

Michigan Bridge Design Standards and Guides

Bridge Week
March 17-19, 2026

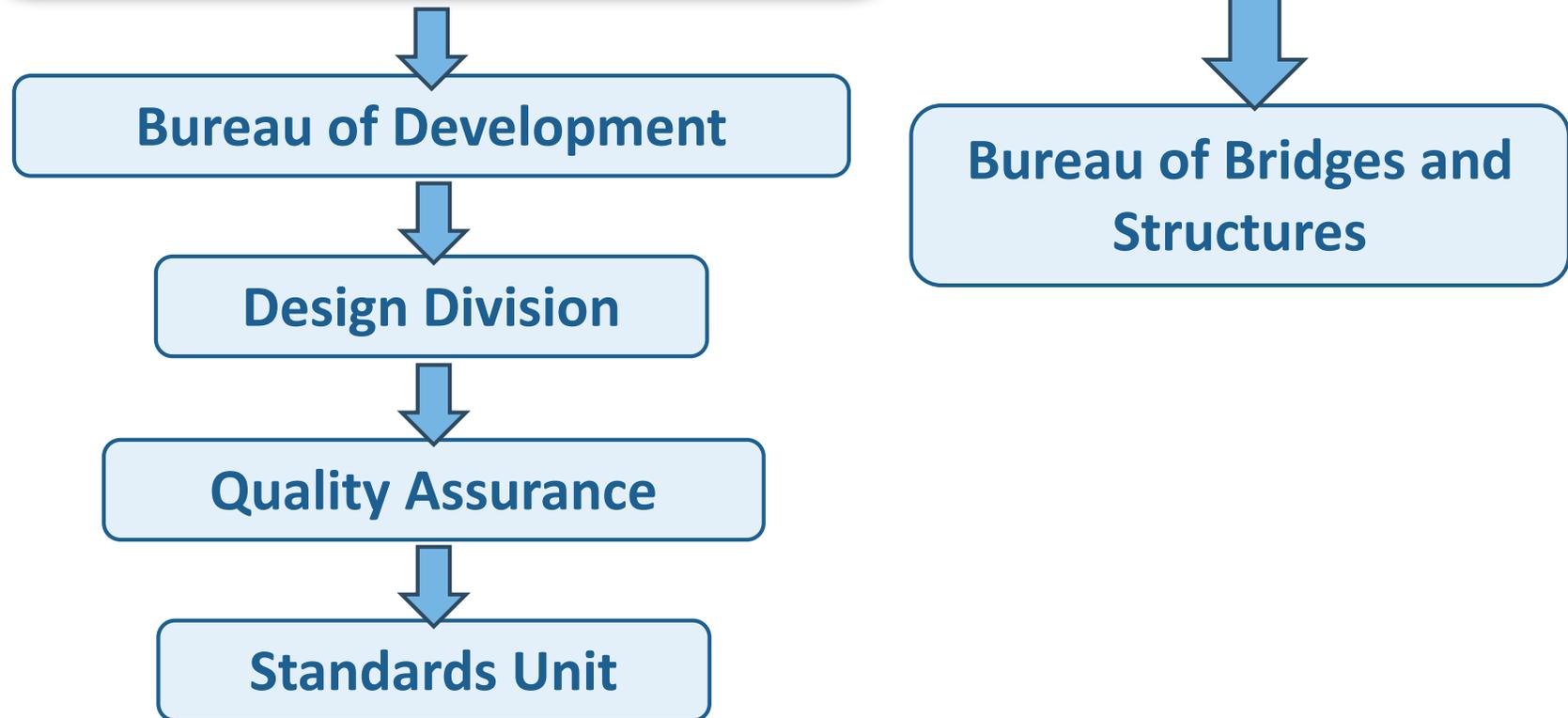
Michigan Design Standards

The Five Ws:

- Who?
- What?
- Why?
- Where?
- When?



Who?



Contact Us:

Standard Plans Information

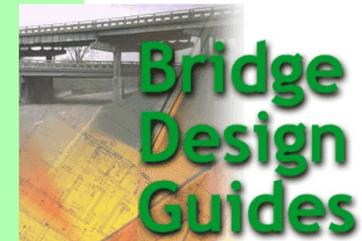
For information regarding the technical content of the Standard Plans contact:

Road Standards: MDOT-Road-Design-Standards@Michigan.gov

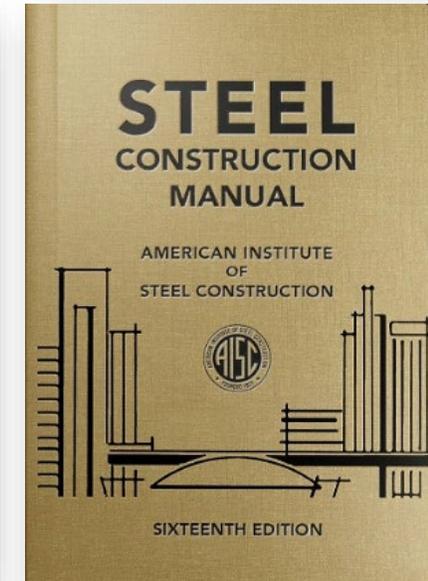
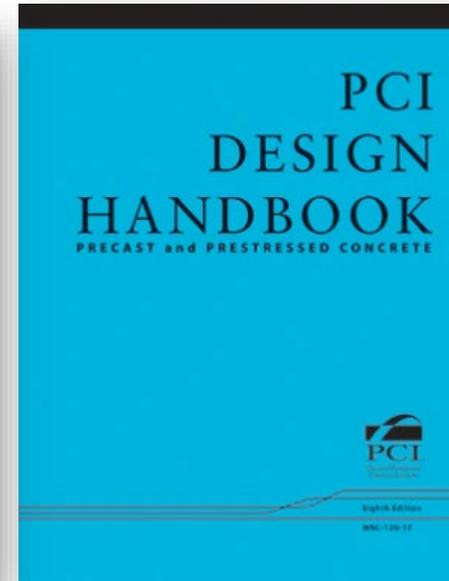
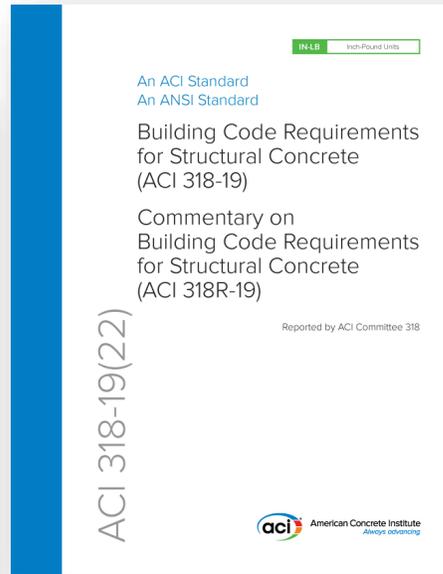
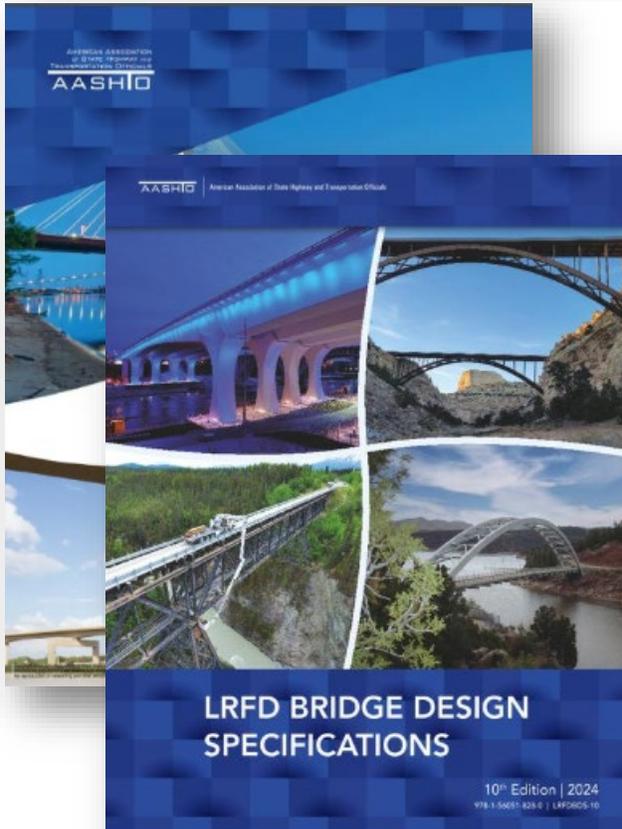
Bridge Standards: MDOT-Bridge-Design-Standards@Michigan.gov

What?

- Bridge Design Manual
- Road Design Manual
- Bridge Design Guides
- Road and Bridge Standard Plans and Special Details



The Bridge Design Manual



And more!

