CHAPTER 2 – GENERAL DESIGN AND LOCATION FEATURES

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2.2—DEFINITIONS

The following shall supplement *A2.2*.

BDEM—LADOTD Bridge Design and Evaluation Manual.

Chief Engineer—The chief of LADOTD Office of Engineering.

Design Speed—A selected speed used to determine the various design features of the roadway. The design speed for each roadway classification is defined in LADOTD Minimum Design Guidelines approved by Chief Engineer. These guidelines can be found in Bridge Design Section website under downloads.

EDSM—LADOTD Engineering Directives and Standards Manual. This manual is posted on LADOTD website.

EOR (Engineer of Record)—The Professional Engineer registered in the State of Louisiana in responsible charge (direct control and personal supervision) of the work. The EOR may be LADOTD in-house staff or a consultant retained by the Department.

Permit Coordinator—The person who is responsible for securing permits (except for the railroad permit) required for LADOTD projects.

Railroad Permit Coordinator—The person who is responsible for securing the railroad permit agreement from railroad companies for LADOTD projects.

2.3—LOCATION FEATURES

2.3.1—Route Location

2.3.1.2—Waterway and Floodplain Crossings

The following shall supplement *A2.3.1.2*.

Refer to LADOTD Hydraulics Manual, which is posted on LADOTD website, for the Department’s hydraulic design policies. Where conflict exists between AASHTO provisions and the Hydraulic Manual, LADOTD Hydraulic Design Unit should be contacted to resolve differences.

2.3.2—Bridge Site Arrangement

2.3.2.2—Traffic Safety

2.3.2.2.1—Protection of Structures

The following shall supplement *A2.3.2.2.1*.

Refer to *LADOTD Guard Rail Standard Plans, EDSM II.3.1.3—Guard Rail, EDSM II.3.1.4—Guardrail, Other Bridge Rail End Treatment, Curbs and Sidewalks on Urban Bridges, and BDEM Part II, Volume 4, "Highway Safety"* for current LADOTD minimum requirements.

Refer to *A3.6.5.1* for additional requirements on the protection of structures for vehicle and railway collision.

2.3.2.2.2—Protection of Users

The following shall replace the last paragraph of *A2.3.2.2.2.*

For bridges in urban areas with design speed of 45 mph or less, refer to *EDSM II.3.1.4—Guardrail, Other Bridge Rail End Treatment, Curbs and Sidewalks on Urban Bridges, EDSM II.2.1.7—Curb Policy, EDSM II.2.1.10—Requirements for Construction of Pedestrian Sidewalk Facilities, and EDSM IV.3.1.3—Sidewalks in Highway Rights-of-Way by Permit.*

For bridges with design speed greater than 45 mph, refer to *EDSM II.2.1.7—Curb Policy*. When sidewalks are used for applications with design speed greater than 45mph, a crash- tested bridge railing shall be used to separate pedestrians from vehicular traffic, along with a required pedestrian railing as per *A13*. The bridge railing test level shall be approved by the Bridge Design Engineer Administrator, but in all cases shall not be less than level TL-4 (*NCHRP 350* or *MASH*).

Sidewalks for pedestrian and bicycle use shall be designed in accordance with the latest edition of *ADA Standards for Accessible Design*, *Life Safety Code*, and AASHTO *Guide for the Development of Bicycle Facilities*. The minimum clear width (completely free of obstacles and protruding objects) shall be 5'-0" for pedestrian sidewalk and 6'-0" for the combination of pedestrian and bicycle sidewalk.

For movable bridges, refer to the latest *AASHTO LRFD Movable Highway Bridge Design Specifications* and *BDEM Part II, Volume 2, Movable Bridge Design* for corresponding safety design requirements.

2.3.2.2.3—Geometric Standards

The following shall supplement *A2.3.2.2.3*.

