEAR ROADWAYS
55081	5/24/2017	STANDARD DETAILS FOR 25'-0" PRECAST CONCRETE SPANS 28'-0" AND 24'-6" CLEAR ROADWAYS
55082	5/24/2017	STANDARD DETAILS FOR 31'-0" PRECAST CONCRETE SPANS 28'-0" AND 24'-6" CLEAR ROADWAYS
55083	2/11/2016	STANDARD DETAILS FOR PRECAST PARAPET RAILS FOR 19'-0", 25'-0" AND 31'-0" PRECAST END SPANS

LIST OF ROADWAY STANDARD DRAWINGS

<u>DWG.</u>	<u>DATE</u>	<u>TITLE</u>
GR-10	11/16/2017	GUARDRAIL DETAILS
GR-12	11/16/2017	GUARDRAIL DETAILS
PU-1	12/6/2016	DETAILS OF PIPE UNDERDRAIN
TC-4	2/27/2014	STANDARD TRAFFIC CONTROLS FOR HIGHWAY CONSTRUCTION - TEMPORARY PRECAST BARRIER
TC-5	10/15/2009	STANDARD TRAFFIC CONTROLS FOR HIGHWAY CONSTRUCTION - TEMPORARY PRECAST BARRIER
WF-3	11/17/2010	CHAIN LINK FENCE

A8.14 Special Provision Guide

- FREQUENTLY USED SPECIAL PROVISIONS**
- JOB _____ ASTM A490 ALLOY STEEL HIGH-STRENGTH BOLTS
(REQUIRED WHEN THESE BOLTS ARE USED, SEE SUPERSTRUCTURE PLANS)
- JOB _____ CONSTRUCTION IN SPECIAL FLOOD HAZARD AREAS
(REQUIRED WHEN PROJECT IS IN FLOODPLAIN, SEE HYDRAULICS' MEMO FOR TYPE)
- JOB _____ BRIDGE DECK REPAIR FOR POLYMER OVERLAYS
(REQUIRED WHEN BRIDGE DECK IS TO BE REPAIRED BY POLYMER OVERLAY)
- JOB _____ DIRECT TENSION INDICATORS FOR HIGH STRENGTH BOLT ASSEMBLIES
(REQUIRED ON ALL BRIDGES WITH HI-STRENGTH BOLTS)
- JOB _____ DRILLED SHAFT FOUNDATIONS
(REQUIRED WHEN DRILLED SHAFTS ARE USED)
- JOB _____ ELASTOMERIC BEARINGS
(REQUIRED WHEN METHOD A BEARING DESIGN IS USED)
- JOB _____ EXPLORATORY HOLES
(REQUIRED WHEN INVESTIGATION OF ROCK DEPTH OR ROCK QUALITY IS NEEDED, SEE LAYOUT)
- JOB _____ FOUNDATION IMPROVEMENT - AGGREGATE PIER
(REQUIRED WHEN BEARING CAPACITY IMPROVEMENT IS NEEDED FOR MSE WALLS)
- JOB _____ GRADE HPS70W STRUCTURAL STEEL
(REQUIRED WHEN THIS TYPE OF STEEL IS USED, SEE SUPERSTRUCTURE PLANS)
- JOB _____ GRAVITY BLOCK RETAINING WALLS
(REQUIRED WHEN THIS TYPE OF RETAINING WALL IS USED, SEE LAYOUT)
- JOB _____ JOINT REHABILITATION FOR BRIDGE DECKS
(REQUIRED WHEN JOINT REHABILITATION IS NEEDED)
- JOB _____ MODULAR BLOCK RETAINING WALLS
(REQUIRED WHEN THIS TYPE OF RETAINING WALL IS USED, SEE LAYOUT)
- JOB _____ NATIVE STONE FOR GABION AND RIPRAP
(REQUIRED AS NEEDED, SEE LAYOUT)
- JOB _____ NONDESTRUCTIVE TESTING OF DRILLED SHAFTS
(REQUIRED WHEN DRILLED SHAFTS ARE USED)

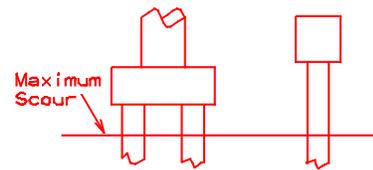
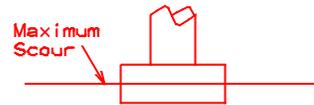
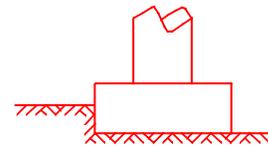
- JOB _____ POLYMER OVERLAY
(REQUIRED WHEN POLYMER OVERLAY ON BRIDGE DECKS IS NEEDED)
- JOB _____ PREFORMED SILICONE JOINT SEAL
(REQUIRED WHEN THIS JOINT TYPE IS USED, SEE LAYOUT)
- JOB _____ RETAINING WALLS
(REQUIRED WHEN RETAINING WALLS ARE USED, SEE LAYOUT)
- JOB _____ SEISMIC ISOLATION BEARINGS
(REQUIRED WHEN THIS TYPE OF BEARING IS USED FOR SEISMIC DESIGN)
- JOB _____ SHORING
(REQUIRED WHEN SHORING IS USED, SEE LAYOUT)
- JOB _____ SPECIAL FACILITIES AT SITE
(REQUIRED WHEN WATER TRANSPORTATION FOR INSPECTORS IS NEEDED)
- JOB _____ SPECIAL SAFETY REQUIREMENTS FOR BRIDGE
**(REQUIRED WHEN CONTRACTOR INTERFERES WITH TRAFFIC FLOW
UNDERNEATH BRIDGE CONSTRUCTION)**
- JOB _____ SPLICING REINFORCING STEEL
**(REQUIRED WHEN NON QPL APPROVED COUPLERS ARE USED, INTENDED FOR
USE ON COLUMNS BUT VERBIAGE MAY BE ADJUSTED FOR USE ELSEWHERE)**
- JOB _____ STEEL SIGN STRUCTURES
(REQUIRED WHEN OVERHEAD SIGN STRUCTURES ARE USED)
- JOB _____ TEMPORARY RETAINING WALLS
(REQUIRED WHEN THIS TYPE OF RETAINING WALL IS USED, SEE LAYOUT)
- JOB _____ TEXTURED COATING FINISH
(REQUIRED WHEN TEXTURED COATING IS USED)
- JOB _____ UNPAINTED WEATHERING STRUCTURAL STEEL
**(REQUIRED WHEN DEEP PLATE GIRDERS ARE USED THAT EXCEED THE
FABRICATOR'S WHEELABRATOR MACHINE SIZE LIMITS)**