Bridge Design Guides

- Common details
- Clarifications
- Definitions
- Examples

PREFACE TO MICHIGAN DEPARTMENT OF TRANSPORTATION BRIDGE DESIGN GUIDES

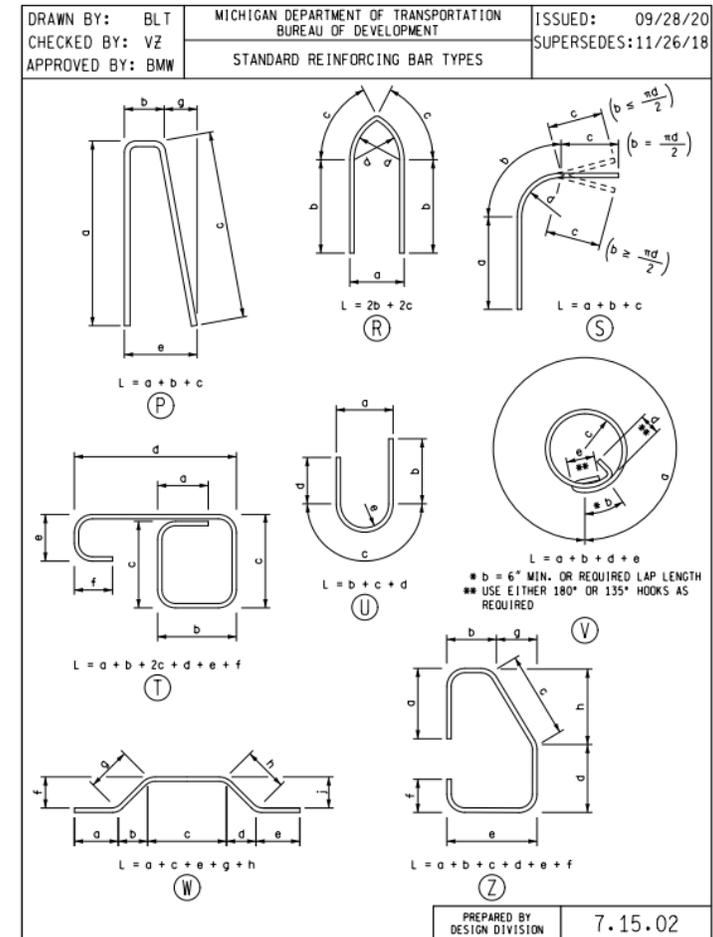
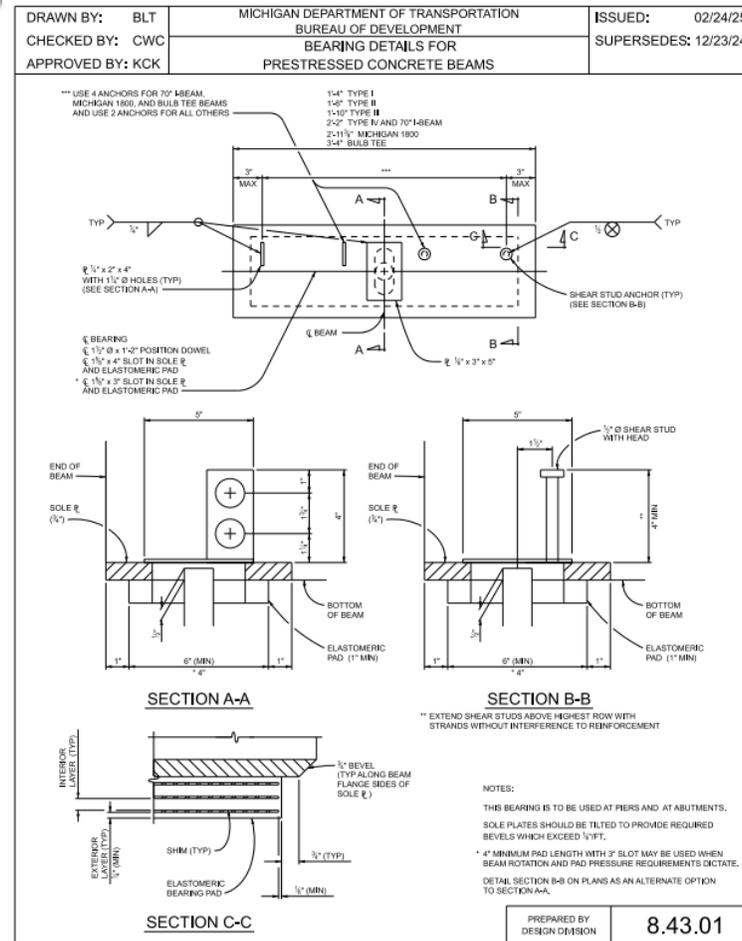
These Guides have been developed to serve as an aid for designing and detailing bridges in Michigan. The intent is to provide consistency in office practice and interpretation of current Specifications.

It is recognized that the details within these Guides are ever evolving, not applicable to all situations and that judgment must be used at times.

The Guides contained herein are to be used for reference only. When using details on plans, designers and detailers shall confirm that design calculations/assumptions, dimensions and notes are appropriate for job specific situations. It is the responsibility of the designer and/or detailer to ensure that all details and notes are the most current and comply with the appropriate specifications (AASHTO, AREMA, AWS, ASTM, MDOT, etc.).

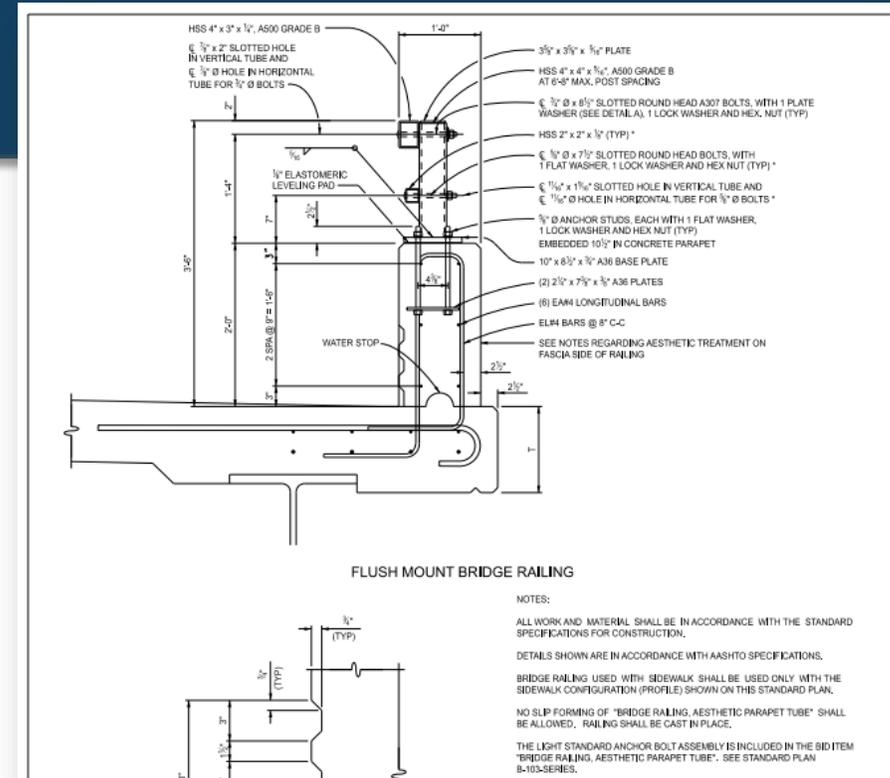
Bridge Design Guides continued

Not a substitute for design!



Special Details

- Similar to the bridge design guides
- Can be used for design
- Included with plans
- Cannot be altered
- Regularly updated!



STANDARD PLAN FOR BRIDGE RAILING, AESTHETIC PARAPET TUBE

DEPARTMENT DIRECTOR
BRADLEY C. WIEFERICH, PE

(SPECIAL DETAIL)
FHWA APPROVAL

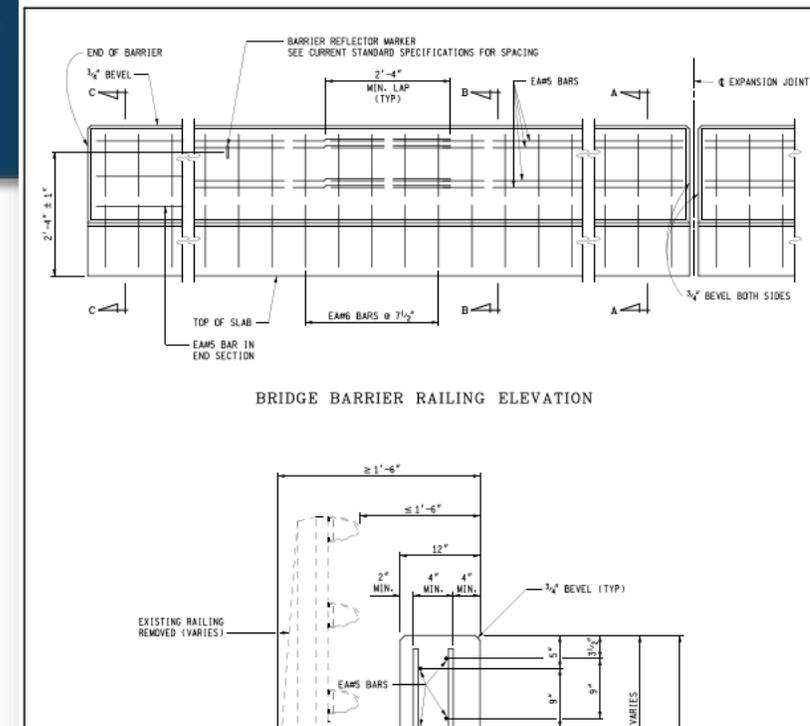
09/09/2024
PLAN DATE

B-25-L

SHEET
1 OF 8

Standard Plans

- Used for design
- Referenced in plans on the project information sheet
- Fully approved by the FHWA



 PREPARED BY DESIGN DIVISION DRAWN BY: <u>B.L.T.</u> CHECKED BY: <u>V.Z.</u>	DEPARTMENT DIRECTOR Paul C. Ajegba	MICHIGAN DEPARTMENT OF TRANSPORTATION BUREAU OF DEVELOPMENT STANDARD PLAN FOR BRIDGE RAILING, CONCRETE BLOCK RETROFIT (CURB HEIGHT ≥ 10")			
	APPROVED BY: <u>Matthew J. Chynoweth, P.E.</u> DIRECTOR, BUREAU OF BRIDGES AND STRUCTURES	Matthew J. Chynoweth Oct 14 2021 4:28 PM	<div style="border: 2px solid red; padding: 2px;"> 4-7-2022 F.H.W.A. APPROVAL </div>	9-29-2021 PLAN DATE	B-50-A
	APPROVED BY: <u>Gregg Brunner, P.E.</u> DIRECTOR, BUREAU OF FIELD SERVICES	Gregg Brunner Oct 14 2021 12:30 PM			
	APPROVED BY: <u>Bradley C. Wiefelich</u> DIRECTOR, BUREAU OF DEVELOPMENT	Bradley C. Wiefelich Oct 14 2021 10:59 AM	SHEET 1 OF 3		

Why?

To ensure **public safety, structural integrity** and **consistency** across the transportation network.



Image of the H-20 Design Truck configuration introduced in 1931.

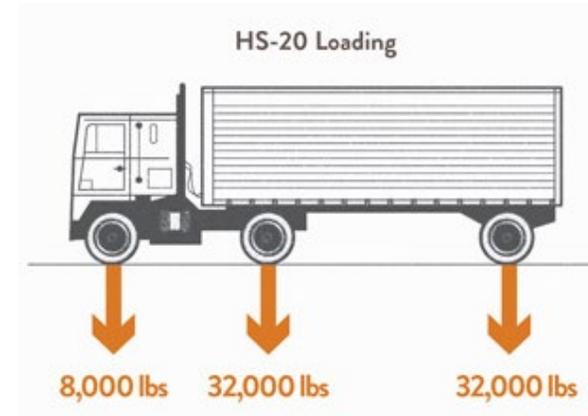
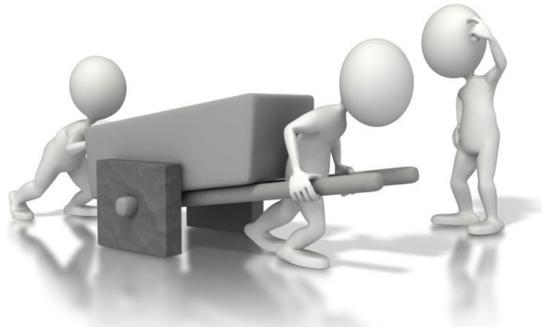


Image of the HS-20 Design Truck configuration introduced in 1944.

