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END OF DOCUMENT
PREFACE

I. ALDOT POLICY STATEMENT

All bridge and miscellaneous transportation structures in Alabama shall be designed in accordance the ALDOT Structures Design Manual except as noted herein.

II. PURPOSE AND SCOPE

This manual contains specific design criteria policies mandated by the ALDOT Bridge Bureau applying equally to ALDOT as well as consultants completing structural designs. The primary purpose of this manual is:

- To provide interpretation and consistency in the application of the AASHTO LRFD Bridge Design Specifications.
- To encourage the uniform preparation of plans and specifications.
- To provide direction to be followed on projects under the authority or oversight of the Bridge Bureau, unless exceptions are approved by the State Bridge Engineer.

Exceptions, based on sound engineering principles and judgment, are expected. Structural plans and specifications must clearly communicate the design intent and construction requirements of each project. This manual is targeted for internal Bridge Bureau use; however, Consultants preparing designs for projects to be let through ALDOT are expected to follow the directives noted herein.

The contents of this manual generally follow the section headings of the AASHTO LRFD Bridge Design Specifications. ALDOT exceptions to specific requirements of the AASHTO LRFD Bridge Design Specifications are indicated as follows:

**ALDOT exception to AASHTO:**

A description of the ALDOT exception is given here.

This manual will be continually updated as revisions and improvements are warranted. Any questions, comments, concerns, and/or suggestions are welcomed and should be submitted to:
III. DESIGN METHOD/SPECIFICATIONS

All bridge and miscellaneous transportation structures in Alabama shall be designed using Load and Resistance Factor Design (LRFD), unless otherwise directed by the State Bridge Engineer. The governing design specification for all bridges and miscellaneous transportation structures in Alabama shall be the *AASHTO LRFD Bridge Design Specifications*, Eighth Edition, applicable Interims along with any notations and exceptions indicated herein. Within this manual, the *AASHTO LRFD Bridge Design Specifications* is referred to as *AASHTO LRFD*. Other AASHTO Specifications, Guide Specifications and the ALDOT Standard Specifications shall also apply as appropriate.

Consultant prepared designs, whether prepared directly for the Bridge Bureau or any other office in the Department, shall be submitted according to the requirements given in the Administrative Code of the Board of Registration for Professional Engineers and Land Surveyors, Chapter 330-X-11-.03.

IV. RELATED ALDOT MANUALS/DOCUMENTS

Other documents maintained and/or used by the ALDOT Bridge Bureau include the following:

- Bridge Plan Development QC/QA Plan and Checklist
- ALDOT Guide for Developing Construction Plans
- Bridge Special Project Drawings
- ALDOT Standard Specifications for Highway Construction
- ALDOT Special and Standard Highway Drawings
- Quality Control Manual for Bridge Plan Detailing
- Guide to Developing Bridge Plans
- ALDOT Guidelines for Operation
V. APPROVAL

This document is approved for implementation and is effective as of the date shown.

William T. Colquett, PE
State Bridge Engineer

Don T. Arkle, PE
Chief Engineer

Mark Bartlett, PE
Division Administrator
FHWA Alabama Division

February 2019
SECTION 1. INTRODUCTION

The requirements of the AASHTO LRFD Section 1 shall apply to this section unless noted and/or excepted below.

1.1 LIMIT STATES

The value of the load modifier, $\eta_i$ (see AASHTO LRFD Article 1.3.2.1) and its factors, $\eta_D$, $\eta_R$, and $\eta_I$, shall all be set equal to 1.00, unless otherwise directed by the State Bridge Engineer.
SECTION 2. GENERAL DESIGN AND LOCATION FEATURES

The requirements of the AASHTO LRFD Section 2 shall apply to this section unless noted and/or excepted below.

2.1 DEFORMATIONS

Criteria for deflection is presented in AASHTO LRFD Article 2.5.2.6.2.

**ALDOT exception to AASHTO:**

Live load deflection shall be checked for both loading options as given in AASHTO LRFD Section 3.6.1.3.2

2.2 CLEARANCES

Criteria for highway vertical and horizontal clearances is presented in AASHTO LRFD Articles 2.3.3.2 and 2.3.3.3 respectively.

**ALDOT exception to AASHTO:**

Horizontal and vertical clearances for Highway Grade Separation structures shall conform to ALDOT Guidelines for Operation Sections 3-25 Bridges Vertical Clearance and 3-76 Bent or Pier Placement Criteria for Proposed Bridges Overpassing Multilane Roadways

2.3 DRAINAGE

Criteria for the Design Storm is presented in AASHTO Article 2.6.6.2.

**ALDOT exception to AASHTO:**

The design storm shall be the 10 year recurrence except where the low point of a sag vertical curve exists on the bridge wherein the 50 year recurrence shall be used. Exceptions to this policy shall have the prior approval of the Bridge Engineer.