LADOTD Minimum Design Guidelines, approved by Chief Engineer, defines the critical design elements for each functional system of the roadway; the minimum requirements in the guidelines shall be met unless otherwise stated herein. The use of a value less than the minimum specified in the guidelines will require a design exception. The design exception shall be approved by the Chief Engineer and documented in the project design criteria. These guidelines can be downloaded from LADOTD Bridge Design Section website under "Downloads".

Refer to *EDSM II.1.1.1—Right-of-Way Widths* for LADOTD minimum right-of-way widths.

Refer to *EDSM II.3.1.2—Stopping Sight Distance on Curve Bridge* for stopping sight distance requirements on curve bridges.

2.3.2.2.4—Road Surfaces

The following shall supplement *A2.3.2.2.4*.

One-way traffic bridges shall have a single tangent with minimum slope of 2.5%. Two-way traffic bridges shall have a two-way tangent with a minimum slope of 2.5% connected by a 4'-0" parabolic crown. Bridge deck crowns shall match connecting roadway crown except for special cases.

Refer to *Standard Specifications* for the requirements on bridge deck finishing.

Pavement surface drainage in superelevation transition must be investigated. Minimum profile grades within the transition shall be provided in accordance with Chapter 3, Minimum Transition Grades, in AASHTO *A Policy on Geometric Design of Highways and Streets*.

2.3.2.2.5—Vessel Collisions

The following shall supplement *A2.3.2.2.5*.

Fixed bridges shall be designed for vessel collision forces in accordance with *A3.14*. Pier protection systems are not required except for existing bridge rehabilitations where it is not feasible to rehabilitate the existing bridge for vessel collision forces. Pier protection may also be required by the Coast Guard to prevent fire in case of impact.

Movable bridges shall be protected with pier protection systems unless the bridge is designed for vessel collision forces in accordance with *A3.14* and the mechanical and electrical equipment is designed to accommodate corresponding displacements. Exceptions must be approved by the Bridge Design Engineer Administrator.

2.3.3—Clearances

2.3.3.1—Navigational

The following shall supplement *A2.3.3.1*.

The U.S. Coast Guard is the sole authority in approving the requirements for horizontal clearance, vertical clearance and navigational lights. Visit the U.S. Coast Guard Bridge Administration Division website for general information. Refer to *U.S. Coast Guard Bridge Permit Application Guide*, *Bridge Guide Clearances,* and *Bridge Lighting Manual* for specific requirements when preparing the permit application and plans. The Permit Coordinator is responsible for securing the Coast Guard Permit. Once the permit is obtained, modifications cannot be made without additional Coast Guard review.

The vertical clearance over water is the minimum distance between the low chord of the superstructure and the specified water level within the channel width, between piers, or between fenders as applicable. The specified water level may be "High Water" (HW), Mean High Water (MHW), Mean Low Water (MLW), "Mean Sea Level" (MSL), "Normal Pool Elevation", "100-Year Flood", or "2% Flow Line". The definitions of the water levels can be found in the Bridge Permits section of the U.S. Coast Guard website. The water elevations shall be determined by the Hydraulic Engineer. The horizontal clearance is the minimum clear distance (completely free of obstacles and protruding objects) between piers, or between fenders, as applicable. Sample bridge permit application plans can be found in the Bridge Permits section of the U.S. Coast Guard website.

2.3.3.2—Highway Vertical

The following shall replace *A2.3.3.2.*

Minimum vertical clearances for structures are as follows:

Freeway, arterials and all other roads and streets (underpass and overpass)	16.5 ft.
Truss portals	17.5 ft.
Pedestrian bridges	20.0 ft.

Other structures	20.0 ft.
Trails/Bikeways (underpass)	12.0 ft.

The above values account for up to 6 inches of future overlay.

The vertical clearance shall be maintained throughout the horizontal clear zone under the bridge as defined in *D2.3.3.3*. In the design process, consideration should be given to possible future widening of the roadway under the structure and the possible future widening of the structure itself.