Lessons from Failures and Testing



The Standards Effect



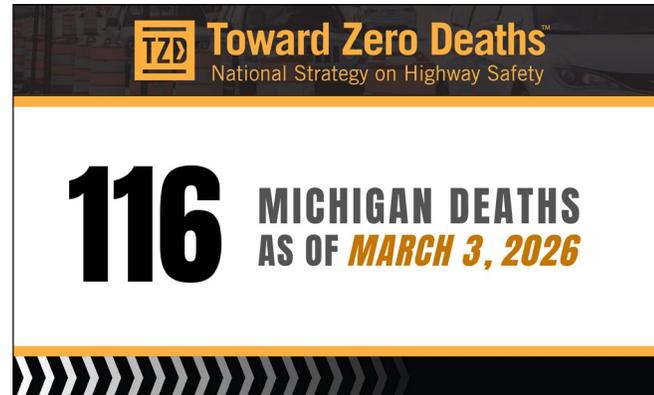
Simplify



Consistency/
Familiarity

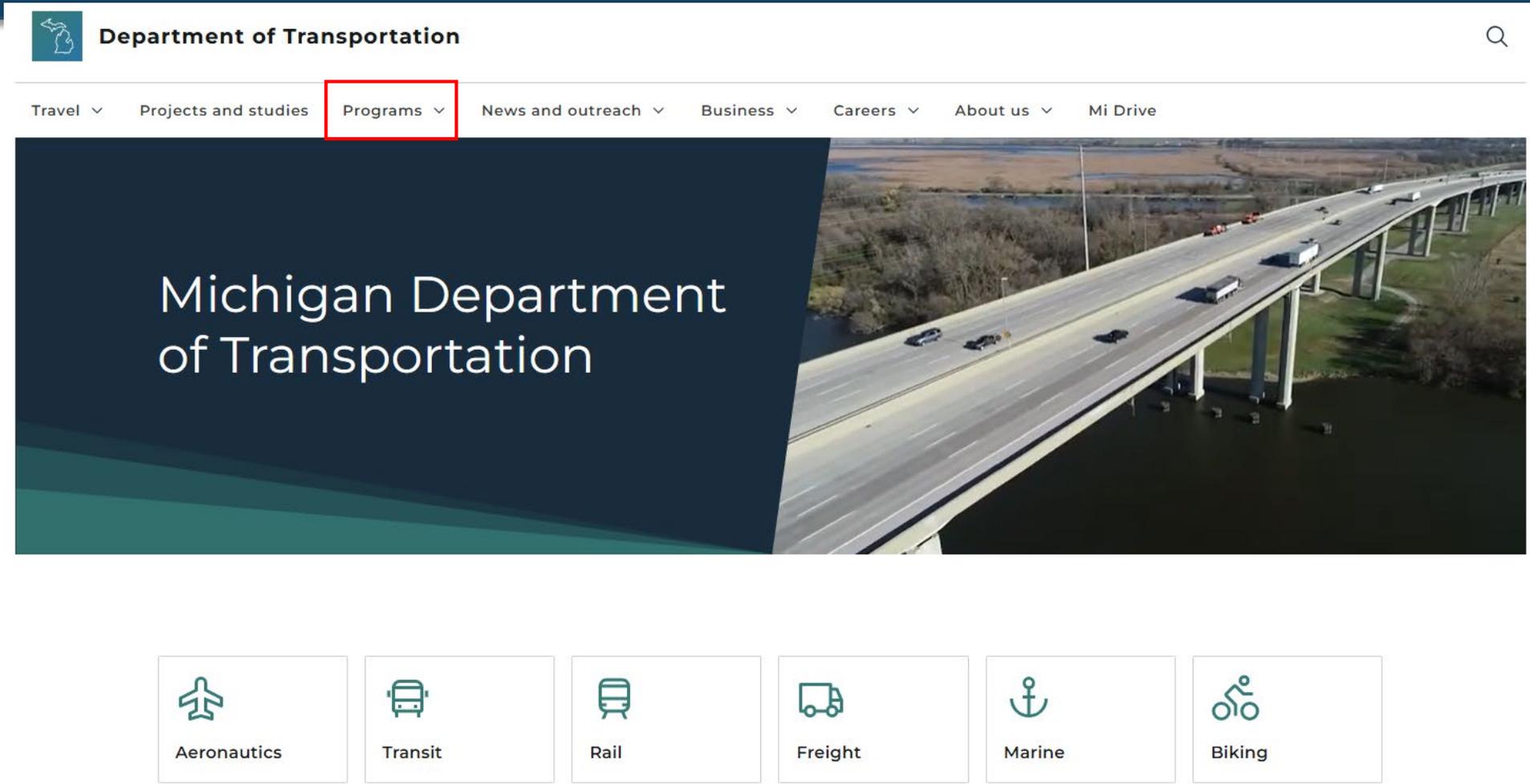


Increase
Efficiency



Safety

Where?



The screenshot shows the Michigan Department of Transportation website. At the top left is the MDOT logo and the text "Department of Transportation". A search icon is at the top right. A navigation bar contains the following items: "Travel", "Projects and studies", "Programs" (highlighted with a red box), "News and outreach", "Business", "Careers", "About us", and "Mi Drive". Below the navigation bar is a large banner image of a highway bridge over a river. The text "Michigan Department of Transportation" is overlaid on the left side of the banner. At the bottom of the page, there are six icons representing different transportation modes: Aeronautics (airplane), Transit (bus), Rail (train), Freight (truck), Marine (anchor), and Biking (bicycle).



Programs

[Go to Programs](#) >

[External Civil Rights](#)

[Title VI Nondiscrimination](#)

[Equal Employment Opportunity \(EEO\) for Contractors](#)

[Small Business Program](#)

[Bridges and Structures](#) >

[Grant programs](#) >

[Highway Programs](#) >

[Planning](#) >

[Research Administration](#) >

[Transportation System Management & Operations](#) >

[Tribal Affairs](#)

Bridges and Structures

[Go to Bridges and Structures](#) >

The Bureau of Bridges and Structures is responsible for statewide policy, procedure development, and execution to ensure all bridges and structures are designed, constructed, maintained, and operated to ensure safety.

[Geotechnical Services](#)

[Structure Construction](#)

[Structure Design](#)

[Structure Preservation and Management](#)

Structure Design



Resources

- [Bridge Design Manual](#)
- [Road Design Manual](#)
- [Bridge Design Guides](#)
- [Road and Bridge Standard Plans](#)
- [Road and Bridge Special Details](#)
- [Guidelines for Plan Preparation, Bridge Sample Plans](#)
- [Miscellaneous Bridge Details \(expansion joint and beam sheet details\)](#)

Constructability assessment tools

- [Constructability evaluation tools](#)
- [Crane assessment tool](#)

Design examples

The designs illustrated in the examples are implemented in accordance with policies documented in the AASHTO LRFD Bridge Design Specifications, MDOT Bridge Design Manual and MDOT Bridge Design Guides that were current at the time of their development. Certain material and design parameters are selected in the design examples to be in compliance with MDOT practice reflected in the Bridge Design System (BDS), the MDOT legacy software.

- [Prestressed concrete beam design example](#)
- [Steel plate girder design example](#)
- [Bridge abutment design example](#)
- [Hammerhead pier design example](#)
- [Multi-column pier design example](#)

[Survey Manual](#)

[English Bridge Guides](#)

[English Bridge Manual](#)

[Geometric Design Guides](#)

[English Road Manual](#)

 [Road and Bridge Design Publications Email Updates](#)

[Standard Plans](#)

English Bridge Design Manual

This manual requires the Adobe Acrobat Reader. [You can get it free from Adobe!](#)



Question or comments regarding the technical content of the Bridge Design Manual can be sent to:

Email: MDOT-Bridge-Design-Standards@michigan.gov

[Road and Bridge Design Publications - Monthly Update](#)

Associated Material

[Bridge Sample Plans](#)

[Engineering Manual Preamble](#)

[Exempted Bridges on Special Routes in Highly Urbanized Areas](#)

[Foreword](#)

[1 - Introduction](#)

[2 - Steps in Producing Plans](#)

[3 - Plan Composition - New and Reconstruction Projects](#)

[4 - Plan Composition - Rehabilitation Projects](#)

[5 - Consultant Contracts](#)

[6 - Plan Sheet Examples](#)

[7 - Design Criteria - New and Reconstruction Projects](#)

[7 - Design Criteria - New and Reconstruction Projects - LFD](#)

[8 - Plan Notes](#)

[9 - Detailing Practices](#)

[10 - Shop Drawing Review](#)

[11 - Plan Revisions](#)

[12 - Rehabilitation Projects](#)

[13 - Railroad Crossings](#)

[14 - Permit Applications](#)

[15 - Specifications](#)

[Complete English Bridge Design Manual](#)

Structure Design



Resources

- [Bridge Design Manual](#)
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English Bridge Design Guides

This manual requires the Adobe Acrobat Reader Plugin. [You can get it free from Adobe!](#)



For information regarding the technical content of the Bridge Design Guides contact:

Email: MDOT-Bridge-Design-Standards@michigan.gov

Bridge Design Guides can be downloaded and printed without charge.

[English Bridge Design Guides - Complete Set](#)

[English Bridge Design Guides - Distribution Package](#)

[English Bridge Design Guides Index](#)

[English Bridge Design Guides Engineering Manual Preamble](#)

[English Bridge Design Guides Preface](#)

*** Design Guides that are marked with an asterisk have not been included in this set. They will be distributed as they become available.**

Select a English Bridge Guide category from the drop down menu:

No Documents Available

[Michigan.gov Home](#) [State Web Sites](#) [Policies](#)

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Structure Design



Resources

- [Bridge Design Manual](#)
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- [Hammerhead pier design example](#)
- [Multi-column pier design example](#)

[Introduction](#)

[Engineering Manual Preamble](#)

[Standard Plans Index](#)

[Road Plans](#)

[Bridge Plans](#)

Keyword Search

Select a Keyword

Search

OR Type in a Keyword

Search Keywords

Search

[Special Details](#)

[Memos & Updates](#)

[Road and Bridge Design
Publications Email Updates](#)

Associated Material

[2020 Standard Specifications
for Construction](#)

Standard Plans

General

Standard Plans are engineering drawings showing standard details of various construction items, representing the current policies of the Michigan Department of Transportation (MDOT), approved for repetitive use where appropriate. The drawings are produced in the Design Standards Unit for statewide use by the Department, counties and cities and are used in conjunction with the Standard Specifications for Construction and other applicable specifications, policies and manuals. Current applicable Standard Plans are listed on the note sheet of a set of construction plans.

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Viewing Information

Get Adobe Acrobat Reader Icon The Standard Plans are available in portable document format (pdf). You will need Adobe Acrobat Reader software to read or print the Standard Plans. This software is free and may be downloaded from the [Adobe Website](#).