Criteria for deck drains is presented in AASHTO Articles 2.6.6.3 and 2.6.6.4.
ALDOT exception to AASHTO:

Bridge deck drainage shall be allowed to fall freely to the ground through deck scuppers unless otherwise directed by the Bridge Engineer. Four inch diameter scuppers spaced on five foot center (maximum) shall provide deck drainage for a normal crowned section with eight to ten foot shoulders. In a super elevated section, four inch diameter scuppers on four foot centers shall be used unless hydraulic calculations indicate that different scuppers and/or spacing is required. Scuppers shall be omitted over pier caps, roadway lanes, and railroad right-of-way. Larger scuppers or deck drain inlets may be required if the above design is not adequate or if a closed system is required.
SECTION 3. LOADS AND LOAD FACTORS

The requirements of AASHTO LRFD Section 3 shall apply to this section unless noted and/or excepted below.

3.1 PERMANENT LOADS

The following loads shall be used:

- Metal stay-in-place forms for bridge decks (as applicable) – Allow 15 psf dead load (this includes the dead weight concrete in the forms).

- Barrier rail load – The barrier rail dead load shall be considered equally distributed across all girders. However, the dead load for girder design shall not be less than 25% of a single barrier rail weight.

3.2 WATER AND WIND LOADS

- Bridges exposed to coastal influences shall be designed in accordance with the latest AASHTO Guide Specifications for Bridges Vulnerable to Coastal Storms.

3.3 TEMPERATURE FORCE EFFECTS

- Thermal baseline shall be set at 70°F.
SECTION 4. STRUCTURAL ANALYSIS AND EVALUATION

The methods of analysis described in AASHTO LRFD Section 4 shall apply to this section unless noted and/or excepted below.

ALDOT has no analysis and evaluation considerations beyond those covered in the AASHTO LRFD Bridge Design Specifications.
SECTION 5. CONCRETE STRUCTURES

The provisions of AASHTO LRFD Section 5 shall apply to this section unless noted and/or excepted below.

5.1 CONCRETE COMPRESSIVE STRENGTHS

- Reinforced Concrete:

  Designers shall refer to the current edition of the ALDOT Standard Specifications for strengths to be used in different structures. Plan sheets of various structural members shall list the concrete strength for that member.

  Superstructure (including barrier rails and deck) and substructure (including footings [except as noted below] and drilled shafts) concrete strength ($f'_c$) shall be 4.0 ksi.

  Retaining wall and cast-in-place box culvert concrete strength ($f'_c$) shall be 4.0 ksi.

  Seal footing and miscellaneous drainage structure concrete strength ($f'_c$) shall be 3.0 ksi.

  Greater concrete strengths may be utilized when required by design, subject to prior approval by the State Bridge Engineer, and shall be noted accordingly on the contract drawings.

- Prestressed Concrete:

  The following values of $f'_c$ shall be used for these structures:

<table>
<thead>
<tr>
<th>Bridge Component</th>
<th>$f'_c$ (ksi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piles</td>
<td>5.0 to 6.0</td>
</tr>
<tr>
<td>Girders</td>
<td>5.0 to 8.0*</td>
</tr>
</tbody>
</table>

  * Higher strengths will require prior approval by the State Bridge Engineer

  For prestressed concrete members, specific concrete strengths used for design and specified for fabrication shall be stated on the contract drawings.
5.2 PRESTRESSED CONCRETE GIRDER DESIGN POLICY

The following policies shall be used for the design of prestressed concrete girders:

1. The following standard shape AASHTO-PCI type girders are preferred: Type I, Type II, Type III, BT-54, BT-63, and BT-72, as well as solid and voided slab beams. Modifications of these girders or other girder types may be proposed for use in special circumstances and shall have the approval of the State Bridge Engineer prior to implementation.

2. Girders shall be designed as simple spans for all dead and live loads. Spans shall not be made continuous for live load. To eliminate joints, decks may be made continuous (link slabs).

3. The transformed area of bonded reinforcement shall not be included in the calculations of section properties for prestressed concrete girders.

4. Pretensioning strands shall be 0.5 or 0.6 inches in diameter, low relaxation, 270 ksi Ultimate Tensile Strength. Use strand areas as follows:
   a. For 0.5" dia. low relaxation strand, use $A = 0.153 \text{ sq. inches}$
   b. For special 0.5" dia. low relaxation strand, use $A = 0.167 \text{ sq. inches}$
   c. For 0.6" dia. low relaxation strand, use $A = 0.217 \text{ sq. inches}$

5. Girders shall be designed so that no tension occurs in the bottom of the girder after losses under the Service III load combination limit state. In no case shall tension in Service III conditions exceed $0.0948 \sqrt{f'c} \text{ (ksi)}$. Exceptions to this policy shall require prior approval of the State Bridge Engineer.

