



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

Jamie F. Farris, P.E.

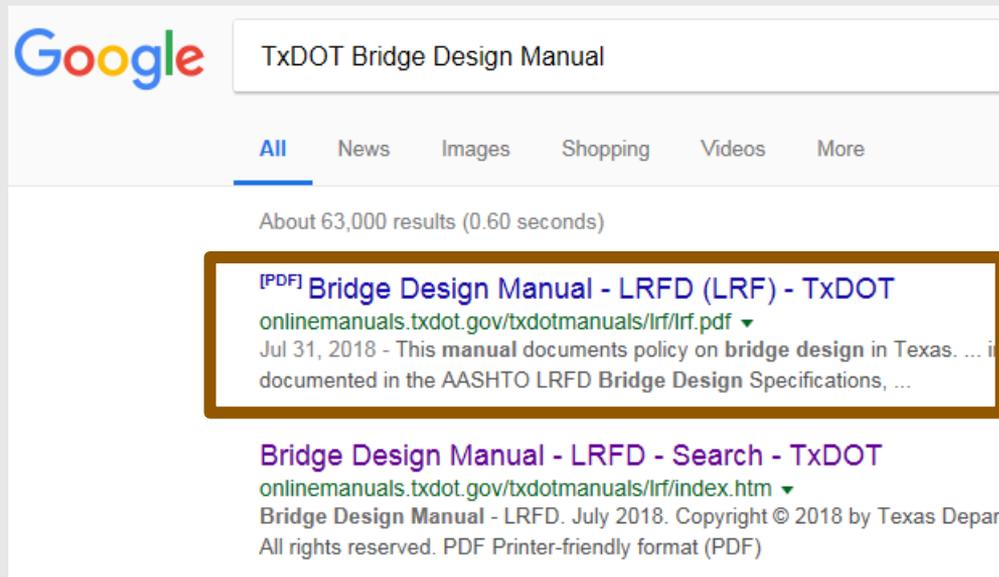
Table of contents

1	Bridge Design Manual Updates	3-29
2	Bridge Design Guide	30-39
3	Updated Corrosion Protection Guidelines	40-48
4	Questions	49



BRIDGE DESIGN MANUAL UPDATES

Bridge Design Manual Location



A screenshot of a Google search results page. The search query is "TxDOT Bridge Design Manual". The search results show "About 63,000 results (0.60 seconds)". The first result is highlighted with a brown border and is titled "[PDF] Bridge Design Manual - LRFD (LRF) - TxDOT". The URL is "onlinemanuals.txdot.gov/txdotmanuals/lrf/lrf.pdf" and the date is "Jul 31, 2018". The second result is titled "Bridge Design Manual - LRFD - Search - TxDOT" with the URL "onlinemanuals.txdot.gov/txdotmanuals/lrf/index.htm" and the date "July 2018".

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Jul 31, 2018 - This manual documents policy on bridge design in Texas. ... i
documented in the AASHTO LRFD Bridge Design Specifications, ...

Bridge Design Manual - LRFD - Search - TxDOT
onlinemanuals.txdot.gov/txdotmanuals/lrf/index.htm ▼
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Bridge Design Manual - LRFD



Revised July 2018

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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

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

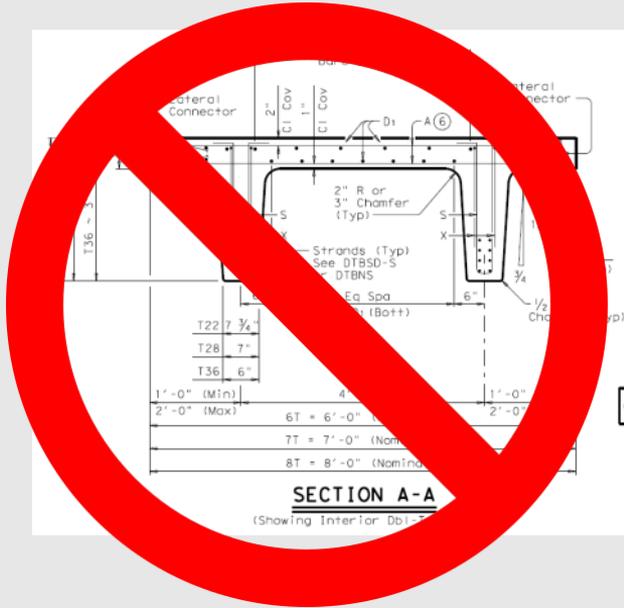
Sections 4, 6 - 10: Pretensioned Concrete Girders and Beams