Standard Plans Information

For information regarding the technical content of the Standard Plans contact:

Road Standards: E-mail: MDOT-Road-Design-Standards@michigan.gov

Bridge Standards: E-mail: MDOT-Bridge-Design-Standards@michigan.gov

[Road and Bridge Standard Plans - Complete Book](#)

[Road and Bridge Standard Plans - Distribution Package](#)

Structure Design



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- [Hammerhead pier design example](#)
- [Multi-column pier design example](#)

Special Details

Introduction

Special Details Index

Keyword Search

- Select a Keyword
- Approach
- Barrier
- Bridge
- Concrete
- Cover
- Culvert
- Curb
- Drain
- End Section
- Fence/Fencing
- Guardrail
- Gutter
- Joint
- Manhole
- Railing
- Repair
- Shoulder

2020 Standard Specifications for Construction

Bridge Design Guides

Special Details

General

Special details are engineering drawings that are frequently draft versions of Standard Plans in the approval process. Once Department Administrators and the FHWA approve a special detail, it becomes a Standard Plan. The Design Standards Unit also produces special details of experimental items that may or may not become Standard Plans and of items that have a special limited use. Most special details that have a special limited use are eventually dropped when all the conditions they were specifically designed for have been met. Current applicable special details are listed on the note sheet of a set of construction plans and are also physically attached to those plans.

Disclaimer

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Viewing Information

Get Adobe Acrobat Reader Icon The Standard Plans are available in portable document format (pdf). You will need Adobe Acrobat Reader software to read or print the Standard Plans. This software is free and may be downloaded from the [Adobe Website](#).

The special details in 11" x 17" pdf format are intended for inclusion in a set of construction plans. Consultants doing business with MDOT may contact their Project Manager to obtain special details.

Special Detail Information

For information regarding the technical content of the special details contact:

Road Special Details: E-mail: MDOT-Road-Design-Standards@michigan.gov

Bridge Special Details: E-mail: MDOT-Bridge-Design-Standards@michigan.gov

Bridge Plans

[View/Print Index in PDF](#)

Download [Special Details](#)

[Up to Road](#)

Bridge Plan Number		Bridge Plan Title	Bridge Plan Date
Bridge Plan Letter Size: ▲ 8.5"x11"	Bridge Plan Tabloid Size: ▼ 11"x17"		
B-21-K	*B-21-K	BRIDGE RAILING, 2 TUBE	09/10/2024
B-25-L	*B-25-L	BRIDGE RAILING, AESTHETIC PARAPET TUBE	09/09/2024
B-26-G	*B-26-G	BRIDGE RAILING, 4 TUBE	09/06/2024
B-27-B	*B-27-B	BRIDGE RAILING, 3 TUBE WITH PICKETS	09/11/2024
B-28-A	*B-28-A	BRIDGE BARRIER RAILING, TYPE 7	12/17/2025
B-29-A	*B-29-A	BRIDGE BARRIER RAILING, TYPE 6	12/17/2025
B-41-D	*B-41-D	FENCING FOR BRIDGE RAILING, ASETHETIC PARAPET TUBE	12/10/2025
B-42-A	*B-42-A	FENCING FOR BRIDGE RAILING, 3 TUBE WITH PICKETS	01/05/2026
B-102-D	*B-102-D	STANDARD SLOPE PAVING DETAILS	09/18/2023
B-103-F	*B-103-F	MOLDING, BEVEL, LIGHT STANDARD ANCHOR BOLT ASSEMBLY AND NAME PLATE DETAILS	12/08/2023

Showing 1 to 10 of 10 entries

***Note:**The special details in 11" x 17" pdf format are intended for inclusion in a set of construction plans. Consultants doing business with MDOT may contact their Project Manager to obtain special details.

Expansion joint sheets and beam sheets have moved. See [Miscellaneous Road, Bridge, and Lighting Details](#) link in column at left.

[Michigan.gov Home](#) [State Web Sites](#) [Policies](#)

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Structure Design

Resources

- [Bridge Design Manual](#)
- [Road Design Manual](#)
- [Bridge Design Guides](#)
- [Road and Bridge Standard Plans](#)
- [Road and Bridge Special Details](#)
- [Guidelines for Plan Preparation, Bridge Sample Plans](#)
- [Miscellaneous Bridge Details \(expansion joint and bearings details\)](#)

Constructability assessment tools

- [Constructability evaluation tools](#)
- [Crane assessment tool](#)

This link will currently bring you to the MDOT Wiki, which is no longer supported. The MDOT Development Guide is now housed on the MDOT SharePoint Site; see Chapter 1 of BDM:

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

1.01 MDOT DEVELOPMENT GUIDE

The MDOT Development Guide is currently available only on the State of Michigan (SOM) SharePoint Site which is open to all SOM Employees. However, external access for design engineers that are not SOM Employees but are responsible for producing road or bridge plans in Michigan is available. Consultants should contact MDOT Engineering Support at MDOT-EngineeringSupportTraining@michigan.gov for instructions on how to create and maintain a SOM M365 guest account to receive access.

Structure Design



Resources

- [Bridge Design Manual](#)
- [Road Design Manual](#)
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- [Hammerhead pier design example](#)
- [Multi-column pier design example](#)

Miscellaneous Road, Bridge, and Lighting Details

Download [Miscellaneous Road, Bridge, and Lighting Details](#)

Plan Number		Title	Date
PDF	DGN		
8-LFD	N/A	BDM Chapter 8 - Plan Notes - LFD	
8-LRFD	N/A	BDM Chapter 8 - Plan Notes	
B-17-D	B-17-D	BRIDGE BARRIER RAILING, TYPE 4	
B-20-D	B-20-D	BRIDGE BARRIER RAILING, TYPE 5	
B-39-C	B-39-C	FENCING FOR PEDESTRIAN STRUCTURE NEW TYPE 4 & 5 BARRIER	
Barrier	Barrier	Bridge Barrier Railing Type 4 and Type 5 Bridge Design Guides	
Box Beam	Box Beam	Discontinued Side by Side Box Beam Bridge Design Guides	
EJ3AG	* EJ3AG	EXPANSION JOINT DETAILS	04/24/2025
EJ4T	* EJ4T	EXPANSION JOINT DETAILS	04/28/2025
PC-1Q	N/A	PRESTRESSED CONCRETE I-BEAM DETAILS	12/22/2025
PC-2L	N/A	70" PRESTRESSED CONCRETE I-BEAM DETAILS	12/22/2025
PC-4J	N/A	PRESTRESSED CONCRETE 1800 BEAM DETAILS	12/22/2025
PC-5D	N/A	PRESTRESSED CONCRETE BULB-TEE BEAM DETAILS	12/22/2025

Showing 1 to 13 of 13 entries

***Note:**Details EJ3-Series & EJ4-Series are interactive, i.e. designers and detailers choose details based upon railing type and angle of crossing and fill in the project specific dimensions for the end plate. Place all details appropriate for the project (including the end plate), structure specific information, and the Expansion Joint Device quantity on the sheet(s). Add the sheet(s) to the plans as normal plan sheets. Call out and designate the location of the expansion joint device and the end plate on the Superstructure Sheet in the plan set. Include Rail Splice Detail sheet with all plans including an Expansion Joint Device. Manufacturer specific expansion joint device details currently approved for use are located here.

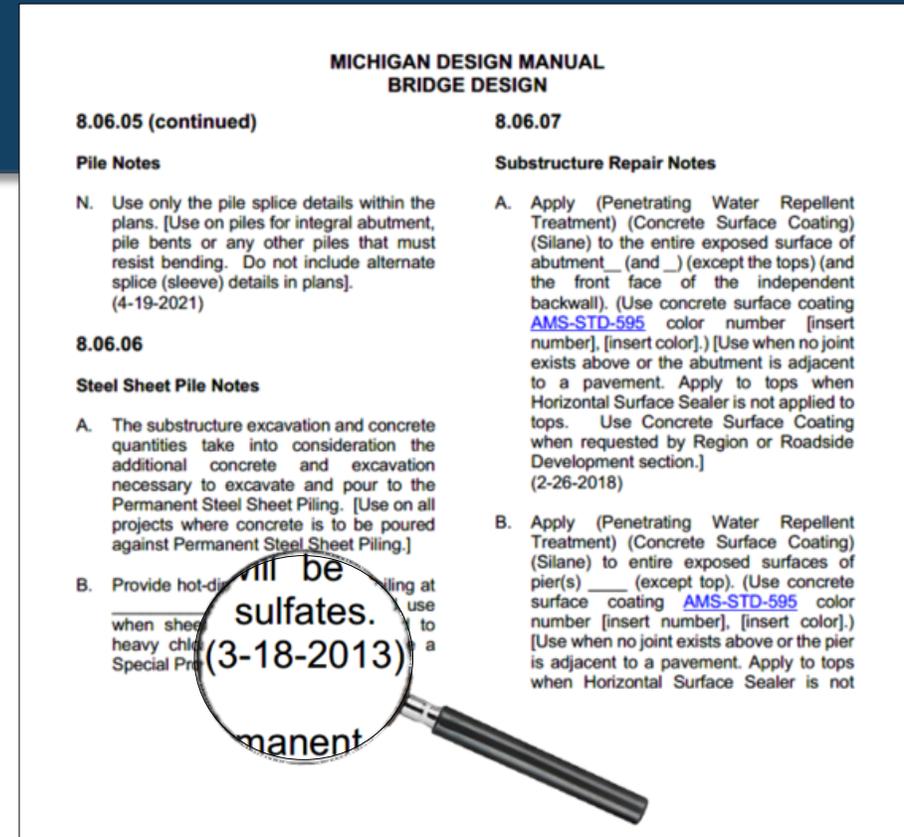
[DS Brown](#)

[Structural Rubber Products](#)

[Watson Bowman Acme](#)

When?

- At the start of a project:
 - ✓ Check for the latest versions!
 - ✓ Check for changes in details.
 - ✓ Check for changes in policy.
 - ✓ Check for changes in submittals.
- At the end of a project:
 - ✓ Make sure you are using the proper Special Details.
 - ✓ Ensure you are referencing the correct Standard Details.
 - ✓ Make sure you are using **up-to-date** Plan Notes.



BDM Chapter 8 - Plan Notes

- Notes in Chapter 8 are intended as a guide, not as a complete list for all cases.
- Fill in blanks with the appropriate word or words.
- Adjust notes to specific project needs.
- Do not use notes to add work to standard pay items or to add requirements to the contractor that are not already included in the Spec Book or Special Provisions.
- Use when writing unique plan notes.
 - Refer to Chapter 8.00 for helpful guidance on writing unique plan notes.

How?

