

# 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](http://www.txdot.gov/business/contractors_consultants/bridge/super_design.htm)

- BRG Webpage: (Easy way).....



txdot bridge info

Advanced Search  
Language Tools

Google Search I'm Feeling Lucky

Make Google my homepage

Advertising Programs Business Solutions About Google



txdot bridge info

Search

About 304,000 results (0.35 seconds)

Advanced search

Everything

More

All results

Timeline

More search tools

### [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](http://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](http://www.txdot.gov/business/motor.../restricted_bridge.htm) - Cached - Similar

Show more results from [www.txdot.gov](http://www.txdot.gov)

### [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](http://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](http://www.dot.state.tx.us/business/standardplanfiles.htm) - Cached - Similar

Show more results from [www.dot.state.tx.us](http://www.dot.state.tx.us)

### [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](http://onlinemanuals.txdot.gov/txdotmanuals/.../history_of_bridge_inspection.htm) -

Sponsored links

#### [Get Live Traffic Info](#)

Download Google Maps for mobile. Avoid delays & get to work on time. [www.google.com/mobile](http://www.google.com/mobile)

#### [Traffic Info](#)

Get Instant Traffic Reports Online. Bing™ Makes Searching Easier. [www.Bing.com](http://www.Bing.com)

[See your ad here »](#)

# Texas Department of Transportation

Providing safe, effective and efficient movement of people and goods.



Business with TxDOT | Careers | Drivers & Vehicles | Local Information | News | Projects | Public Involvement | Safety | Travel | TxDOT Library | About Us

E-Mail Us

Districts, Divisions, Offices

Business with TxDOT

Doing Business

Business Outreach

Aviation

Rail

Road Construction

Other Upcoming Projects

**Contractors/Consultants**

Consultant Information

Contractor Information

CAD Standards

Specifications

Plans Online

Bridge Information

Environmental Information

Materials Information

Resources

Forms

Motor Carriers

Motor Vehicle Dealers

## 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.

### Construction and Maintenance

- [Bridge Specifications](#)
- [Shop Drawings](#)
- [Bridge Expansion Joints](#)
- [Proprietary Concrete Repair Materials](#)
- [Curing Mats for Concrete Structures](#)
- [Construction Tips](#)
- [Welding Certifications](#)

### Geotechnical Services

- [Geotechnical Field Testing](#)
- [Retaining Wall Information](#)
- [Soil and Bedrock Information](#)
- [Geotechnical Design Examples](#)

### Design

- [Bridge Standards](#)
- [Superstructure Design Information](#)
- [Substructure Design Information](#)
- [Other Design Information](#)
- [Steel Bridge Design Preferred Practices](#)
- [LFRD Bridge Design FAQs](#)

### Project Development

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

### Other

- [Webinars](#)

# Texas Department of Transportation

Providing safe, effective and efficient movement of people and goods.



[Business with TxDOT](#) | [Careers](#) | [Drivers & Vehicles](#) | [Local Information](#) | [News](#) | [Projects](#) | [Public Involvement](#) | [Safety](#) | [Travel](#) | [TxDOT Library](#) | [About Us](#)

Search TxDOT

E-Mail Us

Districts, Divisions, Offices

**Business with TxDOT**

Doing Business

Business Outreach

Aviation

Rail

Road Construction

**Other Upcoming Projects**

Aviation Projects

Freight Transportation

Other Maintenance Projects

Professional Services Projects

Right of Way Acquisition

Scientific Services

Toll Plaza Operations

Contractors/Consultants

Motor Carriers

Motor Vehicle Dealers

Lienholders

## 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.

District Name	HPC Bridge Slabs & Rails	HPC Sub-structure	Epoxy Coated Reinf. Bridge Slabs & Rails	Epoxy Coated Reinf. Sub-structure	<sup>D</sup> Increased clear cover for bridge slabs	<sup>D</sup> Increased clear cover for sub-structure	Class II (Penetrating) Concrete Surface Treatment	Waive Air Entrainment? (Bridge Slab & Rails)	Waive Air Entrainment? (Sub-structure)	Corrosion Inhibiting Admixtures (Prestressed only)
ABL	Y	Y	Y	Y	Y	See note A	Y	N	Y	N
AMA	Y	Y	Y	Y	Y	See note A	Y	N	N	Y
ATL	Y	Y	Y	Y	Y	See note A	Y	N	Y	N
AUS	N	N	N	N	N	See note A	Y	Y	Y	N
BMT	N	N	N	N	N	See note A	Y	Y	Y	N
BRY	N	N	N	N	N	See note A	Y	Y	Y	N
BWD	Eastland and Stephens counties only.	Eastland and Stephens counties only.	Eastland and Stephens counties only.	Eastland and Stephens counties only.	Eastland and Stephens counties only.	See note A	Y	N	Y	N
CHS	Y	Y	Y	Y	Y	See note A	Y	N	N	Y
CRP	N	N	N	N	N	See note A	Y	Y	Y	N
DAL	Y	Y	Y	N	Y	See note A	Y	N	Y	N
ELP	Y	Y	N	N	Y	See note A	Y	Y	Y	N
FTW	Y	Y	Y	N	Y	See note A	Y	N	Y	N
HOU	N	N	N	N	N	See note A	See Note C	Y	Y	N
<sup>B</sup> LBB	Y	Y	Y	Y	Y	See note A	Y	N	N	Y
LFK	N	N	N	N	N	See note A	Y	Y	Y	N
LRD	N	N	N	N	N	See note A	Y	Y	Y	N
ODA	Andrews, Martin, Midland and Ector counties	N	Andrews, Martin, Midland and Ector counties only.	N	N	See note A	Y	N	Y	N

# Texas Department of Transportation

Providing safe, effective and efficient movement of people and goods.