- Updated AASHTO LRFD Chapter 5 references due to AASHTO's organizational changes



Chapter 3: Superstructure Design

Removed Section - Pretensioned Concrete Double Tee Beams

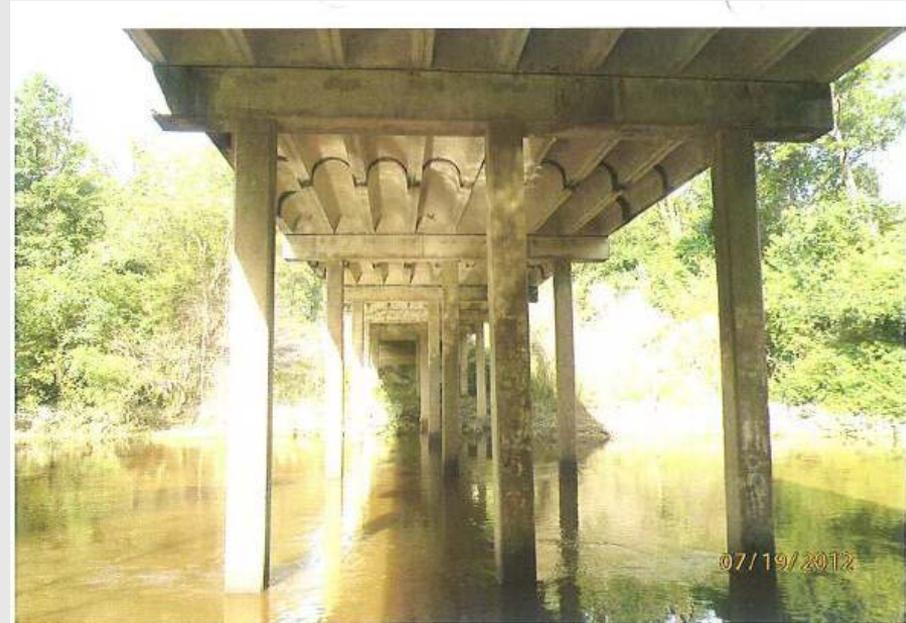


Chapter 3: Superstructure Design

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



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



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



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

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.

Section 2 : Foundations

- Added monoshaft requirements:
 - Monshafts framing into dissimilarly sized columns must conform to the non-contact splice conditions of Article 5.10.8.4.2.
 - For monshafts framing with single column bents, perform analysis to examine the consequences of deflection under lateral loads



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



Section 4 : Rectangular Reinforced Concrete Bent Caps

- Sections Near Supports

Ignore requirements in Article 5.7.3.2 requiring that concentrated loads located within d_v 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.

Chapter 4: Substructure Design

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

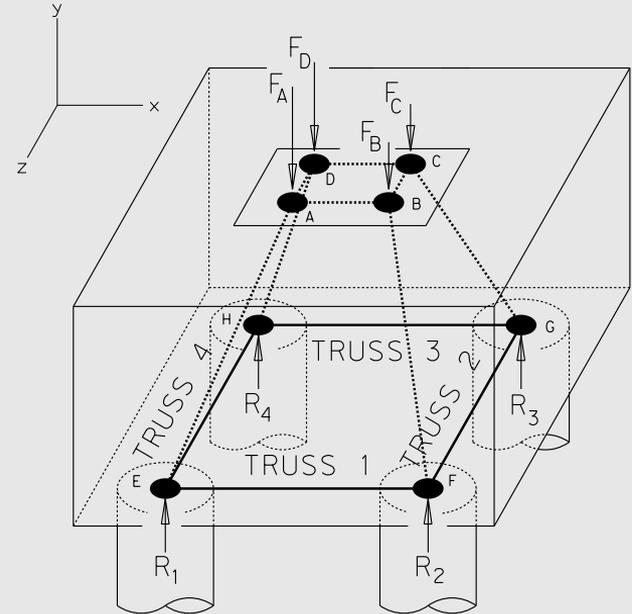
- Incorporated requirements from 8/8/2016 Memo
- Includes requirements for:
 - Bridges crossing water features
 - I Girder, U Beam, Spread Slab Beam, Spread Box Beam bridges
 - Steel girder bridges