6. Girder shear steel reinforcement shall not be spaced greater than 18 inches on center. Shear steel reinforcement in the girder ends shall be spaced 4 inches on center and shall extend from the end of the girder for a distance equal to the girder depth. Shear steel reinforcement shall be spaced so that no additional reinforcement is necessary to address horizontal shear forces at the top of the girder. Confinement steel reinforcement shall be #3 spaced at 4" and shall extend from the end of the girder for a distance equal to the beam depth. Vertical shear steel reinforcement shall be no smaller than #5. Shear steel reinforcement shall extend above the top of the girder to engage the slab at approximate mid-depth with a standard 90° hook.

7. Calculation of camber due to prestress prior to pouring the bridge deck shall be based on a 60-day interval between release of the strand and erection of the girder.

8. Debonding of prestressed concrete girders shall be as given in AASHTO LRFD Section 5.11.4.3.
9. For calculating losses, use the *AASHTO LRFD Approximate Method*, neglecting gains. The following values shall be used for calculating losses:

- Time at release: 0.75 days
- Age of deck placement: 60 days
- Final age: 27,500 days
- Relative Humidity: 75%

10. Section 5.10.10.1 – Splitting Resistance, of the AASHTO LRFD Section, Pretensioned Anchorage Zones, has the following paragraph:

“The resistance shall not be less than four percent of the total prestressing force at transfer”

ALDOT defines, “…force at transfer”, to be the stress inducing force in the girder end at release.

11. For purposes of mitigating horizontal cracking in girder webs at the ends, draped strands should have an angle of incidence no larger than 1.75 degrees from horizontal along with de-bonding of straight strands. *(Research has indicated that horizontal cracking in the web of bulb tees at girder ends results from tensile stresses induced by moments created by forces from both draped and straight strands. It suggests, to the largest extent possible, lowering the drape angle below that noted above along with de-bonding the straight strands. It also recommended dropping the usual practice of including short horizontal bars in the webs (for ALDOT known as M bars) as they are of little value in mitigating the cracking issue.)*

12. The following shall be shown on the prestress camber diagram for the ends of the prestressed concrete girder:

- Girder depth
- Haunch thickness
- Deck thickness
- Total deck plus haunch thickness
- Theoretical camber
- Dead load deflection

The reporting format for this information is graphically presented in the Quality Control Manual for Bridge Plan Detailing.
13. A minimum one inch haunch shall be provided at girder mid-span, calculated at the critical edge of the girder flange. Minimum buildup at girder ends shall take into consideration vertical curve, superelevation transition, or other complex roadway geometry. The build-up should be investigated for each girder line and adjusted as necessary.

5.3 INTERMEDIATE DIAPHRAGMS

For concrete girders, intermediate diaphragms shall be used only when required by calculation and shall be concrete.

5.4 STEEL REINFORCEMENT

Steel grade shall be as stated in the ALDOT Standard Specifications and shall also be stated on bridge plan sheets where reinforcing steel is called for.

The following design clearances (concrete cover) shall be used for reinforced concrete structures: See Section 3.3.3 of the Quality Control Manual for Bridge Plan Detailing.

The following reinforcing steel spacing requirements shall be satisfied:

1. Criteria for minimum and maximum spacing of reinforcement shall be in accordance with AASHTO LRFD Article 5.10.3.

**ALDOT exception to AASHTO:**

The maximum spacing of flexural reinforcement shall not exceed 9 inches.

2. Where flexural reinforcement is placed in two or more layers, bars in the upper layers shall be placed directly above the bottom layer with layers not less than 4 inches on center.
SECTION 6. STEEL STRUCTURES

The provisions of AASHTO LRFD Section 6 shall apply to this section unless noted and/or excepted below.

6.1 MATERIALS

Main members (such as girders, rolled beams, lateral bracing, diaphragms, stiffeners, and vertical connection plates) shall be AASHTO M 270 Grade 36, Grade 50, or Grade 70.

The use of weathering steel is prohibited.

Miscellaneous members (such as armor plates, ladders, catwalks, and clip angles) shall be AASHTO M 270 Grade 36 or Grade 50.

Anchor bolts shall conform to AASHTO M 314.

6.2 GIRDER DESIGN POLICY

The following policies shall be used for the design of steel girders:

1. Girders shall be designed as a composite section in the region where the concrete slab is in compression under dead load. For continuous girders, the regions where the slab is in tension shall be designed as non-composite.

2. Flange plates shall be a minimum of 1 inch thick and 12 inches wide.

3. Use of hybrid sections (flange and web of different materials) in bridge sections (such as over bents) shall require prior approval of the State Bridge Engineer.

4. Shop flange splices required by a change in plate thickness or width shall not be used unless a minimum of 1,500 pounds of structural steel can be saved by the addition of the shop splice.

5. The minimum radius for heat curving of beams and girders shall be checked in accordance with AASHTO LRFD Article 6.7.7.2. The plans shall note if heat curving is prohibited by the specifications.

6. Fabrication, transportation, and erection of structural steel members shall be considered during design. The length of shipped pieces (girder flanges and web) joined by bolted field splices shall not exceed 140 feet, and the gross weight of shipped pieces shall not exceed 50 tons. Longer pieces shall require the prior approval of the State Bridge Engineer.
7. The following two sets of camber ordinates shall be calculated and shown:
   1. Camber due to dead load of steel only.
   2. Total non-composite dead load camber (dead load of both steel and concrete).