For prestressed concrete beams, any beam camber shall be disregarded when determining actual vertical clearance, unless the beam is cast or assembled specifically to provide vertical curvature at the bottom of the beam.

For minimum vertical clearance for traffic signs, refer to the Standard Plans for traffic signs and the latest edition of *AASHTO Standard Specifications* for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

For minimum vertical clearance for lighting, refer to the latest edition of LADOTD *A Guide to Constructing, Operating, and Maintaining Highway Lighting System*, which is posted on LADOTD website.

2.3.3.3—Highway Horizontal

The following shall supplement *A2.3.3.3.*

The bridge width shall be in accordance with LADOTD Minimum Design Guidelines unless the Chief Engineer approves an exception. It is preferable for the bridge width to match the approach roadway width. In some cases, such as long structures where approach roadway shoulder width is narrow, it is desirable to provide wider bridge shoulder width than approach roadway shoulder width.

The horizontal clear zone distance under the bridge is defined as the clear horizontal distance from the edge of travel lane to the edge of nearest object. Refer to AASHTO *Roadside Design Guide* for guidance on horizontal clear zone distance. The horizontal clear zone distance shall also meet the requirements of *A2.3.2.2.1*, *D2.3.2.2.1*, *A2.3.2.2.3*, and *D2.3.2.2.3*.

For horizontal clear zone distance for traffic signs, refer to the Standard Plans for traffic signs and the latest edition of *AASHTO Standard Specifications* for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

For horizontal clear zone distance for lighting, refer to the latest edition of LADOTD *A Guide to Constructing, Operating, and Maintaining Highway Lighting System*, which is posted on LADOTD website.

2.3.3.4—Railroad Overpass

The following shall supplement *A2.3.3.4*.

The vertical clearance for a railroad overpass shall be the minimum distance between the low chord of the overpass superstructure (including live load deflection) and the highest rail within the horizontal clearance window specified by the railroad owner. The amount of vertical clearance provided shall be the stated vertical clearance provided by the railroad owner plus 6 inches. This is to account for future adjustments to either the road or railroad and to allow for construction tolerances. Minimum vertical clearance shall be shown on the plans as specified by the railroad owner.

The horizontal clearance for a railroad overpass is typically measured as the minimum distance between the centerline of the nearest track to the face of the pier. Minimum horizontal clearance shall be shown on plans as specified by the railroad owner.

Pier protection shall be provided as specified by the railroad owner and AASHTO specifications. Refer to *A3.6.5* for the protection of structures for railway collision forces.

Proper drainage of the structure must be considered during the layout and design process to avoid impact on the railroad right-of-way.

Railroad Permit Coordinator is responsible for securing the railroad permit agreement. Designers should work closely with the Coordinator while preparing railroad permit agreement applications. Planning and communication with railroad should begin at preliminary design stage while determining structure type, size, and locations (T, S, & L).

2.3.4—Environment

The following shall supplement *A2.3.4.*

Refer to LADOTD *Environmental Manual of Standard Practice* for LADOTD environmental policy and guidance on LADOTD environmental process. This manual is posted on the LADOTD website. LADOTD Environmental Section is responsible for preparing the environmental decision documents and determining the type of permit required for each project. Permit Coordinator in the Environmental Section is responsible for securing all environmental permits. A list of permits and approvals are included in the *Environmental Manual of Standard Practice*. The Bridge Designer should work closely with the Permit Coordinator while preparing permit applications.

2.5—DESIGN OBJECTIVES

2.5.1—Safety

The following shall supplement *A2.5.1*.

Refer to *BDEM, Part I, Chapter 3* for LADOTD Bridge Design Section Policy on QC/QA.

2.5.2—Serviceability

2.5.2.1—Durability

2.5.2.1.1—Materials

The following shall supplement *A2.5.2.1.1*.

Refer to *Standard Specifications* for material specifications.