A8.16 Scour Form 113

FORM 113 STRUCTURE INVENTORY AND APPRAISAL ITEM 113 FOR NEW BRIDGES

Select the appropriate value (N, 9, 8, 5) for the new bridge you are designing and fill in all blanks at the bottom of the page. See the descriptions below. Use the bent that gives the lowest value; disregard end bents of spill through embankment type.

Item 113	Description
N	Bridge not over Water.
9	Foundations (including piles) above Q500 stage.
8	<ul style="list-style-type: none"> Spread footings on soil, rock or foundation pile footings; in each case the maximum scour depth is above the top of the footing. Rock-socketed drilled shafts.
5	<ul style="list-style-type: none"> Spread footings on soil, rock, with the maximum scour depth falling between the top and bottom of the footing. Foundation pile footings or trestle pile bents with the maximum scour depth falling on the piles. Drilled shafts in soil



Notes: Riprap is not to be used as a scour countermeasure on new bridges.
Maximum scour depth in rock may be based on a relationship to RQD, assessment of cores, historical scour resistance of the founding material, or another acceptable procedure.

Job No: _____ Layout Drawing No.: _____ Bridge No: _____
 Design Engineer: _____ Date: Date Item 113: Item
 District: District County: County Route: _____

Forward a Copy of this Form to the Rating Section Staff Engineer

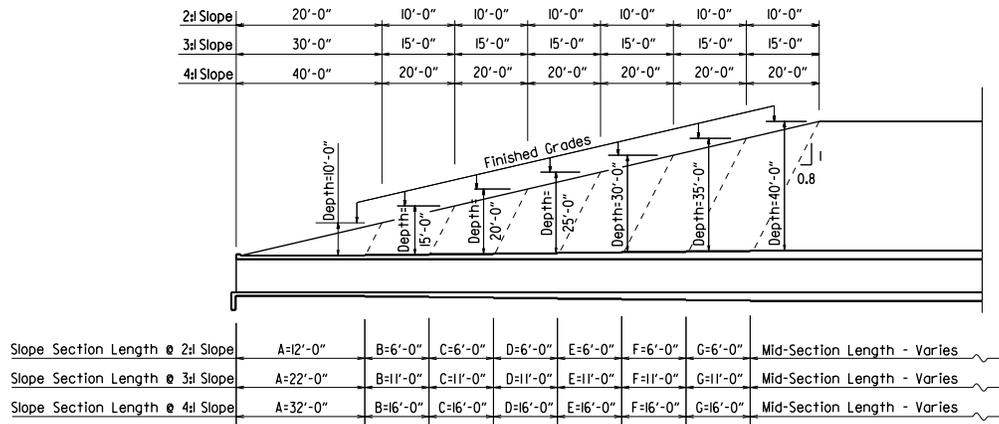
Appendix A9

Miscellaneous Structures

A9.1	Culvert Slope Section Lengths	A9-1
A9.2	Example - Box Culvert Design No. 1	A9-2
A9.3	Example - Box Culvert Design No. 2	A9-4
A9.4	Example - Box Culvert Design No. 3	A9-6

A9.1 Culvert Slope Section Lengths

FOR DESIGNER INFORMATION/TABULAR CULVERT DATA



LONGITUDINAL SECTION LENGTH SCHEDULE FOR VARYING FILL DEPTHS OVER 10'

Lengths for Non-Skewed Boxes

Note: For fill depths 10' and under, use Mid-Section full length of box culvert.

Lengths for Skewed Boxes

SLOPE SECTION		2:1		3:1		4:1	
		A	B, C, D, E, F, G	A	B, C, D, E, F, G	A	B, C, D, E, F, G
SKEW ANGLE (SK)	15	12'-5 1/8"	6'-2 1/2"	22'-9 3/8"	11'-4 5/8"	33'-1 1/2"	16'-6 3/4"
	30	13'-10 1/4"	6'-11 1/8"	25'-4 7/8"	12'-8 3/8"	36'-11 3/8"	18'-5 3/4"
	45	16'-11 5/8"	8'-5 7/8"	31'-1 3/8"	15'-6 5/8"	45'-3"	22'-7 1/2"

Note to Designer:
The section lengths shown in the above table include the "LL" section length.