Camber ordinates shall be calculated and shown at the same points required for finished grade elevations, as follows:

- Camber ordinates at tenth points shall be provided on the plans for all simple and continuous spans.
- Camber ordinates at twentieth points shall be provided for spans greater than 100 feet in length.

8. Minimum edge distances shall be as follows in the following table:

<table>
<thead>
<tr>
<th>ALDOT exception to AASHTO:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolt Diameter</td>
</tr>
<tr>
<td>In.</td>
</tr>
<tr>
<td>7/8</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>1-1/8</td>
</tr>
<tr>
<td>1-1/4</td>
</tr>
</tbody>
</table>

9. The minimum fillet weld size shall be as shown below. Using this table, the minimum weld size shall be determined by the thicker of the two parts joined. The minimum fillet weld size shall be used unless a larger size is required by design based on the calculated stress. The weld size need not exceed the thickness of the thinner part joined. Fabrication of ancillary members, as defined in the currently used AWS Bridge Welding Code, is exempted from these requirements.

<table>
<thead>
<tr>
<th>Material Thickness of Thicker Part Joined</th>
<th>Minimum Size of Fillet Weld (Inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>To ¾” inclusive</td>
<td>1/4</td>
</tr>
<tr>
<td>Over ¾” to 1½”</td>
<td>5/16</td>
</tr>
<tr>
<td>Over 1½” to 2¼”</td>
<td>3/8</td>
</tr>
<tr>
<td>Over 2¼” to 6”</td>
<td>1/2</td>
</tr>
</tbody>
</table>
For additional guidance regarding design considerations for fabrication, transportation, and erection of structural steel members, the designer is encouraged to refer to AASHTO/NSBA Steel Bridge Collaboration Manual G12.1-2016, *Guidelines for Design for Constructability*.

### 6.3 SHEAR CONNECTORS

Shear connectors shall conform to criteria given in AASHTO LRFD Section 6.10.10.

**ALDOT exception to AASHTO:**

In addition to LRFD requirements, shear connectors shall only be studs with a minimum length of 5 inches and shall conform to AASHTO M 169.

### 6.4 SHOP CONNECTIONS

During fabrication of steel girders, the following policies shall be used for shop connections:

1. All shop-welded joints shall be made using pre-qualified joints for bridge applications of the current ANSI/AASHTO/AWS code adopted by ALDOT, modified in accordance with the provisions of the Standard Specifications and Special Provisions.

2. Intersecting welds shall not be permitted.
   a. Corners of transverse stiffeners shall be clipped and welded as follows:
      1) Stiffener-to-web welds shall be terminated 1 inch plus or minus ¼ inch from the clip.
      2) Stiffener-to-flange welds shall be terminated ½ inch plus or minus ¼ inch from the clip and the edges of the stiffener plate.
   b. Longitudinal stiffeners shall be cut back a minimum of 2 inches to avoid intersecting welds.

3. When design lengths of web and flange plates exceed available lengths from rolling mills, material may be shop spliced utilizing pre-qualified full penetration butt welds at approximately the one-quarter and/or three-quarter point of the required material lengths. Shop welded flange splices shall be a minimum of 2 feet from shop web splices.
6.5 FIELD CONNECTIONS

Bolted connections shall be made using 7/8-inch diameter (minimum) ASTM F3125 Grade A325 High Strength Bolts in standard sized holes. Holes in gusset plates for lateral bracing member connections may be oversized (hole spacing and edge distances must be increased also). All bolts, nuts and washers shall be mechanically galvanized in accordance with ASTM B695 Class 50.

Field welding is prohibited except for attachment of bearings, shear studs, armor plate splices, pile cap plates and channels and swaybracing.
SECTION 7. ALUMINUM STRUCTURES

The provisions of AASHTO LRFD Section 7 shall apply to this section unless noted and/or excepted below.

ALDOT has no design considerations beyond those covered in the AASHTO LRFD Bridge Design Specifications.
THIS PAGE INTENTIONALLY LEFT BLANK
SECTION 8. WOOD STRUCTURES

The provisions of AASHTO LRFD Section 8 shall apply to this section unless noted and/or excepted below.

ALDOT has no design considerations beyond those covered in the AASHTO LRFD Bridge Design Specifications.
SECTION 9. DECKS AND DECK SYSTEMS

The provisions of AASHTO LRFD Section 9 shall apply to this section unless noted and/or excepted below.