Refer to *BDEM, Part I, Chapter 2—Bridge Design Committees* for new material approval process. Implementation of new materials or products must be approved by the Bridge Design Specification Committee.

Refer to LADOTD *Approved Material List* (AML) for approved materials.

Refer to LADOTD *Materials Sampling Manual* for the material sampling standards and acceptance requirements.

All above references are posted on LADOTD website.

2.5.2.1.2—Self-protecting Measures

The following shall replace the first paragraph of *A2.5.2.1.2*.

Continuous drip grooves or drip beads shall be provided along underside of a concrete deck at a

C2.5.2.1.2

The following shall replace the first paragraph of *AC2.5.2.1.2*.

Due to the limited use of salt in Louisiana, a minimum slope of 5 percent is considered a distance not exceeding 10.0 in. from fascia edge. Except for substructures under continuous deck without joints, all top surfaces of substructures, other than bearing seats, shall have a minimum slope of 5 percent toward the edge, typically in the direction of traffic.

2.5.2.2—Inspectability

The following shall supplement *A2.5.2.2.*

Inspection and maintenance requirements for critical details shall be stipulated on the plans. Adequate and safe means of access for bridge inspection shall be provided. Bridge plans shall specify methodologies by which access can be provided to such locations for inspection purposes. Design information for inspectability shall be reviewed during preliminary design, final design and construction.

For special bridge conditions, the inspectability requirements shall be approved by the Bridge Design Engineer Administrator.

Inspection walks are required on spans having any of the following conditions:

- Span length > 300 feet and the span cannot be readily inspected with conventional equipment (such as "snoopers", "reach-alls", etc.) from the bridge deck or the span is inaccessible from underneath.
- Total bridge width > 60 feet and the span is inaccessible from underneath.
- Combined depth of beam, girder, deck, barrier railing, fence, noise wall, etc. > 11.5 feet and the span is inaccessible from underneath.
- Vertical clearance > 30 feet.

A minimum design live load of 80 psf shall be used in the design of inspection walks. The minimum clear walkway width (completely free of any protruding objects) of the inspection walk shall be 3’-6”. The minimum overhead clearance within the walkway shall be 6 feet. Toe guard protection and railing shall be provided if the walk is not protected by the girders.

Access and entrance to the inspection walk shall be secured to prevent unauthorized use. Walks shall be designed to provide safe access, exit, and transfer from one area to another for at least one person 6

reasonable slope to enable rains to wash away debris and salt.

feet tall carrying tools and equipment. Walks shall be designed for all applicable loads and vibration shall be considered in the design of all members, connections, and fasteners.

For piers supporting spans that require inspection walks, access to the top of the pier and inspection walks along the faces of the pier cap shall be provided.

In addition to the inspection walk requirements, inspection cables shall be provided on spans having any of the following conditions:

- Steel girder with web depth > 6 feet over water.
- Steel girder with web depth > 6 feet over land with vertical clearance > 30 feet.

Refer to *Steel Girder Details* Standard Plans for inspection cable details.

Vent holes and inspection hatches shall be provided for enclosed sections to meet the requirements for inspection purpose and worker safety, and the dimensions shall meet industry standards. Provisions for lighting, cross ventilation, and steps shall be made where required. Interiors of steel box girders shall have white top coat paint for inspection purposes.

2.5.2.3—Maintainability

The following shall replace the first sentence in the first paragraph of *A2.5.2.3*.

Structural systems and devices (such as joints, bearings, etc.) whose future maintenance is expected to be difficult, should be avoided.

The following shall supplement the second paragraph of *A2.5.2.3.*

Minimum 4 inches of vertical clearance above top of cap and 9 inches of horizontal distance between edge of bearing support or riser and edge of cap shall be provided to facilitate inspection, jacking, cleaning, repair, and replacement of bearings.

For joints that require access from underside of deck for inspection, repair, and maintenance, such as pivot pin (rack & pinion), compression joints, etc., adequate clearance shall be provided and shown on the plans.

