BRIDGE DESIGN MANUAL UPDATES, BRIDGE DESIGN GUIDE, AND CORROSION GUIDELINES UPDATES

Jamie F. Farris, P.E.
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BRIDGE DESIGN MANUAL UPDATES
Bridge Design Manual Location

[PDF] Bridge Design Manual - LRFD (LRF) - TxDOT
onlinemanuals.txdot.gov/txdotmanuals/lrf/lrf.pdf
Jul 31, 2018 - This manual documents policy on bridge design in Texas. It is documented in the AASHTO LRFD Bridge Design Specifications, ...

Bridge Design Manual - LRFD - Search - TxDOT
onlinemanuals.txdot.gov/txdotmanuals/lrf/index.htm
Bridge Design Manual - LRFD. July 2016. Copyright © 2016 by Texas Depart
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CHAPTER 2: LIMIT STATES AND LOADS
Chapter 2: Limit States and Loads

- Relocated column collision guidance

Chapter 4 Substructure Design - Sections 6 and 7
CHAPTER 3:
SUPERSTRUCTURE DESIGN

Bridge Design Manual Updates
Chapter 3: Superstructure Design

- Materials: Specified more corrosion resistant options and information in:
  - Section 2: Concrete Deck Slabs on I-Girders, U-Beams, Spread Box Beams, Spread Slab Beams, Steel Plate Girders, and Steel Tub Girders
  - Section 3: Concrete Deck Slabs on Adjacent-Framed Beams (Slab Beams and Box Beams)
Chapter 3: Superstructure Design

- Section 2 and 3: Corrosion resistant reinforcing options now include:
  - Epoxy-Coated bar
  - Epoxy-Coated WWR
  - Hot-Dip Galvanized
  - GFRP
  - Dual Coated
  - Low Carbon/Chromium
  - Stainless

If thus required, use one of the following types of corrosion resistant reinforcement (refer also to Item 440):
- Epoxy-Coated Reinforcing Steel meeting the requirements of ASTM A775 or A934
- Epoxy-Coated WWR meeting the requirements of ASTM A884 Class A or B
- Hot-Dip Galvanized Reinforcing Steel
- Glass Fiber Reinforced Polymer (GFRP) Bars: The design for GFRP reinforcement in bridge decks must adhere to the AASHTO LRFD Guide Specifications for GFRP-Reinforced Concrete Bridge Decks and Traffic Railings.
- Dual Coated Reinforcing Steel meeting the requirements of ASTM A1055
- Low Carbon/Chromium Reinforcing Steel meeting the requirements of ASTM A1035 Gr 100 Ty CS
- Stainless Reinforcing Steel meeting the requirements of ASTM A955 Ty 316LN, XM-28, 2205, or 2304; Use only for extreme chloride exposure in coastal areas.
Chapter 3: Superstructure Design

Sections 4, 6 - 10: Pretensioned Concrete Girders and Beams

- Updated AASHTO LRFD Chapter 5 references due to AASHTO’s organizational changes
Chapter 3: Superstructure Design

Removed Section - Pretensioned Concrete Double Tee Beams
Chapter 3: Superstructure Design

Section 11 (Previously Section 12): Cast-in-Place Concrete Slab and Girder Spans (Pan Forms)
Section 12 (Previously Section 13): Cast-in-Place Concrete Slab Spans

- Updated AASHTO LRFD Chapter 5 references due to AASHTO’s organizational changes
- Materials: Specified more corrosion resistant options and information
Chapter 3: Superstructure Design

Section 13 (Previously Section 14): Straight Plate Girders

- Added requirement to specify fit condition for steel plate girder spans
  - Specify Steel Dead Load Fit (SDLF) where possible
- Added requirement for primary method of splicing in plans to bolted
Chapter 3: Superstructure Design

Section 14 (Previously Section 15): Curved Plate Girders

- Added requirement to specify fit condition for steel plate girder spans
  - Specify Steel Dead Load Fit (SDLF) where possible
- Added requirement for primary method of splicing in plans to bolted
Chapter 3: Superstructure Design

Section 15 (Previously Section 16): Segmental Spans

- Added spacing and geometric requirements for access openings in segmental spans
  - For maintenance, the clear height of interior box section should not be less than 6 feet
  - Provide access openings at maximum 600 feet spacing and the distance from any location of box girder to the nearest opening should not be more than 300 feet. Provide at least two openings per box girder line. The size of access opening should be 32 inch x 42 inch or 36 inch diameter at minimum.
Section 16 (Previously Section 17): Spliced Precast Girders

- Removed requirement to use TxDOT section properties
  - Moved this information and link location to the Bridge Design Guide
- Added requirement to provide a full depth diaphragm at all splice and anchorage locations
CHAPTER 4: SUBSTRUCTURE DESIGN
Chapter 4: Substructure Design

Section 2: Foundations

- Added requirements for foundations in tension
  - If foundations are in tension in the service or factored limits states, including structures with significant staged construction foundation variations, provide structural details that ensure adequate load transfer throughout the substructure.