For input into the "SLOPE SECTION" table on the culvert drawings:

When "LL" is less than "A":

A = A - "LL"
B, C, D, E, F, G = Input lengths as shown in above table

When "LL" is greater than "A", but less than "A"+"B":

B = A + B - "LL" (No "A" section shown)
C, D, E, F, G = Input lengths as shown in above table

When "LL" is greater than "A"+"B", but less than "A"+"B"+"C":

C = A + B + C - "LL" (No "A" or "B" section shown)
D, E, F, G = Input lengths as shown in above table

A9.4 Example - Box Culvert Design No. 3

MID-SECTION

DATE REVISED	DATE PLUMED										

DESIGN NO. _____

PROJECT NO. _____

CONTRACT NO. _____

SECTION NO. _____

DATE _____

BY _____

CHECKED BY _____

PRELIMINARY

SUBJECT TO REVISION

BRIDGE DIVISION

PRINT DATE

08-APR-2006

PLLS

TABLE DATA BY: _____ DATE: _____

CHECKED BY: _____ DATE: _____

DRAWN BY: _____ DATE: _____

BAR LAP TABLE

Bar No.	Bar Dia.	Bar Spacing	Section Length	Min. Bar Lap Length
#4	1/2"	12"	< 40 FT	1'-3"
#5	3/8"	12"	> 40 FT	2'-2"
#6	3/4"	12"	> 40 FT	3'-0"
#7	7/8"	12"	> 40 FT	3'-6"
#8	1"	12"	> 40 FT	4'-7"

GENERAL NOTES & LONGITUDINAL SECTION LENGTH SCHEDULE:

SHEET 1 OF 4, GENERAL DETAILS OF R.C. BOX CULVERT.

SHEET 2 OF 4, GENERAL DETAILS OF R.C. BOX CULVERT.

SHEET 3 OF 4, GENERAL DETAILS OF R.C. BOX CULVERT.

SHEET 4 OF 4, GENERAL DETAILS OF R.C. BOX CULVERT.

STANDARD DRAWING REC-2.

For additional information and other sections, see Sheet 2 of 2.

MID-SECTION

CLASS 'S'	CONCRETE	REINFORCING STEEL	FOOTING DIMENSION PARALLEL TO HDWL	FOOTING DIMENSION PERPENDICULAR TO HDWL	LENGTH OF WING WALLS	LENGTH OF FOOTING HEEL	CLASS 'S'	CONCRETE	REINFORCING STEEL
1	4'-0"	12"	4'-0"	4'-0"	4'-0"	4'-0"	1	4'-0"	12"
2	4'-0"	12"	4'-0"	4'-0"	4'-0"	4'-0"	2	4'-0"	12"
3	4'-0"	12"	4'-0"	4'-0"	4'-0"	4'-0"	3	4'-0"	12"
4	4'-0"	12"	4'-0"	4'-0"	4'-0"	4'-0"	4	4'-0"	12"
5	4'-0"	12"	4'-0"	4'-0"	4'-0"	4'-0"	5	4'-0"	12"
6	4'-0"	12"	4'-0"	4'-0"	4'-0"	4'-0"	6	4'-0"	12"
7	4'-0"	12"	4'-0"	4'-0"	4'-0"	4'-0"	7	4'-0"	12"
8	4'-0"	12"	4'-0"	4'-0"	4'-0"	4'-0"	8	4'-0"	12"

INLET SKEWED END SECTION

NO.	SECTION HEIGHT (FT)	SECTION WIDTH (FT)	SECTION LENGTH (FT)	OVERALL HEIGHT	OVERALL WIDTH	OVERALL LENGTH
1	4.1	4.1	4.1	4.1	4.1	4.1
2	4.1	4.1	4.1	4.1	4.1	4.1
3	4.1	4.1	4.1	4.1	4.1	4.1
4	4.1	4.1	4.1	4.1	4.1	4.1
5	4.1	4.1	4.1	4.1	4.1	4.1
6	4.1	4.1	4.1	4.1	4.1	4.1
7	4.1	4.1	4.1	4.1	4.1	4.1
8	4.1	4.1	4.1	4.1	4.1	4.1

INLET SKEWED END SECTION

NO.	SECTION HEIGHT (FT)	SECTION WIDTH (FT)	SECTION LENGTH (FT)	OVERALL HEIGHT	OVERALL WIDTH	OVERALL LENGTH
1	4.1	4.1	4.1	4.1	4.1	4.1
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5	4.1	4.1	4.1	4.1	4.1	4.1
6	4.1	4.1	4.1	4.1	4.1	4.1
7	4.1	4.1	4.1	4.1	4.1	4.1
8	4.1	4.1	4.1	4.1	4.1	4.1

TOP SUB-SECTION

NO.	SECTION HEIGHT (FT)	SECTION WIDTH (FT)	SECTION LENGTH (FT)	OVERALL HEIGHT	OVERALL WIDTH	OVERALL LENGTH
1	4.1	4.1	4.1	4.1	4.1	4.1
2	4.1	4.1	4.1	4.1	4.1	4.1
3	4.1	4.1	4.1	4.1	4.1	4.1
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5	4.1	4.1	4.1	4.1	4.1	4.1
6	4.1	4.1	4.1	4.1	4.1	4.1
7	4.1	4.1	4.1	4.1	4.1	4.1
8	4.1	4.1	4.1	4.1	4.1	4.1

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7	4.1	4.1	4.1	4.1	4.1	4.1
8	4.1	4.1	4.1	4.1	4.1	4.1

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7	4.1	4.1	4.1	4.1	4.1	4.1
8	4.1	4.1	4.1	4.1	4.1	4.1