- **To use Standards:**

- Guidance
- Examples
- Templates
- Procedures

- **Not to use Standards:**

- Copy and paste
- Only source of information
- Replacement for design



Updating Michigan's Standards

Design



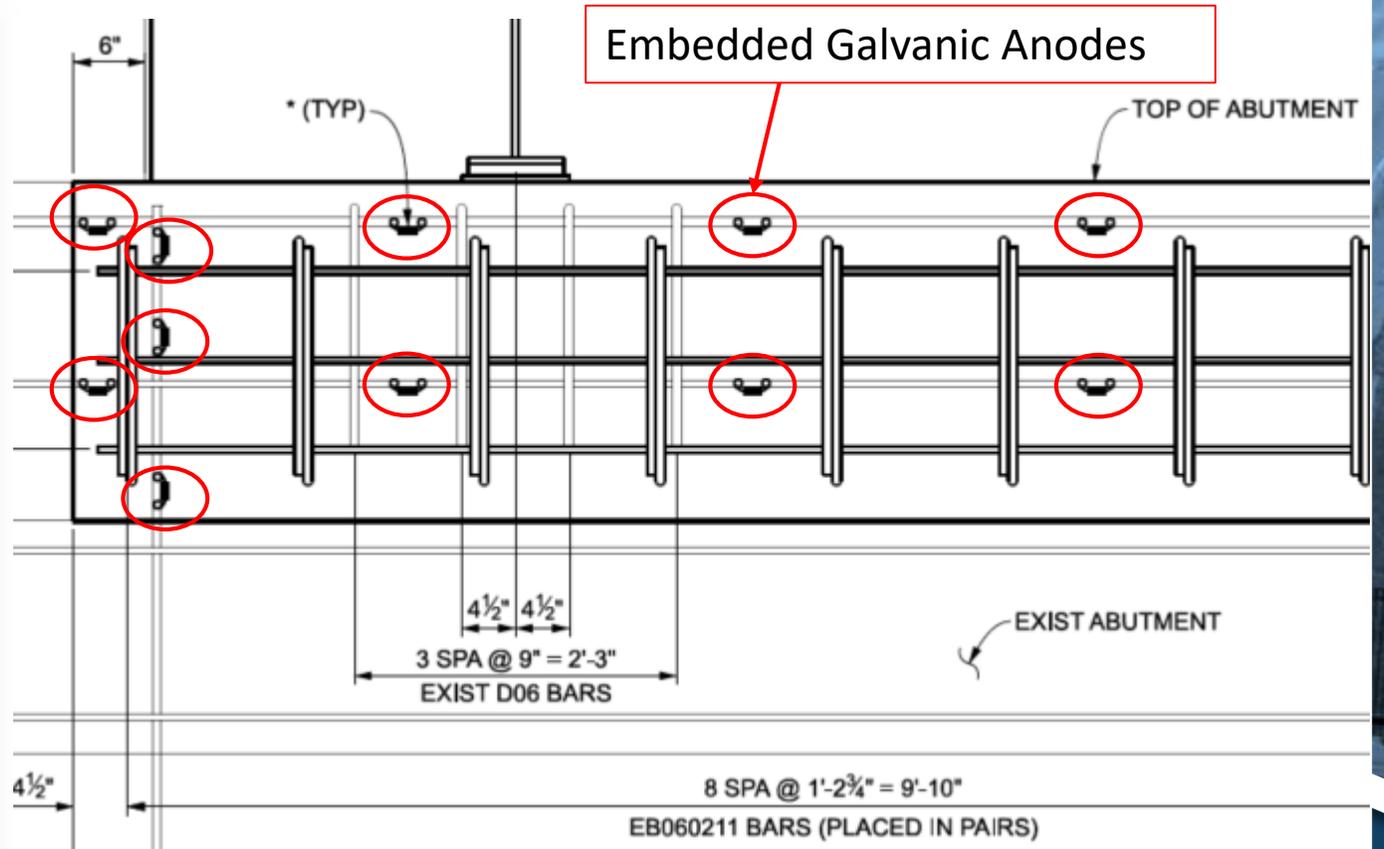
Construction



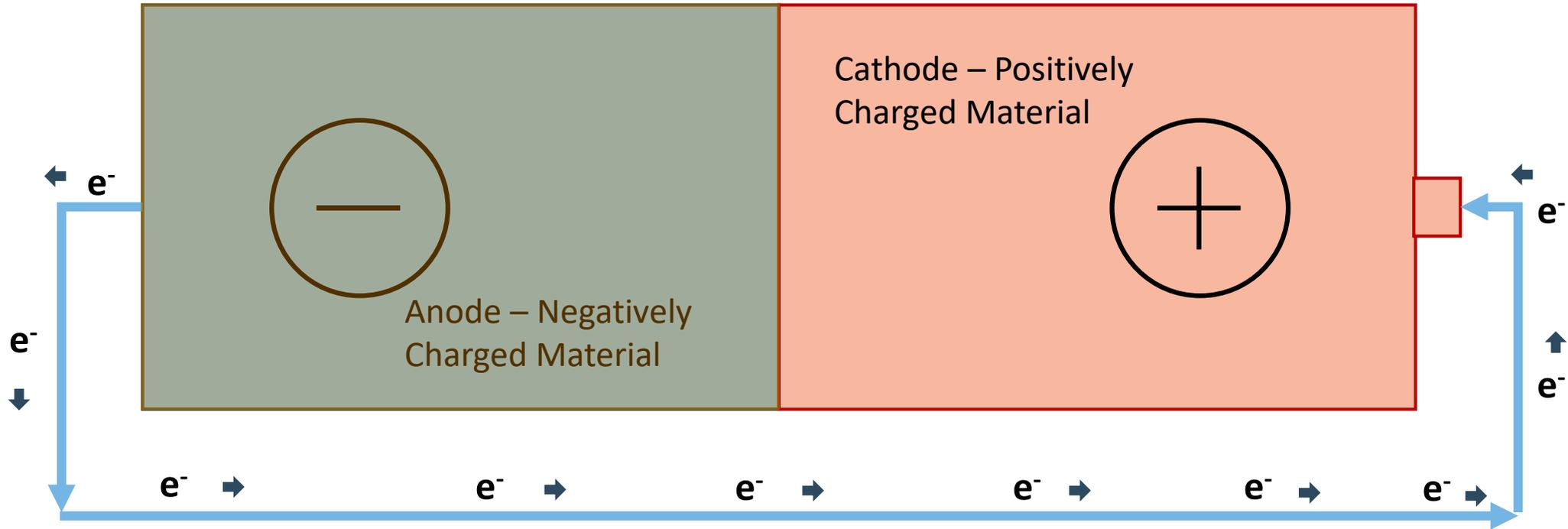
Fabrication



Galvanic Anodes

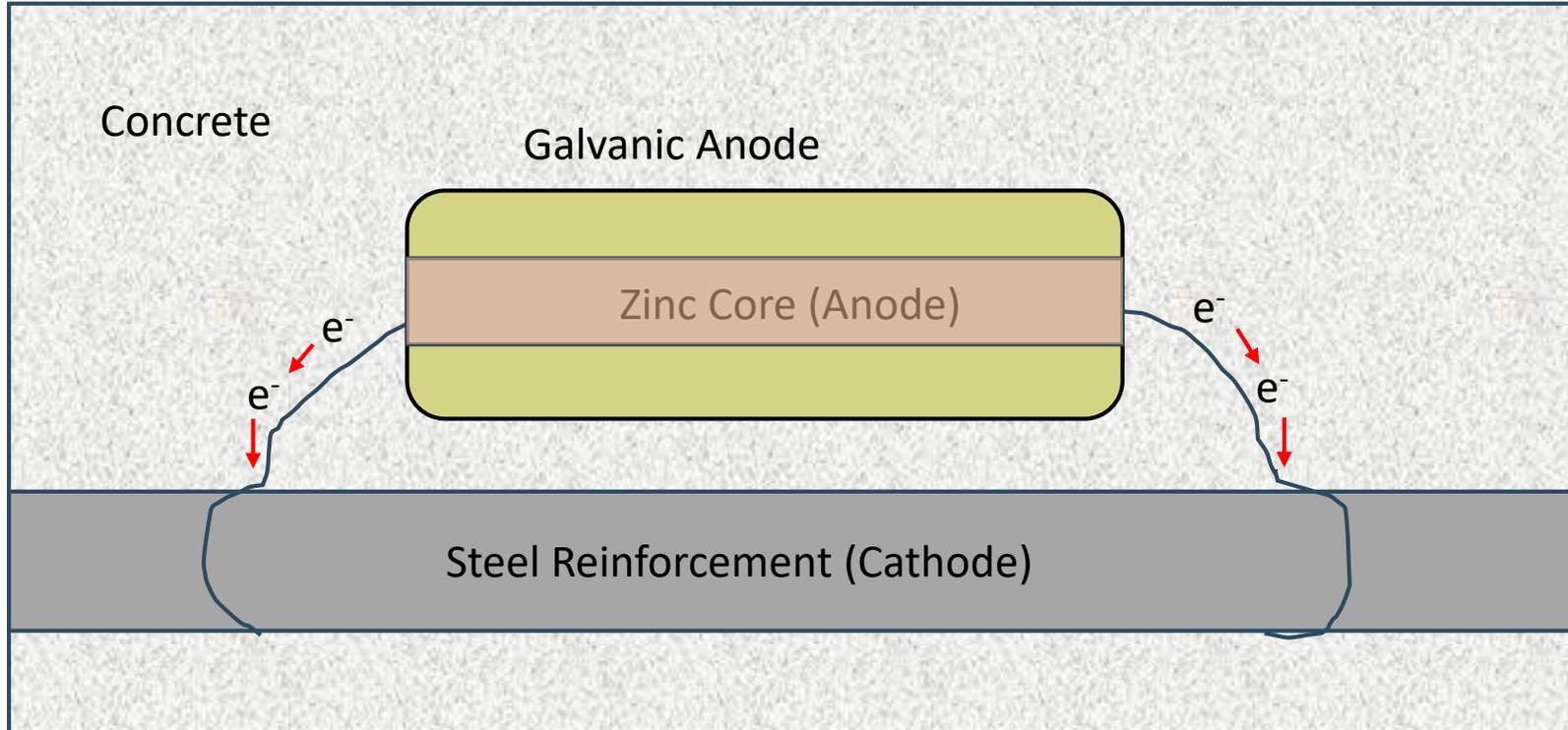


The Chemistry of GAs



As the anode loses electrons, it undergoes oxidation which causes corrosion.

