Corrosion Protection Measures for Bridges

Lloyd M. Wolf, P. E.
Introduction

• Recommendations posted on TxDOT Webpage for regions of the state where deicing chemicals are used.
• Marine recommendations will be posted at a later date, but are similar in many ways to these recommendations.
How to find them

• BRG Webpage: (Hard way)
http://www.txdot.gov/business/contractors_consultants/bridge/super_design.htm

• BRG Webpage: (Easy way)........
txdot bridge info
Bridge Information - www.txdot.gov

The following firms have indicated they will reproduce plans and Informational Proposals used in Construction and Routine Maintenance contracts.
www.txdot.gov/business/contractors.../bridge/default.htm - Cached - Similar

Load Restricted Bridge Map - www.txdot.gov

In the case of load-restricted bridges, the maximum safe weight limit is available. This information may be used as a tool to assist motorists in avoiding ...
www.txdot.gov/business/motor.../restricted_bridge.htm - Cached - Similar

Bridge Standards (English)

TxDOT New Prestressed I-Beam Standard Drawings (English) .... Guide To Bridge Standard Drawings. Provides quick reference information on the following ...
www.dot.state.tx.us/insdtdot/orgchart/cmd/.../bridge-e.htm - Cached - Similar

TxDOT CAD Standards

TxDOT provides computer-aided drawing (CAD) Standard Plan files that may be ... For information regarding Bridge Standards, contact Jon T. Ries at (512) ...
www.dot.state.tx.us/business/standardplanfiles.htm - Cached - Similar

Bridge Inspection Manual: History of Bridge Inspection

* General Forms Information; * Bridge Inspection Record, Old Form 1085 (for on- and off-system ... 4. Administrative Circular No. 60-75. TxDOT. 1975. ... onlinemanuals.txdot.gov/txdotmanuals/.../history_of_bridge_inspection.htm -
Bridge Information

TxDOT provides assistance at the local and regional levels in all aspects of planning, design, construction and maintenance of bridges. The Department also develops policies for a safe and comprehensive state bridge system.

Note: The link to the Shop Drawings page has changed. Please update your bookmarks.

- Bridge Specifications
- Shop Drawings
- Bridge Expansion Joints
- Proprietary Concrete Repair Materials
- Curing Mats for Concrete Structures
- Construction Tips
- Welding Certifications

- Bridge Standards
- Superstructure Design Information
- Substructure Design Information
- Other Design Information
- Steel Bridge Design Preferred Practices
- LFRD Bridge Design FAQs

Geotechnical Services

- Geotechnical Field Testing
- Retaining Wall Information
- Soil and Bedrock Information
- Geotechnical Design Examples

Project Development

- Railroad Information
- Bridge Unit Cost Tables
- Participation-Waived/Equivalent-Match Project Program (PWP/EMP)
- Report on Texas Bridges

Other

- Webinars
Superstructure Design Information

This page provides guidance and recommendations on Load and Resistance Factor Design (LRFD) of specific bridge superstructure components.

- General Recommendations
- Deck Surface Texture Requirements
- 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.

District-specific requirements are available for review.

- Concrete Deck Slabs on Stringers
- Concrete Deck Slabs on U Beams (U40 and U54)
- Prestressed Concrete I Beams and I Girders
- Prestressed Concrete U Beams (Types U40 and U54)
- Prestressed Slab Beams
- Prestressed Concrete Double-Tee Beams
- Prestressed Concrete Box Beams (B20, B28, B34, and B40)
- Design Resources
- Design Examples and Spreadsheets
## RECOMMENDED CORROSION PROTECTION MEASURES

For areas of the state where deicing agents are frequently used during winter storms. Refer to Corrosion Protection Measures on the TxDOT web site for additional information. Recommendations are for on-system structures. Off-system structures will require case-by-case measures.

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Superstructure Design Information

This page provides guidance and recommendations on Load and Resistance Factor Design (LRFD) of specific bridge superstructure components.

- General Recommendations
- Deck Surface Texture Requirements
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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.

District-specific requirements are available for review.

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Superstructure Design Information - 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 rehabilitation 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

The most commonly used corrosion protection measures are:

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

- HPC = High Performance Concrete
- Mix designed for reduced permeability
- FIRST and BEST line of defense in aggressive environments
- Covered by State-wide Special Provision to Item 421 “Hydraulic Cement Concrete”
High Performance Concrete

- Class “S” HPC in bridge deck
  - Also approach slab
  - HPC in PCP not required
- Class “C” HPC in all bent caps, columns, and abutments
- HPC in piling, DS, buried footings not recommended, except for marine.
High Performance Concrete

- Class “C” HPC in concrete bridge rails
- Special Provision to Item 424 “Precast Concrete Structures (Fab)” effectively requires HPC mixes for all prestressed beams, precast panels
Epoxy Coated Reinforcement

Item 440 “Reinforcing Steel”
Epoxy Coated Reinforcement

• Both top mats of all slabs
  • Bridge rail standards require ECR if in deck
  • Approach slab
• Direct traffic culvert top slabs
• CG (pan form) all reinforcing
Epoxy Coated Reinforcement

• Substructure
  • All abutment and bent reinforcement
  • Columns only if in an extremely aggressive or marine environment
• Not in foundation elements
Increased Clear Cover

• Bridge Slabs
  • 2 ½” clear cover top reinforcing
  • Increase slab thickness
• Direct traffic culvert top slabs
• CG (pan form) – Do not increase cover
8 ½ inch Deck on Tx Girders

Requires engineer to modify:
Bridge Standard Drawings!
Increased Clear Cover

- Substructure
- Case-by-case basis at District discretion
- $\frac{1}{2}$" additional for bent caps, abuts, footings
- Columns have sufficient clear cover
- Account for in design
- Marine will need additional column cover
Concrete Surface Treatment
Concrete Surface Treatment

• Effective barrier

• Item 428 “Concrete Surface Treatment”
  • Surface Treatment Class II (Penetrating)

• Use on bridge slabs, rails, sidewalks, medians in exposed areas
Crack Control in Structural Design

• Limit crack width in concrete members to limit conduits for ingress of moisture
• AASHTO LRFD 5.7.3.4 Class 2 exposure
• See TxDOT Bridge Design Manual (LRFD)
• Apply to Abut and Bent Caps only
Air Entrainment

• Covered by State-wide Special Provision to Item 421 “Hydraulic Cement Concrete”

• Increases freeze-thaw resistance

• See Corrosion Protection Measures for specific recommendations by District
Exp Joints and Bridge Rails

No open exp joints or bridge rails, use sealed exp joints and closed rails
ACP Overlay

Traps moisture and promotes corrosion

If used, specify a two-course surface treatment first
Other Considerations
Epoxy Waterproofing

- Bent Caps
- Abutment Caps & Backwalls
- Columns

Surface Prep is Crucial
Sloped Caps

Slope top portion of Cap (between Bearing Seats)
Corrosion Inhibiting Admixtures

- Aggressive environments only
- Calcium-nitrite - delays onset of corrosion
- Approved concrete set accelerator
- Not recommended for CIP Concrete
- Prestressed beams only
- High cost \sim equal to cost of concrete / CY
Stainless Steel Reinforcement

- Recommended only for aggressive environments
- Effective
- High Cost
  - ~20 x black steel
Where can I find these Recommendations?
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