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6	4.1	4.1	4.1	4.1	4.1	4.1
7	4.1	4.1	4.1	4.1	4.1	4.1
8	4.1	4.1	4.1	4.1	4.1	4.1

TOP SUB-SECTION

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5	4.1	4.1	4.1	4.1	4.1	4.1
6	4.1	4.1	4.1	4.1	4.1	4.1
7	4.1	4.1	4.1	4.1	4.1	4.1
8	4.1	4.1	4.1	4.1	4.1	4.1

TOP SUB-SECTION

NO.	SECTION HEIGHT (FT)	SECTION WIDTH (FT)	SECTION LENGTH (FT)	OVERALL HEIGHT	OVERALL WIDTH	OVERALL LENGTH
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6	4.1	4.1	4.1	4.1	4.1	4.1
7	4.1	4.1	4.1	4.1	4.1	4.1
8	4.1	4.1	4.1	4.1	4.1	4.1

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6	4.1	4.1	4.1	4.1	4.1	4.1
7	4.1	4.1	4.1	4.1	4.1	4.1
8	4.1	4.1	4.1	4.1	4.1	4.1

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6	4.1	4.1	4.1	4.1	4.1	4.1
7	4.1	4.1	4.1	4.1	4.1	4.1
8	4.1	4.1	4.1	4.1	4.1	4.1

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7	4.1	4.1	4.1	4.1	4.1	4.1
8	4.1	4.1	4.1	4.1	4.1	4.1

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6	4.1	4.1	4.1	4.1	4.1	4.1
7	4.1	4.1	4.1	4.1	4.1	4.1
8	4.1	4.1	4.1	4.1	4.1	4.1

TOP SUB-SECTION

NO.	SECTION HEIGHT (FT)	SECTION WIDTH (FT)	SECTION LENGTH (FT)	OVERALL HEIGHT	OVERALL WIDTH	OVERALL LENGTH
1	4.1	4.1	4.1	4.1	4.1	4.1
2	4.1	4.1	4.1	4.1	4.1	4.1
3	4.1	4.1	4.1	4.1	4.1	4.1
4	4.1	4.1	4.1	4.1	4.1	4.1
5	4.1	4.1	4.1	4.1	4.1	4.1
6	4.1	4.1	4.1	4.1	4.1	4.1
7	4.1	4.1	4.1	4.1	4.1	4.1
8	4.1	4.1	4.1	4.1	4.1	4.1

TOP SUB-SECTION

NO.	SECTION HEIGHT (FT)	SECTION WIDTH (FT)	SECTION LENGTH (FT)	OVERALL HEIGHT	OVERALL WIDTH	OVERALL LENGTH
1	4.1	4.1	4.1	4.1	4.1	4.1
2	4.1	4.1	4.1	4.1	4.1	4.1
3	4.1	4.1	4.1	4.1	4.1	4.1
4	4.1	4.1	4.1	4.1	4.1	4.1
5	4.1	4.1	4.1	4.1	4.1	4.1
6	4.1	4.1	4.1	4.1	4.1	4.1
7	4.1	4.1	4.1	4.1	4.1	4.1
8	4.1	4.1	4.1	4.1	4.1	4.1

TOP SUB-SECTION

NO.	SECTION HEIGHT (FT)	SECTION WIDTH (FT)	SECTION LENGTH (FT)	OVERALL HEIGHT	OVERALL WIDTH	OVERALL LENGTH
1	4.1	4.1	4.1	4.1	4.1	4.1
2	4.1	4.1	4.1	4.1	4.1	4.1
3	4.1	4.1	4.1	4.1	4.1	4.1
4	4.1	4.1	4.1	4.1	4.1	4.1
5	4.1	4.1	4.1	4.1	4.1	4.1
6	4.1	4.1	4.1	4.1	4.1	4.1

Appendix A10

Aesthetics

A10.1 Example - Combination Bridge Rail	A10-1
A10.2 Example - Details of Ornamental Fence	A10-4

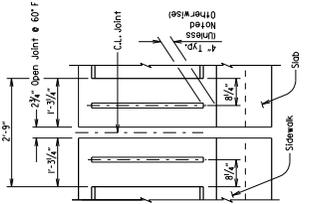
TABLE OF VARIABLES

Span No.	"B"	"C"	No. of Windows Per Bay	Window Type	"D"	"E"
1	4	26'-4 1/2"	5	B	0 3/4"	11 1/4"
2	5	29'-3 1/2"	17	B	1 1/8"	11 1/4"
3	5	29'-3 1/2"	17	B	1 1/8"	11 1/4"
4	5	26'-0"	5	B	8"	9 1/2"
5	5	26'-3 3/4"	5	B	9 1/4"	11 1/4"

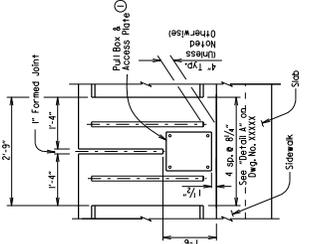
TABLE OF QUANTITIES

(FOR INFORMATION ONLY)

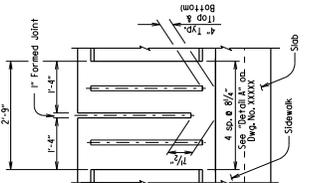
Item 802	Concrete	1000
Item 804	Epoxy Coated Rebar	1000
Item 805	Steel Reinforcing Bars	1000
Item 806	Cast-in-place Concrete	1000
Item 807	Formwork	1000
Item 808	Subgrade	1000