Business with TxDOT | Careers | Drivers & Vehicles | Local Information | News | Projects | Public Involvement | Safety | Travel | TxDOT Library | About Us

Search TxDOT

E-Mail Us

Districts, Divisions, Offices

Business with TxDOT

Doing Business

Business Outreach

Aviation

Rail

Road Construction

Other Upcoming Projects

Aviation Projects

Freight Transportation

Other Maintenance Projects

Professional Services Projects

Right of Way Acquisition

Scientific Services

Toll Plaza Operations

Contractors/Consultants

Motor Carriers

Motor Vehicle Dealers

Lienholders

## 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](#)

# Texas Department of Transportation

Providing safe, effective and efficient movement of people and goods.



[Business with TxDOT](#) | [Careers](#) | [Drivers & Vehicles](#) | [Local Information](#) | [News](#) | [Projects](#) | [Public Involvement](#) | [Safety](#) | [Travel](#) | [TxDOT Library](#) | [About Us](#)

E-Mail Us

Districts, Divisions, Offices

Business with TxDOT

Doing Business

Business Outreach

Aviation

Rail

Road Construction

Other Upcoming Projects

Aviation Projects

Freight Transportation

Other Maintenance Projects

Professional Services Projects

Right of Way Acquisition

Scientific Services

Toll Plaza Operations

Contractors/Consultants

Motor Carriers

Motor Vehicle Dealers

Lienholders

Public-Private Partnerships

Government

Conferences & Meetings

Training & Development

## 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 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

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](#)

# Recommendations

# 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

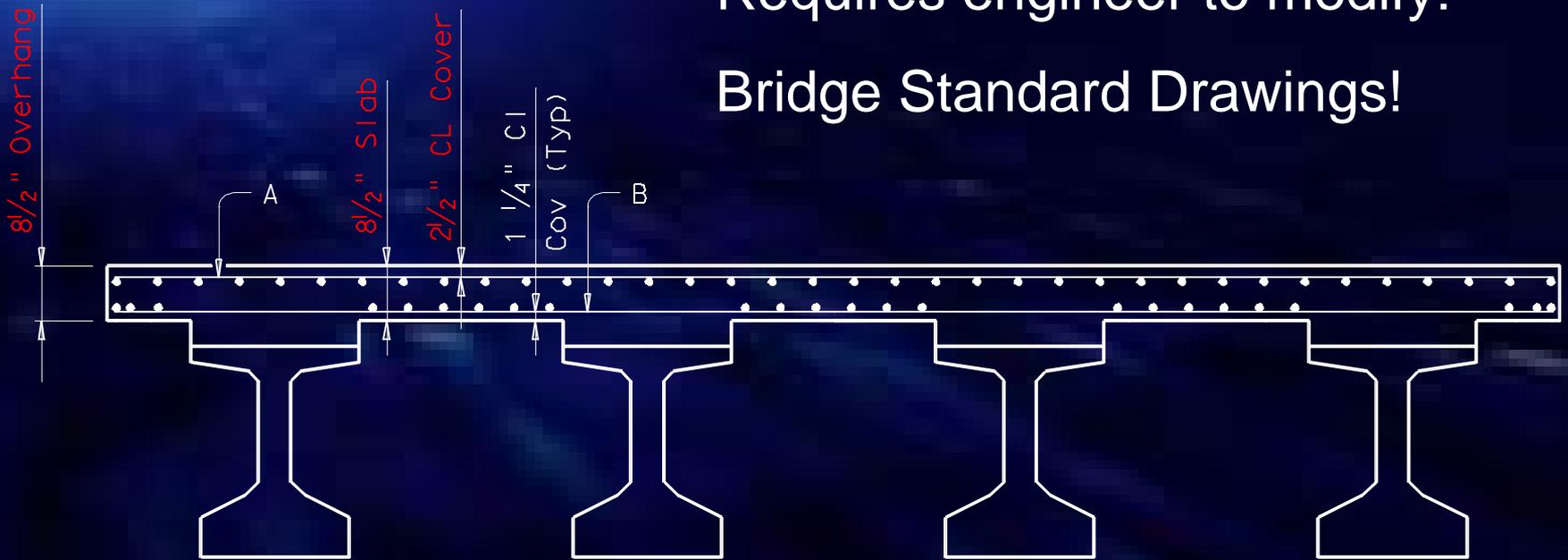


# Increased Clear Cover

- Bridge Slabs
  - 2 1/2" clear cover top reinforcing
  - Increase slab thickness
- Direct traffic culvert top slabs
- CG (pan form) – Do not increase cover

# 8 1/2 inch Deck on Tx Girders

Requires engineer to modify:  
Bridge Standard Drawings!



# Increased Clear Cover

- Substructure
  - Case-by-case basis at District discretion
  - 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



CAP SLOPE  
DETAIL

---

---

# 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 ~ 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?

# Texas Department of Transportation

Providing safe, effective and efficient movement of people and goods.



Business with TxDOT | Careers | Drivers & Vehicles | Local Information | News | Projects | Public Involvement | Safety | Travel | TxDOT Library | About Us

Search TxDOT

E-Mail Us

Districts, Divisions, Offices

Business with TxDOT

Doing Business

Business Outreach

Aviation

Rail

Road Construction

Other Upcoming Projects

Aviation Projects

Freight Transportation

Other Maintenance Projects

Professional Services Projects

Right of Way Acquisition

Scientific Services

Toll Plaza Operations

Contractors/Consultants

Motor Carriers

Motor Vehicle Dealers

Lienholders

## 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](#)

*Thank You*

Lloyd M. Wolf, P.E.  
512-416-2279  
Lloyd.Wolf@txdot.gov