2.5.2.4—Rideability

The following shall supplement the first paragraph of *A2.5.2.4*.

A reinforced concrete approach slab shall be required at the ends of all bridges to create a smoother transition from the rigid bridge structure to the flexible road embankment. Standards have been developed for 10', 20' and 40' long approach slabs. 10' slab shall be used on off-system bridges only. 20' and 40' slabs shall be used on on-system bridges and may be used on off-system bridges when needed. Refer to *Approach Slabs* Standard Plans for details. Use of all other types of approach slabs shall be approved by the Bridge Design Engineer Administrator.

Approach slabs shall meet the following requirements:

- Minimum thickness: 1'-6" (20' and 40' slabs)
  1'-0" (10' slab)
- Minimum length:

  On-system bridges: Use 40' slab for fill embankment and 20' slab for cut embankment

  Off-system bridges: Use 10' slab for cut sections or for embankment with less than 2 feet of fill. Where higher traffic count and/or larger embankment settlement is expected, it may be justified to use 20' or 40' slabs. The bridge engineer should work with Geotech to make that determination. In general, consider a 20' slab for fill heights between 2 and 8 feet, and a 40' slab for fill heights above 8 feet.
- Concrete cover: 2 ½" top, 2" bottom
- Concrete strength: f'_c = 4000 psi
- Steel yield strength: f_y = 60 ksi
- Longitudinal reinforcement (parallel to roadway):
  - #8@6" top, #10@6" bottom (40' slab)
  - #8@6" top and bottom (20' slab)
  - #4@12" top, #6@6" bottom (10' slab)
- Transverse reinforcement (perpendicular to roadway):
  - #8@6" top and bottom (20' and 40' slab)
  - #4@12" (10' slab)

The following shall replace the last paragraph of *A2.5.2.4*.

Correction of the deck profile by grinding is

C2.5.2.4

The following shall supplement *AC2.5.2.4*.

The on-system approach slab design was based on the research performed in LTRC project 03-4GT, "*Determination of Interaction Between Concrete Approach Slab and Embankment Settlement*", and LTRC project 05-1GT, *"Field Demonstration of New Bridge Approach Slab Designs and Performance"*. The final reports for these two projects are published in LADOTD LTRC website. Additional analysis was performed to verify the results from LTRC 03-4GT and extend the design to account for LADV-11 live load.

For the design of the main bottom longitudinal reinforcement, the slab was assumed to have lost all contact with the supporting soil and was designed as a simply-supported slab. Design conditions of partial embankment loss (assume ½ and ¾ unsupported length) were also examined, but the cost comparison of the designs showed that the simply-supported slab would not be significantly more expensive. For the design of top longitudinal reinforcement and transverse reinforcement, a design condition of 10 feet of embankment loss at the edge of the slab was assumed. The design also considered a maximum 45-degree skew condition, and finite element models were generated to verify the design. Edge beams were included to control live load deflection. A sleeper slab and geosynthetic soil reinforcement were added under the roadway end of the approach slab to reduce settlement based on the recommendations in LTRC project 05-1GT.

Pile-supported approach slabs with varying pile lengths have been used in the past for sites with large embankment settlement in south Louisiana. This pile-supported approach slab standard was evaluated in LTRC project 97-4GT. The results indicated that the standard being used by LADOTD did not always produce acceptable results. The research provided a design methodology, however, from a practical stand point, it is impossible to accurately predict the surface settlement of a pile-embankment composite, which is necessary to create a smooth transition between the roadway and the bridge.

generally not performed on bridge decks unless requested by the Bridge Design Engineer Administrator for specific projects. The EOR should consider providing additional thickness to the deck to compensate for thickness loss due to grinding. The thickness requirement should be determined on a case-by-case basis for these projects.

Therefore, it is no longer recommended to use a pile-supported approach slab. For project sites that need special attention in controlling the settlement, the designer should work with the geotechnical engineer and may utilize other means to control or mitigate the settlement.