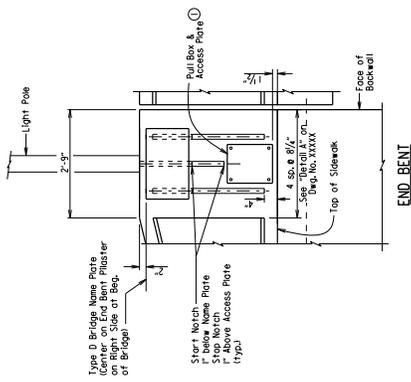
AT EXP. JOINT
BENT 4 ONLY



WITH PEDESTAL



WITHOUT PEDESTAL



END BENT

① See Lighting Details

INTERIOR ELEVATION OF PILASTERS

3/4" ± 1/8"

BAR RSXXE LOCATIONS

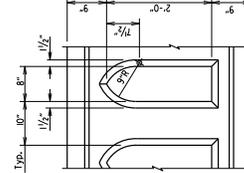
Bay Length	No. of Bars	RSXXE
26'-4 1/2"	2	RS02E
26'-4 1/2"	6	RS02E
29'-1 1/8"	20	RS02E
26'-0"	10	RS02E
26'-3 3/4"	8	RS02E
24'-3 3/4"	2	RS02E

② First and Last Pilaster Bays. Bay length shown measured to end of bay.

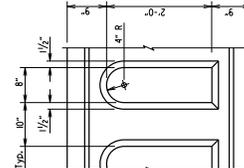
BAR LIST

Mark	No.	Req'd.	Length	A	B	Pin Dia.
RS02E	1000	7'-0"	3'-3"	2"		
RS02E	1750	5'-4"	1'-11"	2 1/2"		
RS02E	28	24'-4"	—	—	—	—
RS02E	46	24'-4"	—	—	—	—
RS02E	70	25'-2"	—	—	—	—
RS02E	70	25'-2"	—	—	—	—
RS02E	56	25'-0"	—	—	—	—
RS02E	60	4'-5"	—	—	—	—
RS02E	3	16'-11"	—	—	—	—
RS02E	6	11'-4"	—	—	—	—
RS02E	6	15'-0"	—	—	—	—
RS02E	12	8'-2"	3'-3"	2 1/2"		
RS02E	3	4'-8" to 8'-0"	1'-6" to 3'-2"			
RS02E	3	8'-0"	7"	3'-2"		
RS02E	68	2'-0"	—	—	—	—
RS02E	34	2'-0"	—	—	—	—
RS02E	34	1'-0"	—	—	—	—
RS02E	28	6'-8"	2'-4"	2 1/2"		
RS02E	6	6'-8"	2'-4"	2 1/2"		
WS0						
WS1						

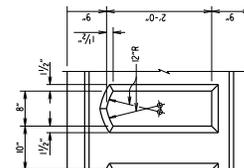
Notes:
Bars with "E" suffix shall be epoxy-coated.
Dimensions are out to out of bars.
Bending Diagrams
Dimensions are out to out of bars.
Bending Diagrams
Dimensions are out to out of bars.
Bending Diagrams
Dimensions are out to out of bars.
Bending Diagrams
Dimensions are out to out of bars.