9.1 REINFORCED CONCRETE DECKS

The State Bridge Engineer has furnished a table that addresses the design of the bridge deck slab. This table is presented in Figure 9-1(page 9-2). Required slab thickness and reinforcement based on girder type and girder spacing are provided in the table. Designs shall be prepared based on this information. Any exceptions will require prior approval of the State Bridge Engineer.
FIGURE 9.1 ALDOT STANDARD BRIDGE DECK – HL93

NOTE: FOR STEEL REINF. IN BARRIER RAIL, SEE BRIDGE SPECIAL PROJECT DRAWING EDR-1 OR EDR-2

STEEL REINF. AT GDR. OVERHANG
(TYP. FOR ALL GIRDERS TYPES)

STEEL CDR.

\[ W = \frac{(X) - F}{5} + \frac{F}{2} + 2" \]

\[ S = \frac{(X) - F}{2} \]

AASHTO CDR. & R.C.D.G.

\[ W = \frac{(X) - F}{5} + \frac{F}{2} + 2" \]

\[ S = (X) - F \]

BULB-TEE CDR.

\[ W = \frac{S}{4} + \frac{F}{2} + 2" \]

\[ S = (X) - F \]

USE NEAREST "S" VALUE, IF 1/2 WAY BETWEEN USE HIGHER "S" VALUE.

<table>
<thead>
<tr>
<th>S</th>
<th>D</th>
<th>TRANS. REINF.</th>
<th>BARS E</th>
<th>AS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4’</td>
<td>7’</td>
<td>5” 5”</td>
<td>6” 5”</td>
<td>.57</td>
</tr>
<tr>
<td>4.5’</td>
<td>7’</td>
<td>5” 5”</td>
<td>6” 5”</td>
<td>.57</td>
</tr>
<tr>
<td>5’</td>
<td>7”</td>
<td>5” 5”</td>
<td>5/2” 5”</td>
<td>.57</td>
</tr>
<tr>
<td>5.5’</td>
<td>7”</td>
<td>5” 5”</td>
<td>5/2” 5”</td>
<td>.62</td>
</tr>
<tr>
<td>6’</td>
<td>7”</td>
<td>5” 5”</td>
<td>5/4” 6”</td>
<td>.68</td>
</tr>
<tr>
<td>6.5’</td>
<td>7”</td>
<td>5” 5”</td>
<td>5/4” 6”</td>
<td>.68</td>
</tr>
<tr>
<td>7’</td>
<td>7”</td>
<td>5” 5”</td>
<td>5” 7”</td>
<td>.68</td>
</tr>
<tr>
<td>7.5’</td>
<td>7”</td>
<td>5” 5”</td>
<td>5” 7”</td>
<td>.71</td>
</tr>
<tr>
<td>8’</td>
<td>7”</td>
<td>5” 5”</td>
<td>5” 8”</td>
<td>.74</td>
</tr>
<tr>
<td>8.5’</td>
<td>7”</td>
<td>5” 5”</td>
<td>5” 9”</td>
<td>.74</td>
</tr>
<tr>
<td>9’</td>
<td>7”</td>
<td>5” 5”</td>
<td>4/2” 10</td>
<td>.83</td>
</tr>
<tr>
<td>9.5’</td>
<td>7”</td>
<td>5” 5”</td>
<td>4/2” 11</td>
<td>.83</td>
</tr>
<tr>
<td>10’</td>
<td>7”</td>
<td>5” 5”</td>
<td>4/2” 11</td>
<td>.83</td>
</tr>
</tbody>
</table>

ALDOT STANDARD BRIDGE SLAB – HL 93 (REV. 11-13)
9.2 INCREMENTAL DECK FINISH GRADE ELEVATIONS

Incremental deck finish grade elevations shall be computed and tabulated in the plans for all spans except those on zero percent grade and on straight grades (no vertical curve). This criterion applies to bridges in tangent and in horizontal curvature. Spans where superelevation transitions fall on the bridge, whether zero percent or straight grades, shall include incremental deck finish grade elevations.

This data shall be furnished at gutterlines and centerlines of girders from centerline of bearing to centerline of bearing. For spans 100 feet or less, elevations shall be furnished at span tenth points between bearings, for spans greater than 100 feet elevations shall be furnished at span twentieth points.
SECTION 10. FOUNDATIONS

The provisions of AASHTO LRFD Section 10 shall apply to this section unless noted and/or excepted below.

10.1 SUBSTRUCTURE TYPES

For short-span structures (structures with span lengths of 50 feet or less), pile bents with reinforced concrete caps may be considered if each of the following conditions is met:

1. Calculated scour does not prohibit the use of this structure type

2. Subsurface material is such that piles can be driven to obtain a minimum of 10 feet of penetration into natural ground

Reinforced concrete framed bents (or hammerhead piers when approved by the State Bridge Engineer) should generally be used when span lengths exceed 50 feet.

ALDOT discourages the use of hammerhead piers on a single drilled shaft. Any design utilizing hammerhead piers on a single drilled shaft shall have prior approval of the State Bridge Engineer.

For designs utilizing drilled shafts, the substructure cap shall be a minimum of 6 inches wider than the column (or the drilled shaft, if the shaft extends to the bottom of the cap as shown on the contract plans).