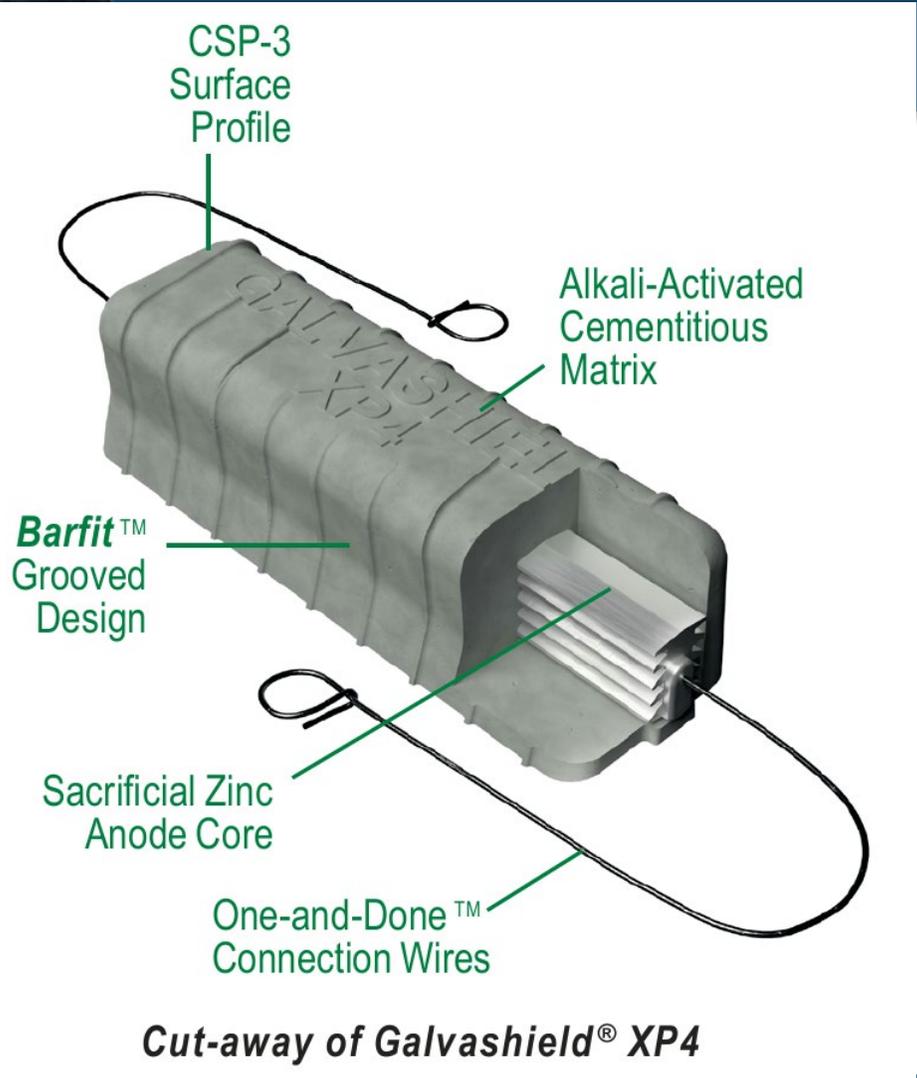
The Chemistry of Gas (continued)



**CHLORIDE CONTAMINATED
CONCRETE**

CHLORIDE-FREE PATCH

**ANODE GALVANICALLY PROTECTS
SURROUNDING REBAR**



Qualified Products List (QPL)		
Spec # and Material Name	Product Name	Manufacturers or Suppliers
712.03Y Embedded Galvanic Anodes	LifeAnode 65, 105 and 160	ARTAZN LLC
	MasterProtect CP Models: 8065, 8105, 8150	BASF Chemical Company
	RebaGuard	CPT/No Corrosion
	RebaGuard Plus	CPT/No Corrosion
	RebaGuard Ultra	CPT/No Corrosion
	Sentinel-GL	Euclid Chemical Co.
	Mapeshield I 70, I 105, I 10/10, I 10/20, I 30/10, and I 30/20	Mapei Corporation
	Sika Galvashield XP	Sika Corporation
	Sika Galvashield XP+	Sika Corporation
	Sika FerroGard 650, 670, 675	Sika Corporation
	Galvashield XP2	Vector Corrosion Technologies, Inc.
	Galvashield XP4	Vector Corrosion Technologies, Inc.
	Galvashield XPX	Vector Corrosion Technologies, Inc.
Galvashield XP+	Vector Corrosion Technologies, Inc.	
Galvashield XPC	Vector Corrosion Technologies, Inc.	
Galvashield XPT	Vector Corrosion Technologies, Inc.	

Galvanic Anodes



SPECIFICATION CLAUSE

Embedded galvanic anodes shall be pre-manufactured with zinc in compliance with ASTM B418 Type II cast around an integral, unspliced, uncoated, non-galvanized double loop steel tie wire and encased in a highly alkaline cementitious shell with a pH of 14 or greater. The anode unit shall contain no intentionally added chloride, bromide or other constituents that are corrosive to reinforcing steel (refer to ACI 562-13, Section 8.4.1). The galvanic anode size and spacing shall be based on achieving the minimum current density for the appropriate corrosion risk category as referenced on the technical data sheet design criteria **20 years after installation.**



Anode Spacing

The following anode spacing guidelines are based on achieving the minimum current density for the appropriate corrosion risk category **20 years after installation.**



EUCLID CHEMICAL PRODUCT CHARACTERISTICS

FEATURES/BENEFITS

- Offers the highest self-generating protective current output of any cathodic protection device on the market ensuring long service life and large coverage area
- Allows the use of repair materials with resistivity values up to 30,000 ohm-cm
- Unique v-notch design snugly fits against any size rebar and minimizes removal of concrete assuring easy, efficient placement using standard tools, reduces labor requirements and lowers installation costs
- Exclusive insulating barrier design will not "dump" current into attachment bar extending the coverage area and service life of the cathodic protection device
- Engineered to provide long lasting service that maximizes the life of the repair and delivers an excellent cost benefit advantage. SENTINEL anodes are designed to deliver beneficial protective current **for 10 to 20 years***, thus allowing the owner to skip a repair cycle or two
- Galvanized tie wire will not rust and mounts tightly to rebar forming a secure connection
- Many successful project references available

*Current required to completely prevent corrosion of steel in concrete will vary with conditions, as will effective service life

Galvanic Anodes

- The design (spacing) depends on:
 - How much corrosion is anticipated
 - The amount of steel that needs to be protected
 - The amount of zinc in the anode

Galvanic Anodes



DESIGN CRITERIA

Corrosion Risk Category	Chloride Level*	Minimum Current Density at 20 Years**
Low to Moderate	<0.8%	0.4mA/m ² (0.04mA/ft ²)
High	0.8%-1.5%	0.8mA/m ² (0.07mA/ft ²)
Extremely High	1.5%	1.6mA/m ² (0.15mA/ft ²)

* Chloride content is based on percent by weight of cement.

**Design current densities for the XPX are double the standard current densities at 20 years.



EUCLID CHEMICAL

Low corrosion levels: < 4 lb/yd³ (< 2.4 kg/m³)

Moderate corrosion levels: 4 - 8 lb/yd³ (2.4 - 4.7 kg/m³)

High corrosion levels: > 8 lb/yd³ (> 4.7 kg/m³)



Table 1 - Design Criteria:

Corrosion Risk Category	Chloride Content***	Minimum Current Density at 20 Years
Low to Moderate	<0.8%	0.4mA/m ²
High	0.8 to 1.5%	0.8mA/m ²
Extremely High	>1.5%	1.6mA/m ²

*** Chloride content is calculated as a percentage by weight of cement.

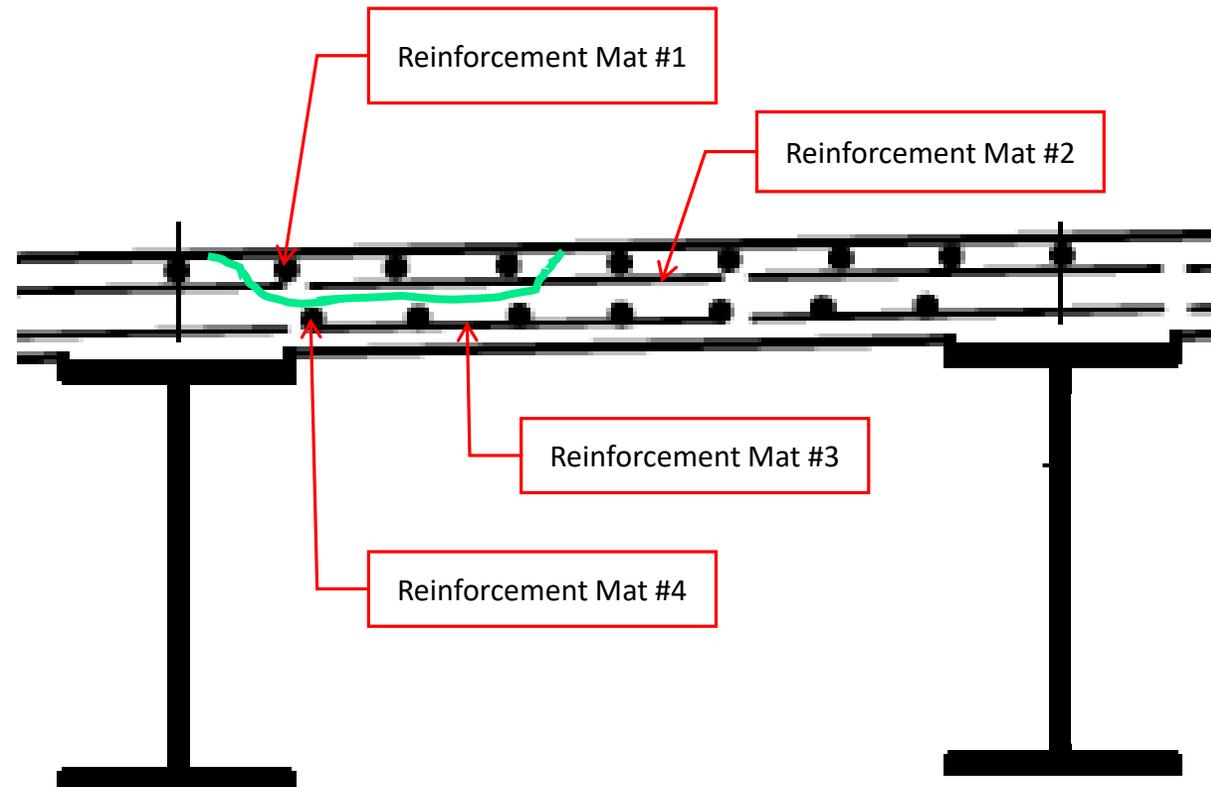
Galvanic Anodes

$$\text{Steel Density} = \frac{\text{Surface Area of Steel to be Protected}}{\text{Surface Area of Concrete}}$$

$$\text{Steel Density per ft}^2 = \frac{\pi * \text{Bar Diameter} * 12'' * \left(\frac{12''}{\text{Spacing}}\right)}{144 \text{ in}^2}$$