TYPE C



TYPE B



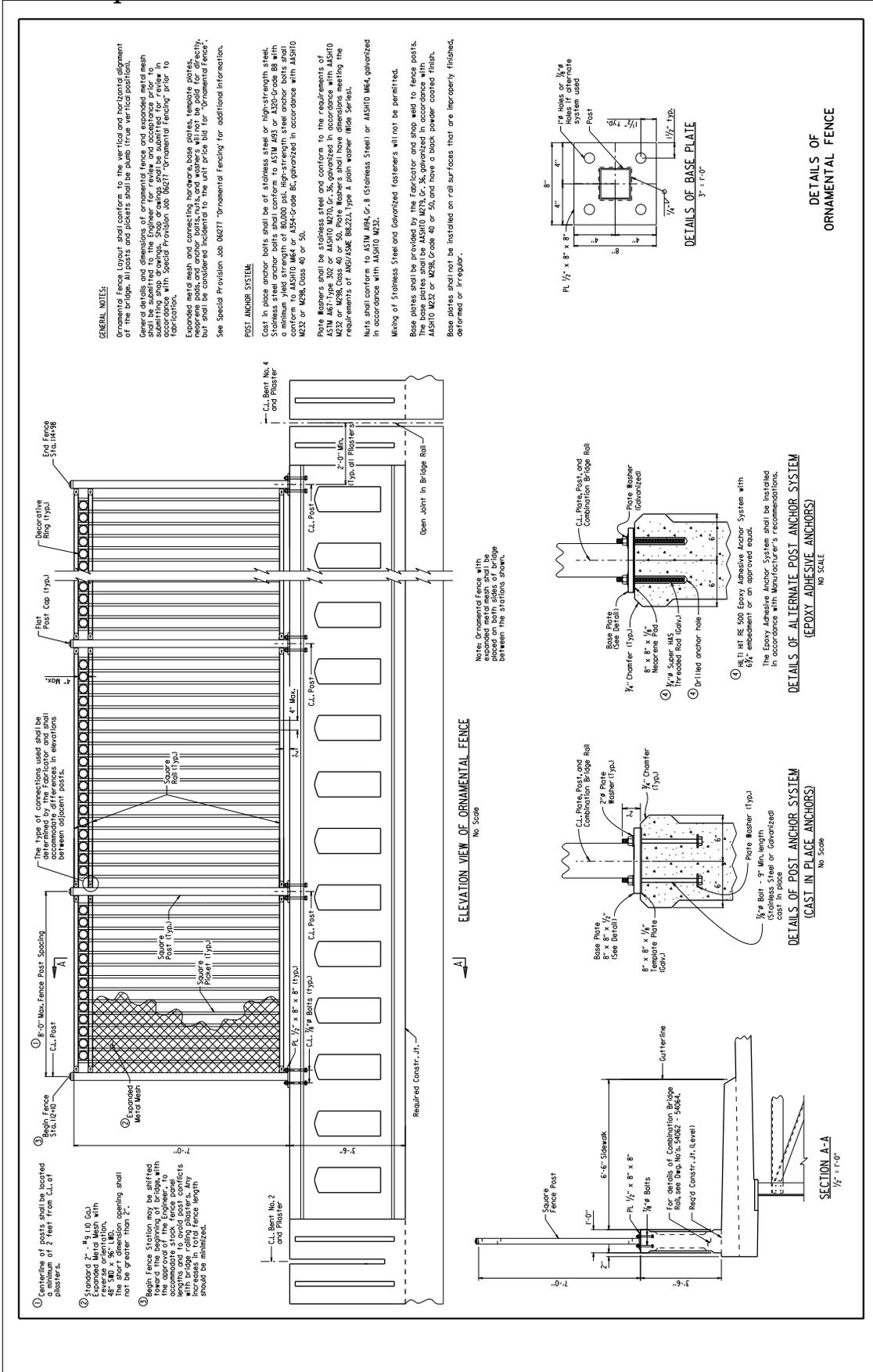
TYPE A

RECESSED WINDOW TYPES

Not to Scale

Notes:
Dimensions shown are for recessed windows on bridge spans.
Dimensions shown are for recessed windows on bridge piers.
Transition rails.
Some window type shall be used at all locations.

A10.2 Example - Details of Ornamental Fence



Appendix A11

Utilities

A11.1 General Guidelines for Attaching Utilities to Bridges A11-1

A11.1 General Guidelines for Attaching Utilities to Bridges

1. Provide a locator map showing the County name, Route number, and feature(s) under the bridge (e.g., name of stream, railroad, or highway).
2. Indicate the type and location of utilities already attached to the bridge.
3. Show the location and spacing of the proposed attachment(s) to the existing bridge.
4. When possible, install the utility line(s) on the downstream side of a bridge over a waterway to minimize the likelihood of snagging drift.
5. The proposed utility shall not hang below the lowest element of the bridge superstructure (i.e., bottom flange of beam).
6. Placing utilities transporting fluid inside of box or tub girders will be prohibited.
7. Attachments to the top of deck or the parapet/rail/curb are not allowed. When possible, attach the utility to the bridge inspection walkway or the bottom of bridge deck. Attachments to the primary structural steel (e.g., beam flanges, web, stiffeners) shall be avoided or minimized.
8. Field welding to the existing bridge is not allowed.
9. Holes drilled in bridge concrete should not cause damage to the primary reinforcing steel. Generally, holes should not be more than 2½" deep.
10. Provide 3" minimum distance from the edge of the drilled hole to the edge of concrete.
11. Provide technical information on the capacity of proposed concrete anchor inserts. The minimum distance between centers of adjacent fasteners embedded in concrete shall meet the requirements of the fastener manufacturer, but shall in no case be less than 3" center to center.

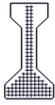
The use of adhesive anchors is allowed in sustained tension situations such as under slab hangers. Refer to Departmental policy memorandum of May 16, 2018 and FHWA Technical Advisory T 5140.34 for additional information.
12. Steel embedded in the superstructure shall be stainless steel or galvanized.
13. Show and identify the type and location of planned expansion joints for the proposed utility. Provide the allowable movement rating for expansion devices.
14. Any longitudinal thrust transmitted by the utility (i.e., water hammer) must not be transmitted to the existing bridge. Provide details of any thrust blocks and joint restraints used.
15. Submit detailed engineering calculations showing the utility dead and live loads transmitted through the attachments to the bridge and, when requested, the structural adequacy of the affected bridge elements to support their design loads, any load(s) added to the structure since its construction, and these additional loadings from the proposed utility.

Appendix A12

Shop Drawings

A12.1	Prestressed Girders Shop Drawing Checklist	A12-1
A12.2	Example - MSE Retaining Wall Revision	A12-2
A12.3	Example - MSE Retaining Wall Distribution	A12-3
A12.4	Example - Modular Block Retaining Wall Distribution	A12-4
A12.5	Example - Gravity Block Retaining Wall	A12-5
A12.6	Example - Aggregate Pier Distribution	A12-6
A12.7	Example - Shop Drawing Transmittal Form	A12-7

A12.1 Prestressed Girders Shop Drawing Checklist



PRESTRESSED GIRDERS SHOP DRAWING CHECKLIST

Notes

- | | |
|---|--------------------------|
| 1.) Concrete Properties | <input type="checkbox"/> |
| 2.) Reinforcing Steel Specifications | <input type="checkbox"/> |
| 3.) Structural Steel Specifications | <input type="checkbox"/> |
| 4.) Strand Specifications | <input type="checkbox"/> |
| 5.) Finishing Method | <input type="checkbox"/> |
| 6.) Beam Marking Method | <input type="checkbox"/> |
| 7.) Accordance with Standard Specifications | <input type="checkbox"/> |
| 8.) Welding per AASHTO/AWS | <input type="checkbox"/> |
| 9.) Detensioning Procedure | <input type="checkbox"/> |
| 10.) Strand Cutting Method | <input type="checkbox"/> |
| 11.) Protection of Exposed Steel Method | <input type="checkbox"/> |
| 12.) Cleaning and Painting Methods | <input type="checkbox"/> |