CHAPTER 5: OTHER DESIGNS

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

NEW

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

<https://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/publications/bridge.html>

The screenshot displays the Texas Department of Transportation website. At the top, the logo and name "TEXAS DEPARTMENT OF TRANSPORTATION" are visible, along with the text "Driver | Government". Below this is a navigation bar with "Inside TxDOT" highlighted in an orange arrow, followed by links for "Get Involved", "Media Center", "Projects", "Forms & Publications", "Administration", "Districts", and "Divisions".

On the left side, there is a "Forms & Publications" sidebar menu with the following items: "Transportation Links", "Complaints", "Federal Transportation Agencies", "Maps", "State Departments of Transportation", "Consultants and Contractors", "Doing Business", and "Newsletters". An orange arrow points from the "Consultants and Contractors" link to the "Design" link in the main content area.

The main content area is titled "Bridge Publications" and includes a breadcrumb trail: "Home > Inside TxDOT > Forms & Publications > Consultants and Contractors". Below the breadcrumb, there is a paragraph: "You may download the software (Tools and Plug-Ins) needed to access forms or view frequently questions regarding forms (Online Forms FAQs)."

Under the heading "Publications", there is a list of links:

- Bridge Facts
- Bridge Unit Costs
- Construction and Maintenance
- Design
- Geotechnical Resources
- Highway Bridge Program
- Inspection
- Report on Texas Bridges

Bridge Design Guide Location

Design	Format
Bridge Detailing Guide (view online)	
Bridge Detailing Guide (download)	
Bridge Design Guide	
Alternate Prestressed Bent or Abutment Designs Standard Operating Procedures	
Design Software Programs	
Pile Type Selection - Geotech	
Prestressed Concrete I-Beams Distribution Factor Spreadsheet	
Prestressed Concrete U-Beams Distribution Factor Spreadsheet	



Bridge Design Guide

Bridge Division

August 2018

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.



Bridge Design Guide

Bridge Division

August 2018

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
- Appendix A, Pretensioned Concrete TxDOT Girder Haunch Design Guide
- Appendix B, Pretensioned Concrete U Beam Design Guide

Chapter 3: Superstructure Design Guidelines - Contents:

Section 1 — General Recommendations	3-2
Section 2 — Superstructure Phasing Guidance	3-4
Section 3 — Corrosion Protection Measures.....	3-10
Section 4 — Concrete Deck Slab on Stringers	3-11
Section 5 — Concrete Deck Slab on U Beams.....	3-13
Section 6 — Pretensioned Concrete I Girders	3-14
Section 7 — Pretensioned Concrete U Beams	3-16
Section 8 — Pretensioned Concrete Slab Beams and Decked Slab Beams	3-18
Section 9 — Pretensioned Concrete Box Beams.....	3-19
Section 10 — Straight and Curved Plate Girders	3-21
Section 11 — Spliced Precast Girders.....	3-22

Chapter 4: Substructure Design Guidelines - Contents:

Section 1 — Overview.....	4-2
Section 2 — General Recommendations.....	4-3
Section 3 — Abutments.....	4-4
Section 4 — Rectangular Reinforced Concrete Caps.....	4-5
Section 5 — Inverted Tee Reinforced Concrete Caps.....	4-8
Section 6 — Substructure Phasing Guidance.....	4-10
Section 7 — Lateral Restraint for Bridge Superstructures.....	4-12
Section 8 — Columns for Multi-Column Bents.....	4-14
Section 9 — Columns for Single Column Bents.....	4-16
Section 10 — Design Resources.....	4-17