For 10' long off-system approach slabs, finite element modeling shows that the current LA DOTD design is sufficient for current loads. Field visits were made to a number of off-system bridges, confirming that these slabs are performing acceptably.

2.5.2.5—Utilities

The following shall replace *A2.5.2.5*.

Utilities shall not be permitted on bridge structures without the approval of the Chief Engineer, except for communication cables which are allowed in accordance with *EDSM IV.2.1.8—Communication Cable Installation on Highway Structures*.

In cases where utilities other than communication cables are permitted on the bridge structures, the utility owner must submit the following information to the Bridge Design Engineer Administrator for review and approval.

- Method of attachment to bridge structure and to the utility support.
- Size, material and weight of the utilities.
- Any special requirements, such as expansion joint locations, pressure test requirements after installation, maintenance and inspection requirements, etc.
- All applicable calculations and drawings which are stamped, signed, and dated by an EOR.

All utility supports shall be designed in accordance with AASHTO *LRFD Bridge Design Specifications* and *BDEM*.

2.5.2.6—Deformations

2.5.2.6.1—General

The following shall replace the first paragraph of *A2.5.2.6.1*.

Deflection limits and minimum span-to-depth

C2.5.2.6.1

The following shall supplement *AC2.5.2.6.1*.

In the absence of better criterion, LADOTD believes that it is appropriate to limit deflections ratios shall be as specified in *A2.5.2.6.2* and *A2.5.2.6.3*.

2.5.2.6.2—Criteria for Deflection

The following shall replace the first paragraph of *A2.5.2.6.2*.

The criteria in this section shall be followed.

The following shall replace the first sentence in the third paragraph of *A2.5.2.6.2*.

The following principles shall be applied for deflection control:

The following shall supplement the third bullet in the third paragraph of *A2.5.2.6.2*.

LADOTD standard barrier design is not structurally continuous; therefore, it shall not be considered in calculating composite section stiffness.

2.5.2.6.3—Optional Criteria for Span-to-Depth Ratios

The following shall replace the first paragraph of *A2.5.2.6.3*.

Structures and components of structures shall satisfy the span-to-depth ratios given in *Table A2.5.2.6.3-1* in which "S" is the slab span length between the centers of supports and "L" is the span length between the center of supports, both in feet. Where used, the limits in Table 2.5.2.6.3-1 shall be taken to apply to overall depth, unless noted.

2.5.2.7—Consideration of Future Widening

2.5.2.7.1—Exterior Beams on Multi-beam Bridges

The following shall replace *A2.5.2.7.1*.

Non-composite section capacity of exterior beams shall not be less than that of interior beams to allow for future widening.

2.5.2.7.2—Substructure

The following shall replace *A2.5.2.7.2*.

When future bridge widening and lengthening can be anticipated, consideration shall be given to designing substructures geometrically and structurally for anticipated conditions.

and span-to-depth ratios.

2.5.3—Constructability

The following shall supplement *A2.5.3.*

Refer to *EDSM III.1.1.32—Constructability/ Biddability Review* for LADOTD Constructability/ Biddability review policy.

2.5.4—Economy

2.5.4.2—Alternative Plans

The following shall replace *A2.5.4.2.*

Alternative plans will not be required, unless requested by the Bridge Design Engineer Administrator.

2.5.5—Bridge Aesthetics

The following shall supplement the first paragraph of *A2.5.5.*

It is LADOTD policy to consider Context Sensitive Solutions (CSS) for all of its transportation and public works projects. Designers should follow LADOTD's policy and work with other project development staff to implement CSS in bridge designs.

The following shall supplement the last paragraph of *A2.5.5.*

- In areas where spans can be observed by passing motorists, businesses, and/or residences on adjacent properties, attention should be paid to surface finishes on exposed concrete surfaces of substructures and superstructures. All surfaces that require special finishes must be clearly defined and shown on the contract plans. Refer to LADOTD *Standard Specifications for Road and Bridges* for the specific requirements of various classes of concrete surface finishes.