Erection Plan

- | | |
|--|--------------------------|
| 1.) Joint Dimensions | <input type="checkbox"/> |
| 2.) Markings of Girders | <input type="checkbox"/> |
| 3.) Lengths and Spacing | <input type="checkbox"/> |
| 4.) Expansion or Fixed Bearing Designation | <input type="checkbox"/> |
| 5.) Extended Strands Marker Identification | <input type="checkbox"/> |
| 6.) Diaphragm Locations | <input type="checkbox"/> |
| 7.) Bent and Span Numbers | <input type="checkbox"/> |
| 8.) Begin and End of Bridge Designation | <input type="checkbox"/> |
| 9.) Bed Layout for Draped Strand Pattern | <input type="checkbox"/> |

Details

- | | |
|---|--------------------------|
| 1.) Tensioning Procedure (Jacking Forces, Losses) | <input type="checkbox"/> |
| 2.) Cutting Method and Sequence of Release | <input type="checkbox"/> |
| 3.) Strand Pattern and Debond or Draped Information | <input type="checkbox"/> |
| 4.) Marking Method and Locations | <input type="checkbox"/> |
| 5.) Beam Dimensions | <input type="checkbox"/> |
| 6.) Camber | <input type="checkbox"/> |
| 7.) Diaphragm Connection Placement and Hole Sizes | <input type="checkbox"/> |
| 8.) Chamfer | <input type="checkbox"/> |
| 9.) Bearing Insert Plate Details | <input type="checkbox"/> |
| 10.) Hanger Information and Placement | <input type="checkbox"/> |
| 11.) Channel Connection Angle Bolt Spacing and Location | <input type="checkbox"/> |
| 12.) Extended Strands for Diaphragm Pattern at both Ends | <input type="checkbox"/> |
| 13.) Lifting Method and Location | <input type="checkbox"/> |
| 14.) Rebar Dimensions, Spacing, and Location | <input type="checkbox"/> |
| 15.) Material List for Concrete, Reinforcing Steel,
Strands, Structural Steel, and Girder Lengths | <input type="checkbox"/> |
| 16.) Inserts for SIP Forms & Overhang Brackets | <input type="checkbox"/> |
| 17.) Midspan diaphragm connection details that correspond
with the concrete or steel alternate selected by the
Contractor | <input type="checkbox"/> |

A12.2 Example - MSE Retaining Wall Revision



ARKANSAS DEPARTMENT OF TRANSPORTATION

ArDOT.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director

10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2000

INTEROFFICE MEMORANDUM

Date

TO: Mr. David Henning, State Construction Engineer

FROM: Rick Ellis, Bridge Engineer

SUBJECT: Retaining Wall Review
Job No. _____
Job Title
Choose a County
Route __, Section __

As requested by your office via Doc Express, we have reviewed the retaining wall details from Fabricator for the subject project. The submitted details do not fully comply with design requirements. We have attached a redlined set of the working drawings for revision by the Fabricator.

Please note that these revisions reflect Bridge Division comments only. Additional comments from the review by the Materials Division will need to be included in our Departmental response.

CRE:xxx
Attachments
Email: Materials Engineer

A12.3 Example - MSE Retaining Wall Distribution



ARKANSAS DEPARTMENT OF TRANSPORTATION

ArDOT.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director

10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2000

INTEROFFICE MEMORANDUM

Date

TO: Mr. David Henning, State Construction Engineer

FROM: Rick Ellis, Bridge Engineer

SUBJECT: Retaining Wall Review
Job No. _____
Job Title
Choose a County
Route __, Section __

As requested by your office via Doc Express, we have reviewed the MSE retaining wall details submitted by Fabricator for the subject project. They are in compliance with design requirements and are verified to be adequate for local and internal stability. Global stability shall be verified by Materials Division.

CRE:xxx
Attachments
Email: Materials Engineer
Concrete & Steel Fabr. Engineer

A12.4 Example - Modular Block Retaining Wall Distribution



ARKANSAS DEPARTMENT OF TRANSPORTATION
 ARDOT.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director
 10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2000

INTEROFFICE MEMORANDUM

Date

TO: Mr. David Henning, State Construction Engineer

FROM: Rick Ellis, Bridge Engineer

SUBJECT: Modular Block Retaining Wall Review
 Job No. _____
Job Title
Choose a County
 Route __, Section __

As requested by your office via Doc Express, we have reviewed the Modular Block retaining wall details submitted by Fabricator for the subject project and they are in compliance with design requirements. The proposed Versa-Lok retaining wall system submitted separately is on the Department's QPL and is acceptable.

CRE:xxx
 Attachments
 Email: Materials Engineer
 Concrete & Steel Fabr. Engineer

A12.5 Example - Gravity Block Retaining Wall



ARKANSAS DEPARTMENT OF TRANSPORTATION

ArDOT.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director

10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2000

INTEROFFICE MEMORANDUM

Date

TO: Mr. David Henning, State Construction Engineer

FROM: Rick Ellis, Bridge Engineer

SUBJECT: Gravity Block Retaining Wall Review
Job No. _____
Job Title
Choose a County
Route __, Section __

As requested by your office via Doc Express, we have reviewed the submittal of the Gravity Block retaining wall for the subject project. They are in compliance with design requirements and are verified to be adequate for local and internal stability. Global stability shall be verified by Materials Division.