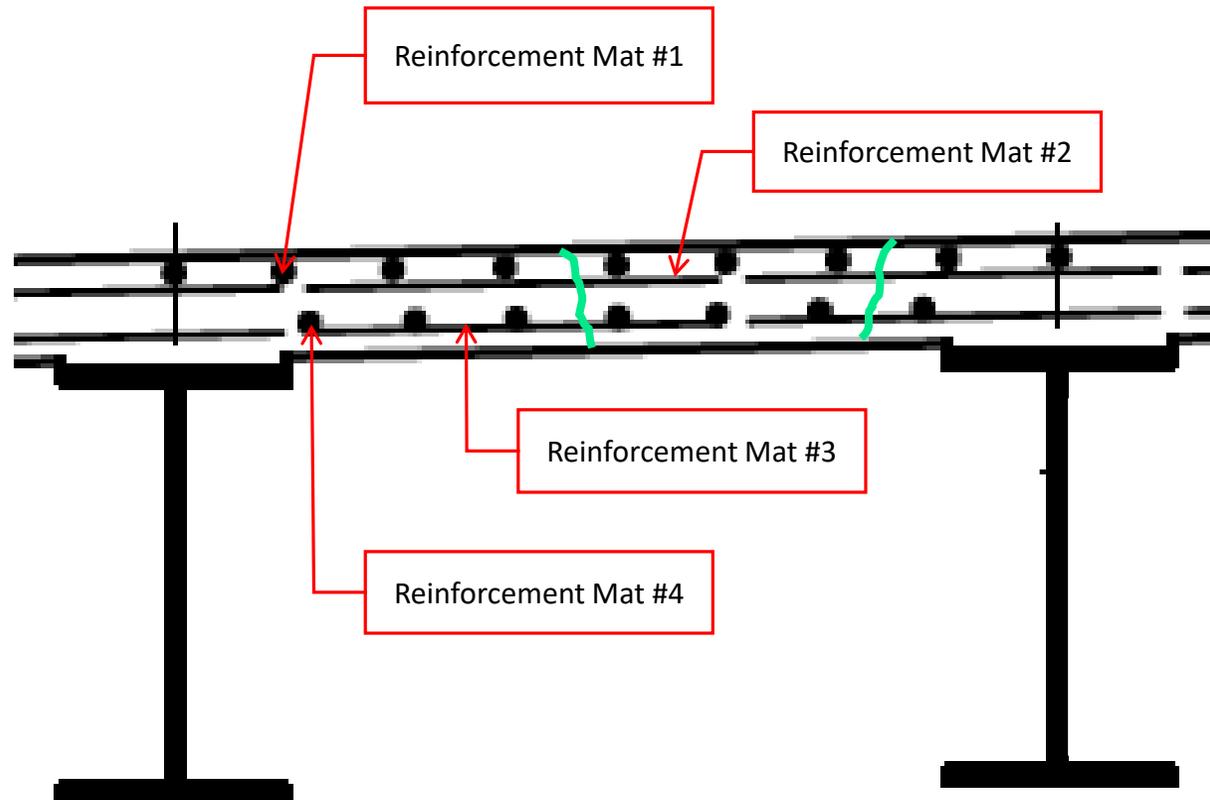
Galvanic Anodes

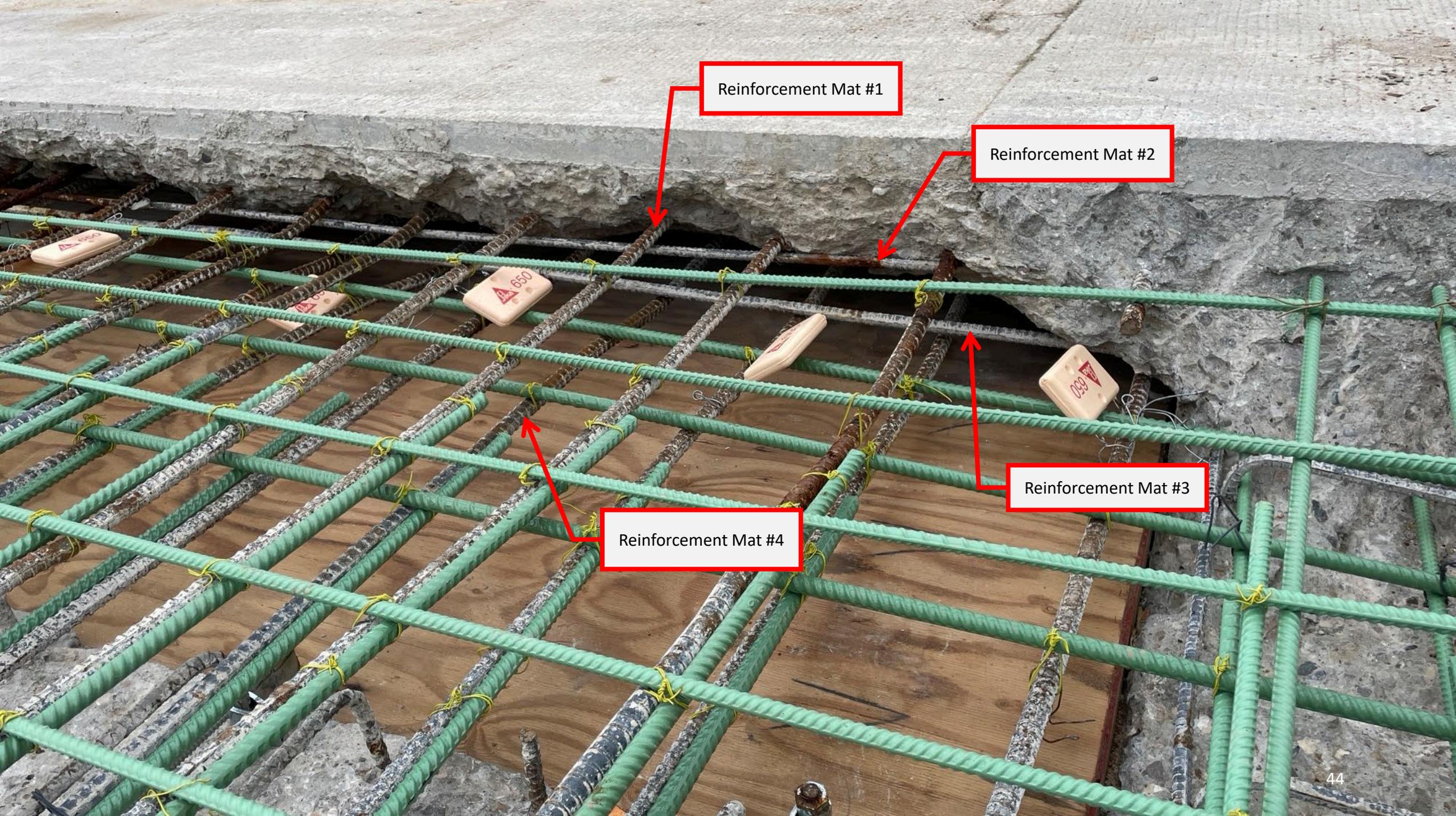
Partial Depth Patch = Steel Density for Mat #1 + Steel Density for Mat #2



Galvanic Anodes

Full Depth Patch = Steel Density Ratio for Mat #1 + Steel Density for Mat #2 + Steel Density for Mat #3 + Steel Density Ratio for Mat #4





Reinforcement Mat #1

Reinforcement Mat #2

Reinforcement Mat #3

Reinforcement Mat #4

Qualified Products List (QPL)

Spec # and Material Name	Product Name	Manufacturers or Suppliers
712.03Y Embedded Galvanic Anodes	LifeAnode 65, 105 and 160	ARTAZN LLC
	MasterProtect CP Models: 8065, 8105, 8150	BASF Chemical Company
	RebaGuard	CPT/No Corrosion
	RebaGuard Plus	CPT/No Corrosion
	RebaGuard Ultra	CPT/No Corrosion
	38 g Sentinel-GL	Euclid Chemical Co.
	Mapeshield I 70, I 105, I 10/10, I 10/20, I 30/10, and I 30/20	Mapei Corporation
	Sika Galvashield XP	Sika Corporation
	Sika Galvashield XP+	Sika Corporation
	65 g, 105 g, 160 g, 100 g Sika FerroGard 650, 670, 675	Sika Corporation
	Galvashield XP2	Vector Corrosion Technologies, Inc.
160 g Galvashield XP4	Vector Corrosion Technologies, Inc.	
330 g Galvashield XPX	Vector Corrosion Technologies, Inc.	
Galvashield XP+	Vector Corrosion Technologies, Inc.	
40 g Galvashield XPC	Vector Corrosion Technologies, Inc.	
60 g Galvashield XPT	Vector Corrosion Technologies, Inc.	



Galvanic Anodes



Low to Moderate Corrosion Risk (Chloride Content* <0.8%)

Steel Density	XPT/XPC**		XP2		XP4/XPX	
	inch	mm	inch	mm	inch	mm
<0.3	27	675	28	700	28	700
0.31-0.6	18	450	28	700	28	700
0.61-0.9	14	350	23	575	28	700
0.91-1.2	12	300	19	475	25	625
1.21-1.5	11	275	17	425	22	550
1.51-1.8	10	250	15	375	20	500
1.81-2.1	9	225	14	350	19	475

High Corrosion Risk (Chloride Content* 0.8% to 1.5%)

Steel Density	XPT/XPC**		XP2		XP4/XPX	
	inch	mm	inch	mm	inch	mm
<0.3	18	450	28	700	28	700
0.31-0.6	12	300	19	475	25	625
0.61-0.9	10	250	15	375	20	500
0.91-1.2	8	200	13	325	17	425
1.21-1.5	7	175	11	275	15	375
1.51-1.8	6	150	10	250	14	350
1.81-2.1	5	125	9	225	13	325

Extremely High Corrosion Risk (Chloride Content* >1.5%)

Steel Density	XPT/XPC**		XP2		XP4/XPX	
	inch	mm	inch	mm	inch	mm
<0.3	12	300	19	475	25	625
0.31-0.6	8	200	13	325	17	425
0.61-0.9	7	175	10	250	14	350
0.91-1.2	6	150	9	225	11	275
1.21-1.5	5	125	7	175	10	250
1.51-1.8	4	100	6	150	9	225
1.81-2.1	N/A	N/A	5	125	8	200

- XPC – 40 grams of zinc
- XPT – 60 grams of zinc
- XP2 – 100 grams of zinc
- XP4 – 160 grams of zinc
- XPX – 330 grams of zinc

Galvanic Anodes

MICHIGAN DEPARTMENT OF TRANSPORTATION



2020 STANDARD SPECIFICATIONS FOR CONSTRUCTION

WITH ERRATA INCORPORATED

Y. **Galvanic Anodes.** Use Portland cement-based repair mortars, concrete, and bonding agents. Do not use non-conductive repair materials, including epoxy, urethane, and magnesium phosphate.