Structural seal concrete footings shall be reinforced. Piers in navigable waterways shall be designed in accordance with Section 3.

10.2 PILE FOOTINGS – SCOUR CONSIDERATIONS

In accordance with FHWA Hydraulic Engineering Circular No. 18 guidelines, the top of footing for pile footing foundations shall be located below the streambed a depth equal to the estimated long-term degradation and contraction scour depth. All exceptions to this requirement shall have prior approval of the State Bridge Engineer. Influences such as corrosion due to exposed piling, debris collection on piling, and unbraced pile length (exposed pile below footing plus depth to fixity) shall be considered in the design of pile footing foundations whenever the top of footing is to be constructed above the estimated long-term degradation and contraction scour depth.
10.3 FOUNDATION PILING

Pile section and length shall be determined by the Load and Resistance Factor Design (LRFD) method, as modified in this and other manual sections, considering structural capacity, geotechnical capacity, and drivability. The Maximum Factored Design Load Allowed, $P_{AL}$, provided in the following tables is for foundation (footing) piles only. Pile types and sections not shown in the tables shall use the following equation to determine the load allowed. The loadings will be less for pile bents depending on the height of the bent and the condition of the subsurface. Piles without lateral support shall be designed as columns. The design policy for foundation piles shall use the following equation:

$$P_{AL} = \varphi_{AL} P_r,$$

where $\varphi_{AL} = 0.65$

Factored Structural Resistance of Piles, $P_r$, is defined by AASHTO. The Alabama factor, $\varphi_{AL}$, reduces the resistance to values representative of past Departmental experience and is used to avoid problems associated with over-stressing during driving.

Uplift in foundation piling is not allowed without prior approval of the State Bridge Engineer.

Steel “H” Piling (Grade 50 only)

HP10x42 piles shall not be used for designs where “drive to refusal” criteria are specified for pile installation.

<table>
<thead>
<tr>
<th>Pile Designation</th>
<th>With Pile Points ($\varnothing_c = 0.5$)</th>
<th>Without Pile Points ($\varnothing_c = 0.6$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10x42</td>
<td>---</td>
<td>120 tons</td>
</tr>
<tr>
<td>12x53</td>
<td>125 tons</td>
<td>150 tons</td>
</tr>
<tr>
<td>14x73</td>
<td>170 tons</td>
<td>205 tons</td>
</tr>
<tr>
<td>14x89</td>
<td>210 tons</td>
<td>250 tons</td>
</tr>
<tr>
<td>14x102</td>
<td>240 tons</td>
<td>290 tons</td>
</tr>
<tr>
<td>14x117</td>
<td>275 tons</td>
<td>335 tons</td>
</tr>
</tbody>
</table>

Table 10-1

Maximum Factored Design Load per Pile for Steel “H” Piling
Precast Prestressed Concrete Piling

Prestressed concrete piling shall be selected from Special Project Drawing No. PSCP-1.

<table>
<thead>
<tr>
<th>Size of Pile</th>
<th>Maximum Factored Design Load Allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>14-inch Square</td>
<td>155 tons</td>
</tr>
<tr>
<td>16-inch Square</td>
<td>210 tons</td>
</tr>
<tr>
<td>18-inch Square</td>
<td>260 tons</td>
</tr>
<tr>
<td>20-inch Square</td>
<td>320 tons</td>
</tr>
<tr>
<td>24-inch Square</td>
<td>400 tons</td>
</tr>
<tr>
<td>30-inch Square</td>
<td>555 tons</td>
</tr>
<tr>
<td>36-inch Square</td>
<td>730 tons</td>
</tr>
</tbody>
</table>

Table 10-2

Maximum Factored Design Load per Pile for Prestressed Piling
Precast Prestressed Spun Cast Cylinder Piling

Precast Prestressed Spun Cast Cylinder Piling is assumed to have a concrete compressive strength of 7 ksi and each tendon is made up of 2 - ½ “ diameter, 270 ksi Low Relaxation strands with an effective stress of 170 ksi.

<table>
<thead>
<tr>
<th>Diameter</th>
<th>No. of Tendons</th>
<th>Maximum Factored Design Load Allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>36&quot;</td>
<td>8</td>
<td>650 tons</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>625 tons</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>600 tons</td>
</tr>
<tr>
<td>42&quot;</td>
<td>12</td>
<td>765 tons</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>745 tons</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>720 tons</td>
</tr>
<tr>
<td>54&quot;</td>
<td>16</td>
<td>1020 tons</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>1000 tons</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>975 tons</td>
</tr>
<tr>
<td>66&quot;</td>
<td>24</td>
<td>1255 tons</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>1230 tons</td>
</tr>
<tr>
<td></td>
<td>32</td>
<td>1210 tons</td>
</tr>
</tbody>
</table>

Table 10-3

Maximum Factored Design Load per Pile for Spun Cast Cylinder Piling

10.4 GEOTECHNICAL COORDINATION

Until the Materials & Tests Bureau can develop a sufficient data base upon which to base their load and resistance factor designs, the following information shall be provided when requesting foundation design information:

1) Substructure type and location
2) Number of piles/shafts
3) LRFD Service I per pile/ shaft (tons)
4) LRFD Strength I per pile/ shaft (tons)
5) Elevation at Load ‘P’
6) Pile/shaft size

Extreme Event II will only be reported for stream crossings
SECTION 11. WALLS, ABUTMENTS AND PIERS

The provisions of AASHTO LRFD Section 11 shall apply to this section unless noted and/or excepted below.