CRE:xxx
Attachments
Email: Materials Engineer

A12.6 Example - Aggregate Pier Distribution



ARKANSAS DEPARTMENT OF TRANSPORTATION

ARDOT.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director

10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2000

INTEROFFICE MEMORANDUM

Date

TO: Mr. David Henning, State Construction Engineer

FROM: Rick Ellis, Bridge Engineer

SUBJECT: Foundation Improvement – Aggregate Piers
Job No. _____
Job Title
Choose a County
Route __, Section __

As requested by your office via Doc Express, we have reviewed the attached details for the Aggregate Piers used for foundation improvement at the MSE retaining walls on the subject project. They are in compliance with design requirements.

CRE:xxx
Attachments
Email: Materials Engineer

A12.7 Example - Shop Drawing Transmittal Form



ARKANSAS DEPARTMENT OF TRANSPORTATION

ArDOT.gov | IDriveArkansas.com | Lorie H. Tudor, P.E., Director

BRIDGE DIVISION

10324 Interstate 30 | P.O. Box 2261 | Little Rock, AR 72203-2261 | Phone: 501.569.2361 | Fax: 501.569.2623

TO: _____

DATE: _____
JOB NO. _____
BRIDGE NO. _____

RETURNED FOR CORRECTION:

DRAWING NO(S). _____

NOTES _____

CORRECT AND RETURN FOR DISTRIBUTION: _____ 11" X 17" PRINTS

APPROVED FOR FABRICATION: (NO FABRICATION SHALL BE ACCOMPLISHED PRIOR TO DISTRIBUTION OF APPROVED PRINTS)

DRAWING NO(S). _____

NOTES _____

ADDITIONAL PRINTS NEEDED FOR DISTRIBUTION: _____ 11" X 17" PRINTS

 Charles R. Ellis
 Bridge Engineer

CRE:xxx
 Attachments

Appendix A13

Archival

A13.1 Bridge Designs Preparation for Digitizing	A13-1
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A13.1 Bridge Designs Preparation for Digitizing

EXAMPLE ORGANIZATION USING HEADER SHEETS FOR **SINGLE** BRIDGE JOB

1	2	3
JOB NO. _____ BRIDGE NO. _____ ROUTE _____ FEATURE INTERSECTED _____	CORRESPONDENCE	LAYOUT DEVELOPMENT
4	5	
SUPERSTRUCTURE DESIGN	SUBSTRUCTURE DESIGN	

**EXAMPLE ORGANIZATION USING HEADER SHEETS
FOR MULTIPLE BRIDGE JOB**

1	2	3
<p>JOB NO. _____</p> <p>BRIDGE NOS. _____ _____</p> <p>(List all bridge nos. in job on this header)</p> <p>ROUTE _____</p>	<p align="center">CORRESPONDENCE (Place all job correspondence documents to be retained after this header)</p> <p align="center"><i>Documents of this type will be repeated by Records Management for each bridge in the job.</i></p>	<p>BRIDGE NO. <u>(1)</u> _____</p> <p>FEATURE INTERSECTED _____</p> <p align="center">LAYOUT DEVELOPMENT (Place all documents of this type for first bridge after this header)</p>
4	5	6
<p>BRIDGE NO. <u>(1)</u> _____</p> <p>FEATURE INTERSECTED _____</p> <p align="center">SUPERSTRUCTURE DESIGN (Place all documents of this type for first bridge after this header)</p>	<p>BRIDGE NO. <u>(1)</u> _____</p> <p>FEATURE INTERSECTED _____</p> <p align="center">SUBSTRUCTURE DESIGN (Place all documents of this type for first bridge after this header)</p>	<p>BRIDGE NO. <u>(2)</u> _____</p> <p>FEATURE INTERSECTED _____</p> <p align="center">LAYOUT DEVELOPMENT (Place all documents of this type for second bridge after this header)</p>
7	8	
<p>BRIDGE NO. <u>(2)</u> _____</p> <p>FEATURE INTERSECTED _____</p> <p align="center">SUPERSTRUCTURE DESIGN (Place all documents of this type for second bridge after this header)</p>	<p>BRIDGE NO. <u>(2)</u> _____</p> <p>FEATURE INTERSECTED _____</p> <p align="center">SUBSTRUCTURE DESIGN (Place all documents of this type for second bridge after this header)</p>	<p align="center">REPEAT SEQUENCE AS NECESSARY FOR ALL BRIDGES IN JOB</p>

References

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- [3] AASHTO. *LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*. American Association of State Highway and Transportation Officials, 444 North Capitol Street, NW, Suite 249, Washington, DC 20001, 1st edition, 2010.
- [4] AASHTO. *A Policy on Geometric Design of Highways and Streets*. American Association of State Highway and Transportation Officials, 444 North Capitol Street, NW, Suite 249, Washington, DC 20001, 6th edition, 2011.
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- [17] P.F. Lagasse, L.W. Zevenbergen, J.D. Schall, and P.E. Clopper. Bridge scour and stream instability countermeasures: Experience, selection, and design guidance-third edition, volume 2, hydraulic engineering circular 23. Technical Report FHWA-NHI-09-112, Federal Highway Administration and National Highway Institute, FHWA, Room 3203, 400 Seventh Street, SW, Washington, D.C. 20590, September 2009.
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