- Added scour language:
  - Design foundations and substructures for changes in foundation conditions due to scour as noted in Article 3.7.5. Refer to TxDOT Hydraulic Manual and TxDOT Geotechnical Manual for additional guidance on design for scour.
Chapter 4: Substructure Design

Section 2: Foundations

- Added monoshaf requirements:
  - Monoshafts framing into dissimilarly sized columns must conform to the non-contact splice conditions of Article 5.10.8.4.2.
  - For monoshafts framing with single column bents, perform analysis to examine the consequences of deflection under lateral loads
Chapter 4: Substructure Design

Section 3: Abutments

- **Pile abutments**
  - If analysis determines adequate resistance to lateral loads, vertical pile abutments in MSE wall backfill are permitted for deeper girders than the standard abutment designs/ details shown on standard drawings.

- **Battered piling**
  - Avoid battered piling in areas immediately adjacent to MSE walls because of the difficulty of installing the backfill. If sufficient room is provided for MSE wall straps and compaction, battered piles may be used.
Chapter 4: Substructure Design

Section 4: Rectangular Reinforced Concrete Bent Caps

- Removed the requirement to not use the simplified method for determining shear resistance
- Guidance is included in the Bridge Design Guide stating that Bridge Division’s preference is the General Procedure for shear design
Ignore requirements in Article 5.7.3.2 requiring that concentrated loads located within $dv$ from the face of support, the shear load and shear resistance shall be calculated at the face of the support. Loads close to the support are transferred directly to the support by compressive arching action without causing additional stresses in the stirrups.
Section 8: Post-Tensioned Concrete Bent Caps

- Include notes indicating that post-tensioning system/stressing sequence shop drawings must be submitted, reviewed, and approved by the Engineer of Record.
NEW Section 9: Lateral Restraint of Bridge Superstructures on Substructure

- Incorporated requirements from 8/8/2016 Memo
- Includes requirements for:
  - Bridges crossing water features
  - I Girder, U Beam, Spread Slab Beam, Spread Box Beam bridges
  - Steel girder bridges
CHAPTER 5: OTHER DESIGNS
Chapter 5: Other Designs

Section 3: Strut-and-Tie Method

- No longer disregard nodal analysis for large nodes
NEW Section 5 : Concrete Culverts

- New section includes requirements for:
  - Materials
  - Geometric Constraints
  - Structural Analysis
  - Design Criteria
  - Detailing
CHAPTER 6: PROCEDURE FOR ARCHIVING DESIGN NOTES
Chapter 6: Procedure for Archiving Design Notes

- To comply with FHWA requirements for maintaining records, BRG implemented a procedure for archiving design notes in 2014 (Memo sent out)

- New Chapter includes requirements from the Memo for:
  - Scanning notes – what parts of the notes to include
  - Naming convention
  - Where to deliver the file
BRIDGE DESIGN GUIDE
Bridge Design Guide Location

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Bridge Design Guide

Purpose

- Presents guidelines for designing bridges in Texas.
- **Should be used in companion with the policies stated in the TxDOT Bridge Design Manual - LRFD.**

Objectives

- Serve as a resource for engineers designing bridges for TxDOT.
- Provide guidelines specific to TxDOT policies, details, and design assumptions.
Contents

- Chapter 1, About this Guide
- Chapter 2, Load and Resistance Factor Design
- Chapter 3, Superstructure Design Guidelines
- Chapter 4, Substructure Design Guidelines
- Chapter 5, Other Design Guidance
- Chapter 6, Frequently Asked Questions
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- Appendix B, Pretensioned Concrete U Beam Design Guide
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CORROSION GUIDELINES UPDATES
Corrosion Guidelines Updates

Corrosion Guidelines Updates

Structure Design - Corrosion Protection Measures

In areas of the state where de-icing agents are frequently used during winter storms, it is recommended that additional corrosion protection measures be incorporated into the bridge design and details. Use district-specific requirements where applicable.

Special consideration should be given on a case-by-case basis for:

1. Retrofit bridge rails
2. Widening or rehabilitations of existing structures
3. Isolated culverts with Class S top slabs
4. Slab replacements or redcking
5. Projects in remote areas and
6. Off-system bridges.

In these cases, consider the availability of materials, extent of corrosion damage of any existing structures, and overall cost-benefit.