11.1 SUBSTRUCTURE

For design criteria, refer to Sections 5 and 10 of this Manual.

11.2 RETAINING WALLS

The Department’s Special and Standard Drawings book has retaining wall details to address fill heights of up to 34 feet. These details are provided on Standard Drawing No. RW 10-4. For fill heights greater than 34 feet requiring special design, the engineer shall be responsible for providing a design that satisfies the latest AASHTO design requirements. Unless geometrics or foundation conditions dictate otherwise, information shown on Standard Drawing No. RW 10-4 shall be used as guidance in preparing the necessary plan details.

Responsibility for design and details of retaining walls shall be as follows:

- Temporary retaining walls – The contractor shall be responsible for providing the design and details for all temporary retaining walls.

- Permanent conventional walls – The Bridge Bureau shall be responsible for providing the design and details for all permanent conventional retaining walls unless a consultant has been contracted to provide such items as part of a complete set of plans.

- Permanent proprietary walls – The contractor shall be responsible for providing the design and details for all permanent proprietary retaining walls.
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SECTION 12: BURIED STRUCTURES AND TUNNEL LINERS

The provisions of AASHTO LRFD Section 12 shall apply to this section unless noted and/or excepted below.

12.1 REINFORCED CONCRETE BOX CULVERTS

The Hydraulic Section of the Bridge Bureau is responsible for sizing all bridge culverts. The Hydraulic Section is responsible for recommending whether the culvert shall be cast-in-place or precast, and the culvert type shall be shown on the roadway plans. The Bridge Bureau (or a selected consultant) is responsible for the design and details of cast-in-place culverts and for reviewing the contractor's structural details for precast culverts. The State Bridge Engineer will furnish culvert details (standards) as needed.

- Cast-In-Place Culverts

The Bridge Bureau (or a selected consultant) is responsible for the design and details of all cast-in-place concrete box culverts, open bottom culverts that are to be constructed on sound rock foundation, and special culvert or special hydraulic structures. The Roadway Designer is responsible for providing the basic geometric, fill height, and slope information needed for the design and detailing of the hydraulic structure.

- Precast Culverts

The structural design and details for precast culverts shall conform to the provisions of ASTM C 1577 (using LRFD design methodology). For culvert openings and fill heights not covered in this specification, the contractor shall submit a design (prepared and stamped by an Alabama Registered Professional Engineer not employed by the Alabama Department of Transportation) to the State Bridge Engineer for approval in accordance with the Standard Specifications. The Bridge Bureau is responsible for the review of the details and designs submitted.
SECTION 13: RAILINGS

The provisions of AASHTO LRFD Section 13 shall apply to this section unless noted and/or excepted below.

13.1 BRIDGE RAILINGS

Use bridge railing as detailed on Bridge Special Project Drawing BBR-1, BBR-2 or BBR-M as appropriate. Use approach railing and/or barrier as per roadway standard drawings and/or plans.

ALDOT exception to AASHTO:

Bridges on secondary roads and other non-interstate roadways, Federal highways, or State roads may continue to use the TL-3 Jersey rail.
SECTION 14: JOINTS AND BEARINGS

The requirements of AASHTO LRFD Section 14 shall apply to this section unless noted and/or excepted below.

14.1 EXPANSION JOINTS

Generally, use armor plate open joints as shown on Bridge Special Project Drawing SBD-1. For bridges with high skews or other unusual joint situations for which the guidelines below might not apply, an alternate arrangement may be proposed to the Bridge Engineer for approval.

Typically, joints shall be set for a 1½" opening (perpendicular to joint) at 70°F unless otherwise required and subsequently indicated on the plans. The calculated minimum joint opening should be no less than ½". When the calculated maximum joint opening exceeds 3", a structural steel expansion dam shall be used.

Example drawings of current expansion dam (finger joint) details are shown in the Quality Control Manual for Bridge Plan Detailing or are available by contacting the State Bridge Engineer. Finger tooth joints shall be constructed with a continuous neoprene trough (minimum 3/16 inches thick) for the full length of the joint.

14.2 BEARING DEVICES

Bearings shall preferably be elastomeric Type 2, Type 4, or Type 5, in accordance with the Standard Specifications. Type 1 bearings are approved for use only on short span precast structures.

Elastomeric bearings shall be designed using “Method A,” as described in the currently adopted edition of AASHTO LRFD Article 14.7.6, with a durometer hardness of 50 for laminated pads and a durometer hardness of 60 for plain pads. The minimum distance from the edge of the elastomer (or the corner of the elastomer when bearings are skewed relative to the cap) to the edge of the cap or pedestal shall be 4 inches.