- For structures in urban areas or locations where aesthetics is important, the following deck drainage provisions apply:

  Deck drainage shall be carried off the structure to minimize staining potential, such as by use of scupper and pipe collection systems. Waterstops shall be used to seal any locations where water is anticipated to cause staining.

  When scupper and pipe collection or similar systems are not used, gutterline deck drain holes shall be used with discharge kept away from girders either by distance or use of downspout extensions. Drain slots in barrier railings shall not be used.

- In urban areas, consideration should be given to placing cover walls at ends of bent caps to hide joint openings, anchor bolts and risers normally seen in the elevation view.
- When weathering steel is to be used, special considerations should be given to keep runoff from staining the substructures.
- The centerline of exterior girders shall be aligned with that of exterior girders in adjacent spans. Centerlines of exterior columns and piles shall be aligned respectively with that of exterior columns and piles in adjacent bents to the extent practical.

2.6—HYDROLOGY AND HYDRAULICS

The following shall supplement *A2.6.*

Refer to LADOTD *Hydraulic Manual*, which is posted on the LADOTD website, for the department’s hydraulic design policies. Where conflict exists in the AASHTO provisions and the *Hydraulic Manual*, the LADOTD Hydraulic Design Unit should be contacted to resolve the differences.

2.6.6—Roadway Drainage

2.6.6.3—Type, Size, and Number of Drains

The following shall supplement *A2.6.6.3.*

Refer to FHWA *Hydraulic Engineering Circular No. 21* for additional guidance on the design of bridge deck drainage.

When scuppers or downspouts are utilized, a minimum size of 8 inch diameter at maximum 10 feet spacing shall be provided. When drain slots in the barrier are used, a minimum slot size of 24 inches (length) × 6 inches (height) at a maximum of 10 feet spacing shall be provided.

2.6.6.4—Discharge From Deck Drains

The following shall supplement *A2.6.6.4.*

Free drops from the deck drains shall be avoided

C 2.6.6.4

The following shall supplement *C2.6.6.4.*

over railroad tracks, roadways, and revetments.

Slot drains in barriers should be used wherever practical and permissible except for structures in urban areas or locations where aesthetics is important (*D2.5.5*). The use of scuppers or drain holes in the deck should be minimized. When used, they should be located midway between cross frames or diaphragms and designed to ensure that run-off will be directed away from superstructure and substructure elements.

Fiberglass or PVC downspouts should be used and shall extend at least 1 foot below the bottom of the superstructure.

Occasionally, downspouts have been encased in the substructure concrete. This practice should be avoided whenever possible, because it usually creates cleanout problems and can result in chloride damage to the concrete.

For drain conveyances encased in concrete, the installation shall include a 1 inch compressible protective covering between the pipe and the concrete to minimize stresses caused by expansion of pipe and shrinkage of the concrete.

2.7—BRIDGE SECURITY

The following shall supplement *A2.7*.

Bridge security considerations will be specified by the Bridge Design Engineer Administrator for bridges deemed critical or essential. If specified, the provisions in AASHTO *Bridge Security Guidelines* should be followed.

2.8—REFERENCES

The following shall supplement *A2.8*.

ADA Standards for Accessible Design, Latest Edition, Department of Justice, www.ADA.gov.

A Policy on Geometric Design of Highways and Streets; Latest Edition, American Association of State Highway and Transportation Officials, Washington, DC.

Guide for the Development of Bicycle Facilities, Latest Edition, American Association of State Highway and Transportation Officials, Washington, DC.

Louisiana Standard Specifications for Roads and Bridges, Latest Edition, State of Louisiana Department of Transportation and Development, Baton Rouge, LA.

U. S. Coast Guard, U.S. Department of Homeland Security. www.uscg.mil.