Corrosion Protection Measures

- High Performance Concrete (HPC)
- Epoxy-Coated Reinforcement
- Other Corrosion Resistant Reinforcing
- Increased Clear Cover
- Air Entrainment
- Corrosion Inhibiting Admixtures
- Limit Use of ACP Overlay on Bridge Decks
- Limit Use of Open Bridge Rails
- Crack Control in Structural Design
- Shrinkage Crack Control Measures
- Other Protection Measures
Corrosion Guidelines Updates

Changes made to the website:

- Main title of Superstructure Design – Corrosion Protection Measures changed to: Structure Design – Corrosion Protection Measures
- Under the High Performance Concrete Section, changed to: Item 421, Hydraulic Cement Concrete, and current statewide Special Provision to Item 421, covers the requirements for HPC.
- New section - Other Corrosion Resistant Reinforcing
  - Info related to stainless, low carbon/low chromium, dual-coated, GFRP, zinc coated, galvanized reinforcement
Corrosion Guidelines Updates

Changes made to the website:

- Increased Clear Cover section - checklists link has been updated
- Air Entrainment Section - changed requirement for ABL, ATL, DAL, ELP, FTW, ODA, PAR, SJT, WAC:
  - Entrained air is required in all bridge deck and slip formed concrete (bridge rail, concrete traffic barrier, pavement, etc.). Adjust the dosage of air entraining agent for low air contents as directed or allowed by the Engineer. If entrained air is provided where not required, only the upper limits of the Special Provision will be enforced.
- New section - Shrinkage Crack Control Measures
Corrosion Guidelines Updates

District Specific Requirements - Updated
Corrosion Guidelines Updates

District Specific Requirements - Updated

- Table A – Concrete Durability Recommendations for Structures in Non-Marine Environment

<table>
<thead>
<tr>
<th>District Name</th>
<th>HPC Bridge Slab, Deck, &amp; Rails</th>
<th>HPC Substructure</th>
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Notes: Y indicates Districtwide application of the specific recommendation.

*In addition, LBB requires epoxy waterproofing on bent caps, abutment caps, and abutment backwalls located under bridge expansion joints.
## Corrosion Guidelines Updates

### District Specific Requirements - Updated

- Table B – Recommended **Reinforcement** for Non-Marine Environments

### Table B – Recommended Reinforcement for Non-Marine Environments

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**Notes:** Y indicates Districtwide application, but dependent on project specific requirements.
Corrosion Guidelines Updates

- Updated website for Modifying Standard Drawings When Increasing Slab Top Clear Cover Checklist
  

- "Modifying Standard Drawings When Increasing Slab Top Clear Cover Checklist"

  Make all modifications listed below. No re-design or analysis of beams or girders is needed.

  **Prestressed Concrete I-girder or X-beam Standard Bridge**
  1. Span Standard:
     - Change slab and slab overhang thickness dimension to 8 ¼”.
     - Change slab top clear cover to 2 ⅛”.
     - Increase DL deflections 6 percent.
     - Add ¾” to top of deck to top of girder dimension (or X dimension) and Y dimension.
     - Increase slab concrete CY volume by an amount equal to (0.00154 * Deck SF).
  2. Abutment Standard:
     - Add 0.2 CY to abutment concrete volume.
  3. PCP Standard:
     - Reduce the maximum allowed slab thickness increase in note 9 from 2½” to 1 ½”.
  4. IGCS or XBCS Standard:
     - Change slab thickness in note 2 and Section A: A to 8 ¼”.

  **Steel Beam Standard Bridge**
  1. Span Standard:
     - Change slab and slab overhang thickness dimension to 8 ¼”.
     - Change slab top clear cover to 2 ⅛”.
     - Add ¾” to top of slab to top of beam dimension.
     - Increase slab concrete CY volume by an amount equal to (0.00154 * Deck SF).
  2. Abutment Standard:
     - Add 0.2 CY to abutment concrete volume.
  3. SBSD Standard:
     - Add ¾” to Y dimension.
     - Increase DL deflections 6 percent.
Questions?

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**Questions and Answers**

**Will the old bridge design examples be updated and added to the Bridge Design Guide?**
No. Originally, the bridge design examples were intended to assist with the transition from ASD to LRFD, which occurred in 2007. Since bridge engineers have been designing bridges using LRFD for over 10 years, design examples provided and maintained by TxDOT should no longer be needed.

**Can links to these materials be accessed only through the internet, or are they also available on the TxDOT intranet (i.e., Crossroads)?**
Official versions are posted on the TxDOT internet website.

**Will the PGSuper Design Guide be part of the Design Manual?**
No – the PGSuper Design Guide is a separate document.

**The Bridge Design Guide states that the max DW Load Factor can be reduced to 1.25; however, we did not see this in the Bridge Design Manual.**
The Bridge Design Manual only contains *policy* information. The Bridge Design Guide indicates that reducing the max $\gamma_{DW}$ to 1.25 is an *option*.

**Does Bridge Division plan to update the recommended beam lengths to be consistent with updated slab thicknesses?**
Yes. The update is underway and is currently going through QA/QC.
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