Chapter 5: Other Design Guidance - Contents:

Section 1 — Bridge Widening Guidance	5-2
Section 2 — Steel-Reinforced Elastomeric Bearings for Pretensioned Concrete Beams	5-4
Section 3 — Approach Slabs	5-5
Section 4 — Strut-and-Tie Method	5-8

Appendix A: Pretensioned Concrete TxGirder Haunch Design Guide - Contents:

Section 1 — Components of Haunch	2
Section 2 — Minimum and Maximum Haunch Values	5
Section 3 — Steps to Calculate Haunch	6
Section 4 — Vertical Curve Effects on Haunch	10
Section 5 — Superelevation Transition Effects on Haunch	12
Section 6 — Example TxGirder Haunch Calculations	15

Appendix B: Pretensioned Concrete U Beam Design Guide - Contents:

Section 1 — Bearing Pad Taper Calculations for U Beams	2
Section 2 — Haunch Calculations for U Beams	6
Section 3 — Beam Framing	16
Section 4 — Restraining Superstructure Lateral Movement.....	17



CORROSION GUIDELINES UPDATES

Corrosion Guidelines Updates

- <https://www.txdot.gov/inside-txdot/division/bridge.html>

TEXAS DEPARTMENT OF TRANSPORTATION

Search

Driver | Government | Business

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Divisions

- Aviation
- Bridge
- Civil Rights
- Communications
- Compliance
- Construction
- Contract Services
- Design
- Environmental Affairs

Bridge

Home > Inside TxDOT > Divisions

The Bridge Division supports the structural planning, design, review, construction and inspection of the state's 50,000 bridges. The division also develops policies, design standards, manuals and guidelines for the design, maintenance and construction of a safe and comprehensive state bridge system.

Gregg Freeby, P.E., serves as director. [Contact us](#) with questions or comments.

General

- Specifications
- Standards
- Pipe Design and Durability
- Shop Drawings
- Corrosion Protection Measures**
- Publications

Approved Systems

- Concrete Block Retaining Walls
- Mechanically Stabilized Earth
- Expansion Joints

Programs

- Highway Bridge Program Brochure
- Highway Bridge Program Video

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[Design](#) ⌵

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[Financial Management](#) ⌵

[Fleet Operations](#) ⌵

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[Government Affairs](#) ⌵

[Human Resources](#) ⌵

[Information Management](#) ⌵

[Internal Audit](#) ⌵

[Maintenance](#) ⌵

[Maritime](#) ⌵

[Occupational Safety](#) ⌵

[Procurement](#) ⌵

Structure Design - Corrosion Protection Measures

[Home](#) > [Inside TxDOT](#) > [Divisions](#) > [Bridge](#) > [General](#)

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 redeckings
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

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

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

District Specific Requirements - Updated

Divisions

Aviation

Bridge

Civil Rights

Communications

Compliance

Construction

Contract Services

Design

Environmental Affairs

Financial Management

Fleet Operations

General Counsel

Government Affairs

Human Resources

Information Management

Internal Audit

Maintenance

Maritime

Occupational Safety

Procurement

Structure Design - Corrosion Protection Measures

Home > Inside TxDOT > Divisions > Bridge > General

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

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- > 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