14.3 ANCHOR BOLTS

Anchor bolts shall be set in corrugated anchor bolt wells. See Bridge Special Project Drawing SBD-1 and the Quality Control Manual for Bridge Plan Detailing for pedestal, anchor bolt and anchor bolt well details. For anchor bolts with diameters larger than those specified on Special Project Drawing SBD-1, the anchor bolt well diameter should be increased proportionally. A minimum of 5 ½” should be provided between the edge of the cap or pedestal and the centerline of the anchor bolt.
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SECTION 15: DESIGN OF SOUND BARRIERS

The provisions of AASHTO LRFD Section 15 shall apply to this section unless noted and/or excepted below.

ALDOT has no design considerations beyond those covered in the AASHTO LRFD Bridge Design Specifications.
SECTION 16: BRIDGE RATING

Bridges designed in-house with LRFD shall be analytically load rated in accordance with the requirements of the current AASHTO Manual For Bridge Evaluation and the FHWA October 30, 2006, policy memorandum on Bridge Load Ratings for the National Bridge Inventory (available at http://www.fhwa.dot.gov/bridge/nbis/103006.cfm) using the current Posting Trucks as shown in Figure 16.1. Rating models for pre-stressed girder bridges, steel girder bridges, and steel reinforced concrete bridges will be built on the most current version of the AASHTO Bridgeware bridge rating program. When a bridge rating model is completed, the Maintenance Bureau shall be notified with the results in writing.

Bridges designed by consultants shall be rated by the consultant, using the same parameters as noted above. If the consultant does not have the AASHTO Bridgeware bridge rating program, then the rating program used shall be able to produce a bridge model that can be imported into the Department’s version of Bridgeware. The consultant shall provide the Bridge Bureau with the rating results in electronic format and a compatible bridge model when or before the final contract drawings are delivered.
Figure 16.1
ALDOT Posting Vehicles
SECTION 17: STRUCTURES FOR TRAFFIC CONTROL DEVICES AND HIGHWAY LIGHTING

All structures shall be designed in accordance with the requirements of the ALDOT Standard Specifications section 718.03(a)2 unless noted and/or excepted below.

17.1 OVERHEAD HIGHWAY SIGN STRUCTURES


- Overhead Sign Bridge (OHSB) and Overhead Cantilever (OHC):
  The contractor is responsible for submitting completed design(s) of required overhead sign structures as well as the accompanying foundation(s) with details, including shop drawings, in accordance with Standard Specification Section 715, Overhead Roadway Sign Structures, and Standard Specification Section 718, Structures for Traffic Control Devices and Highway Lighting.

- Bridge Mounted and OHSB or OHC Mounted to Bridge Substructure:
  Definitions:
  - Sign Structure – The structure that is attached to a bridge member providing support to the sign brackets.
  - Sign Brackets – The structural members to which the sign is directly attached.
  The Bridge Bureau or consultants under direct contract with the Department shall be responsible for providing the design and details for bridge-mounted signs or sign structures mounted to a bridge substructure. The contractor is responsible for submitting shop drawings in accordance with Standard Specification Section 715, Overhead Roadway Sign Structures and Standard Specification Section 718, Structures for Traffic Control Devices and Highway Lighting.

- Re-evaluation of Existing OHSB or OHC:
  The Bridge Bureau or a consultant under direct contract with the Department shall be responsible for re-evaluating existing OHSB or OHC sign structures where additional signage is needed or existing signs are replaced with larger ones. The Specification and design methodology used to design the structure shall be the specification and design methodology used to conduct the analysis.
SECTION 18: PRE-CAST BRIDGES

The context of Pre-Cast Bridges used here refers to bridges consisting of pre-cast concrete bridge components and are normally used for bridges located on off-system roadways. These include pre-cast superstructure channel beams, pre-cast barrier rail, pre-cast abutment caps, pre-cast intermediate bent caps, abutment and wing panels.

The Bridge Bureau maintains an inventory of Bridge Special Project Drawings that contain standard details (includes spans, barrier rail, abutments and bents) for span lengths of 24, 34 and 40 feet and for bridge widths (gutter to gutter) of 24.5, 28 and 40 feet.
APPENDIX A: PROCEDURE FOR PROPOSING CHANGES TO THE DESIGN MANUAL

To effect a change to the document:

1) copy & paste the passage in question into an e-mail twice

2) on the second paste, make the proposed change, with all changes in color (deletions in red, additions in blue)

3) send the e-mail to the Miscellaneous Structures and Bridge Design Section Supervisor for distribution to the Design Manual Oversight Committee and resolution.
APPENDIX B: RECORD OF REVISIONS

Modifications reflected in this version (month year) of the Design Manual include:

1. Entire Manual

Re-write and update for AASHTO LRFD 8th Edition - February 2019