District Specific Requirements - Updated

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

District Name	HPC Bridge Slab, Deck, & Rails	HPC Sub-structure	Require Air Entrainment Slab, Deck, & Rails	Require Air Entrainment Substructure	Poly Fibers Slab & Deck	Poly Fibers Slipform Rail	Surface Protective Coatings Sub-structure	Corrosion Inhibiting Admixture Beams	Corrosion Inhibiting Admixture Sub-structure
ABL	Y	Y	Y	N	Y	Y	Y	Y	Y
AMA	Y	Y	Y	Y	Y	Y	Y	Y	Y
ATL	Y	Y	Y	N	N	N	Y	Y	Y
AUS	N	N	N	N	N	N	N	N	N
BMT	N	N	N	N	N	N	N	N	N
BRY	N	N	N	N	N	N	N	N	N
BWD	Y	Y	N	N	Y	N	Y	Y	Y
CHS	Y	Y	Y	Y	Y	Y	Y	Y	Y
CRP	N	N	N	N	N	N	N	N	N
DAL	Y	Y	Y	N	N	N	Y	Y	Y
ELP	Y	Y	Y	N	Y	Y	Y	Y	Y
FTW	Y	Y	Y	N	N	N	Y	Y	Y
HOU	N	Y	N	N	N	N	N	N	N
^A LBB	Y	Y	Y	Y	Y	Y	Y	Y	Y
LFK	N	N	N	N	N	N	N	N	N
LRD	N	N	N	N	N	N	N	N	N
ODA	Y	N	Y	N	Y	Y	Y	Y	Y
PAR	Y	Y	Y	N	N	N	Y	Y	Y
PHR	N	N	N	N	N	N	N	N	N
SAT	N	N	N	N	N	N	N	N	N
SJT	N	N	Y	N	Y	N	Y	N	Y
TYL	N	Y	N	N	N	N	Y	N	Y
WAC	N	Y	Y	N	N	N	Y	N	N
WFS	Y	Y	Y	Y	Y	Y	Y	Y	Y
YKM	N	N	N	N	N	N	N	N	N

Notes: Y indicates Districtwide application of the specific recommendation.

^A 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

District Name	Epoxy Coated Reinf. Bridge Slabs & Rails	Epoxy Coated Reinf. Sub-structure	Stainless Reinforcing Steel	Low Carbon/Chromium Reinforcing Steel	Dual-Coated Reinforcing Steel	Glass Fiber Reinforced polymer Bars (GFRP) Deck
ABL	Y	Y	Y	Y	Y	Y
AMA	Y	Y	Y	Y	Y	Y
ATL	Y	Y	N	N	N	N
AUS	N	N	N	N	N	N
BMT	N	N	N	N	N	N
BRY	N	N	N	N	N	N
BWD	Y	N	Y	Y	Y	Y
CHS	Y	Y	Y	Y	Y	Y
CRP	N	N	N	N	N	N
DAL	Y	Y	Y	Y	Y	Y
ELP	Y	Y	Y	Y	Y	Y
FTW	Y	Y	Y	Y	Y	Y
HOU	N	N	N	N	N	N
LBB	Y	Y	Y	Y	Y	Y
LFK	N	N	N	N	N	N
LRD	N	N	N	N	N	N
ODA	Y	N	Y	Y	Y	Y
PAR	Y	Y	N	N	N	N
PHR	N	N	N	N	N	N
SAT	N	N	N	N	N	N
SJT	Y	N	Y	Y	Y	Y
TYL	N	N	N	N	Y	N
WAC	N	N	N	N	Y	N
WFS	Y	Y	Y	Y	Y	Y
YKM	N	N	N	N	N	N

Notes: Y indicates Districtwide application, but dependent on project specific requirements.

- Updated website for Modifying Standard Drawings When Increasing Slab Top Clear Cover Checklist
- <https://www.txdot.gov/business/resources/specifications/clear-checklist.html>

Modifying Standard Drawings When Increasing Slab Top Clear Cover Checklist

[Home](#) > [Business](#) > [Resources](#) > [General](#)

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 ½".
 - Change slab top clear cover to 2 ½".
 - Increase DL deflections 6 percent.
 - Add ½" 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 2" to 1 ½".
4. IGCS or XBCS Standard:
 - Change slab thickness in note 2 and Section A-A to 8 ½".

Steel Beam Standard Bridge

1. Span Standard:
 - Change slab and slab overhang thickness dimension to 8 ½".
 - Change slab top clear cover to 2 ½".
 - Add ½" 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. SBSB Standard:
 - Add ½" to Y dimension.
 - Increase DL deflections 6 percent.

Questions?

Jamie F. Farris, PE
Jamie.Farris@txdot.gov
512-416-2433

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 γ_{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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