Install galvanic anodes to existing uncoated reinforcement along the perimeter of the repair, spaced as shown on the plans and in accordance with the manufacturer's recommendations. Do not space anodes more than 24 inches apart.

Provide $\frac{3}{4}$ -inch clearance between anodes and substrate to allow repair material to encase anodes.

Secure galvanic anodes as close as possible to the patch edge using anode tie wires. Tighten tie wires to prevent free movement.

If tying anodes onto a single uncoated steel reinforcing bar or covering with less than $1\frac{1}{2}$ inches of concrete, place anodes under the uncoated reinforcing steel. Secure anodes to uncoated reinforcing steel according to the manufacturer's recommendations.

If $1\frac{1}{2}$ inches of concrete covers the anode, anodes may be placed at the intersection between two uncoated bars and secured to each bar. Confirm electrical connection between anode tie wires and uncoated reinforcing steel with a multi-meter. Ensure a direct current (DC) resistance of no greater than 1 ohm.

Confirm electrical continuity of exposed, uncoated reinforcing steel in the repair area. Steel reinforcement is considered continuous if the DC resistance is not greater than 1 ohm. If the DC resistance is greater than 1 ohm, establish electrical continuity with uncoated steel tie wire.

Obtain verification of installation of galvanic anodes from the Engineer before concrete placement.

Galvanic Anodes

- Special Provision
20SP-712G-01
- Use on all projects where galvanic anodes are called for.

SPECIAL PROVISION FOR EMBEDDED GALVANIC ANODES, HIGH PERFORMING FOR CORROSION CONTROL

BRG:KCK

1 of 2

APPR:JAB:TEB:08-22-25
FHWA:APPR:08-26-25

a. Description. This work includes furnishing and properly installing embedded galvanic anodes in concrete. The embedded galvanic anodes serve to provide corrosion protection to existing steel reinforcement. When placed at the specified spacing along the perimeter of concrete patches or along the interface between the new and existing concrete, the anodes mitigate the formation of new corrosion sites in the existing concrete.

b. Materials. Embedded galvanic anodes should be approximately 4 to 5 inches in length and 1½ inches high, pre-manufactured, and **must consist of 100 grams (3.5 ounces) minimum** of electrolytic high-grade zinc in compliance with *ASTM B418* cast around a pair of steel tie wires. Furnish embedded galvanic anodes from Vector Corrosion Technologies (Galvashield XP2), phone number (813) 830-7566, or from Euclid Chemical Company (Euclid SENTINEL Silver), phone number (800) 321-7628, or an Engineer approved equal. The approved equal anode must supply the calculated amount of zinc in pounds/foot (lb/ft) in Table 1. Furnish the anodes with a general certification provided by the manufacturers. Deliver, store, and handle all materials in accordance with the manufacturer's instructions.

Ensure repair mortars, concrete, and bonding agents are Portland cement-based materials. Non-conductive repair materials such as epoxy, urethane, or magnesium phosphate are prohibited.

c. Construction. Perform the concrete work in accordance with sections 706 and 712 of the Standard Specifications for Construction.

1. Galvanic Anode Installation.

A. Install galvanic anodes along the perimeter of the repair. Determine the maximum spacing of the galvanic anode selected based on Table 1 and the steel density specified on the plans. Do not mix anode types.

Table 1. Anode spacing based on steel density for 100 grams (0.22 lb) of zinc per anode(a).

Steel Density	Maximum Anode Spacing (inches)	Zinc (lb/ft)
< 0.3	22	0.12
0.31 to 0.6	20	0.13
0.61 to 0.9	18	0.15
0.91 to 1.2	16	0.17
1.21 to 1.5	15	0.18

Galvanic Anodes - BDM Chapter 8 Update

8.09.01 (continued)

Miscellaneous Notes

- I. The steel density of the existing reinforcement to be protected by galvanic anodes is _____. [This note is to be used with Special Provision for Embedded Galvanic Anodes, High Performing for Corrosion Control on all rehabilitation projects that include concrete repair.] (7-28-2025)

THE STEEL DENSITY OF THE EXISTING REINFORCEMENT TO BE PROTECTED BY GALVANIC ANODES IS LISTED IN THE TABLE BELOW.

BRIDGE COMPONENT	STEEL DENSITY RATIO
DECK *	0.787
BARRIER	0.339
ABUTMENT	0.159

* STEEL DENSITY RATIO ASSUMES EACH ANODE IS TIED TO BOTH THE TOP AND BOTTOM MATS.

Galvanic Anodes - BDM Chapter 12 Update

12.08.02

Concrete Repair - General (9-22-2025)

Embedded Galvanic Anodes for Concrete Repairs

Galvanic anodes consist of a cementitious shell encapsulating a zinc electrolyte. The embedded galvanic anodes serve to provide localized corrosion protection to existing steel reinforcement through the principles of electrochemistry. Often, when new concrete is placed adjacent to old concrete, corrosion in the old concrete is accelerated. This is the result of a difference in the electrolytic potential between the new and old concrete. By introducing zinc to the system through galvanic anodes, a new galvanic cell is created which results in the accelerated deterioration of the anodes rather than the existing reinforcement. This protection is directly related to the amount of zinc contained in the anodes as the protection lasts only until the anodes have fully oxidized.

12.08.02 (continued)

The embedded anodes have a life expectancy of 15 to 20 years, which is dependent on anode spacing, environmental exposure, zinc content, and the amount of existing steel reinforcement in the structure element being repaired. Galvanic anodes must be specified with an adequate amount of zinc content per foot along the perimeter of concrete patches or along the interface between new/existing concrete to reach the desired service life.

Use galvanic anodes with uncoated and epoxy coated reinforcement. Embedded anodes must be tied to uncoated steel reinforcement for proper function. Where galvanic anode is connected to coated rebar the coating must be removed to ensure electrical connection between anode tie wire and reinforcing steel.

Use embedded galvanic anodes whenever existing reinforcement will be encased in both new concrete and existing concrete after the proposed work is completed. Suggested uses are as follows:

1. Bridge deck widening.
2. Deck joint replacement.
3. Substructure repairs.
4. Deck repairs, where greater than ten years patch service life is required.
5. Substructure widening.
6. Concrete superstructure repair and patching.
7. Concrete bridge railing repairs and/or replacements.

For items 1 thru 7, placement of anodes will follow the Frequently Used Special Provision for Embedded Galvanic Anodes, High Performing for Corrosion Control. Include Special Provision in proposal for all rehabilitation projects including concrete repair. The steel density of each bridge element being repaired utilizing galvanic anodes must be reported in the project plans. (9-22-2025)

Prestressed Concrete Beams

- Recent updates related to stability analysis during lifting and transportation.
- Check girder stability on all projects during design.
- Specify lifting loop locations used during the analysis on the plans.

7.02.18 (continued)

Prestressed Concrete Design

9. Stability During Lifting and Transportation (7-28-2025)

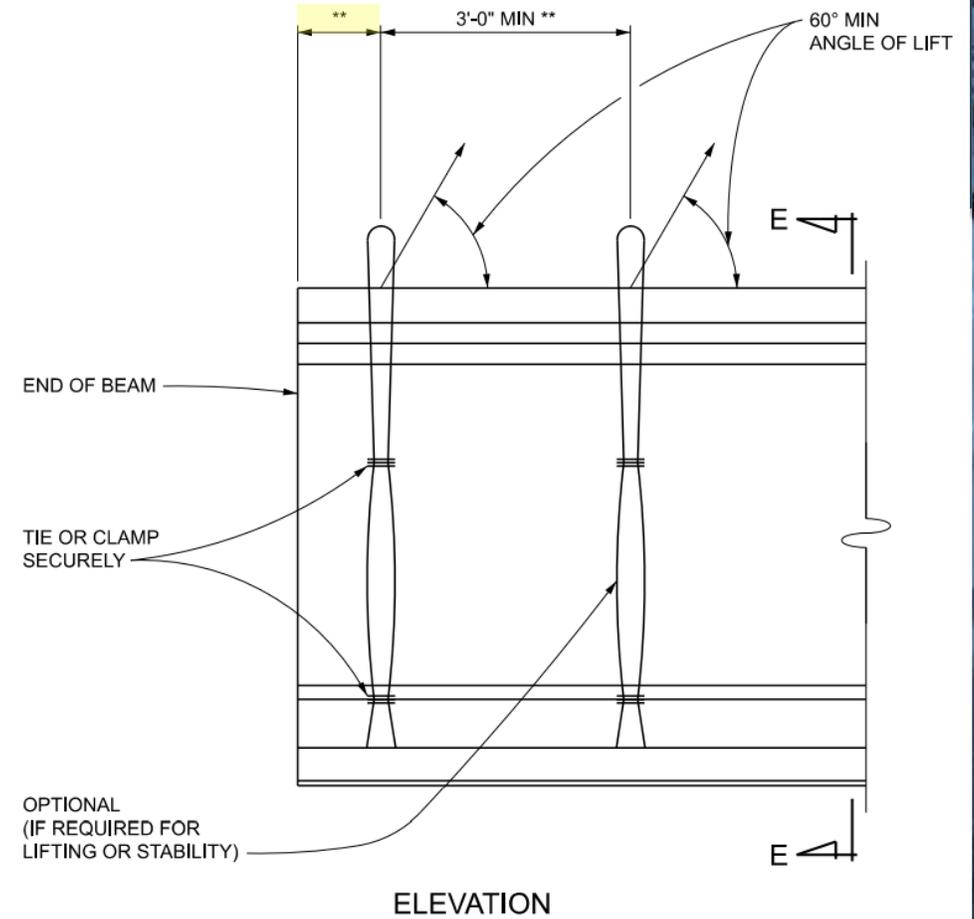
Investigate the buckling and stability of prestressed concrete beams during handling, transportation and erection on all projects. When deemed necessary by calculations, include any temporary measures needed to ensure the stability of the proposed beams in the plans for the project. Base the analysis on the stress limits specified in AASHTO LRFD.

Alternate means for ensuring the stability of prestressed concrete beams during handling, transportation and erection may be proposed by the Contractor or Fabricator. Any deviations from the details included in the plans must be submitted to the Engineer for review and approval as specified in Section 104 of the MDOT Standard Specifications for Construction.

Stability of PC Beams

Reflected in updates to:

- Bridge Design Guides
 - 6.65.14
 - 6.65.14 A.
 - 6.65.14 B.
- Special Details - Prestressed Concrete Beam Sheets
 - PC-1Q
 - PC-2L
 - PC-4J
 - PC-5D

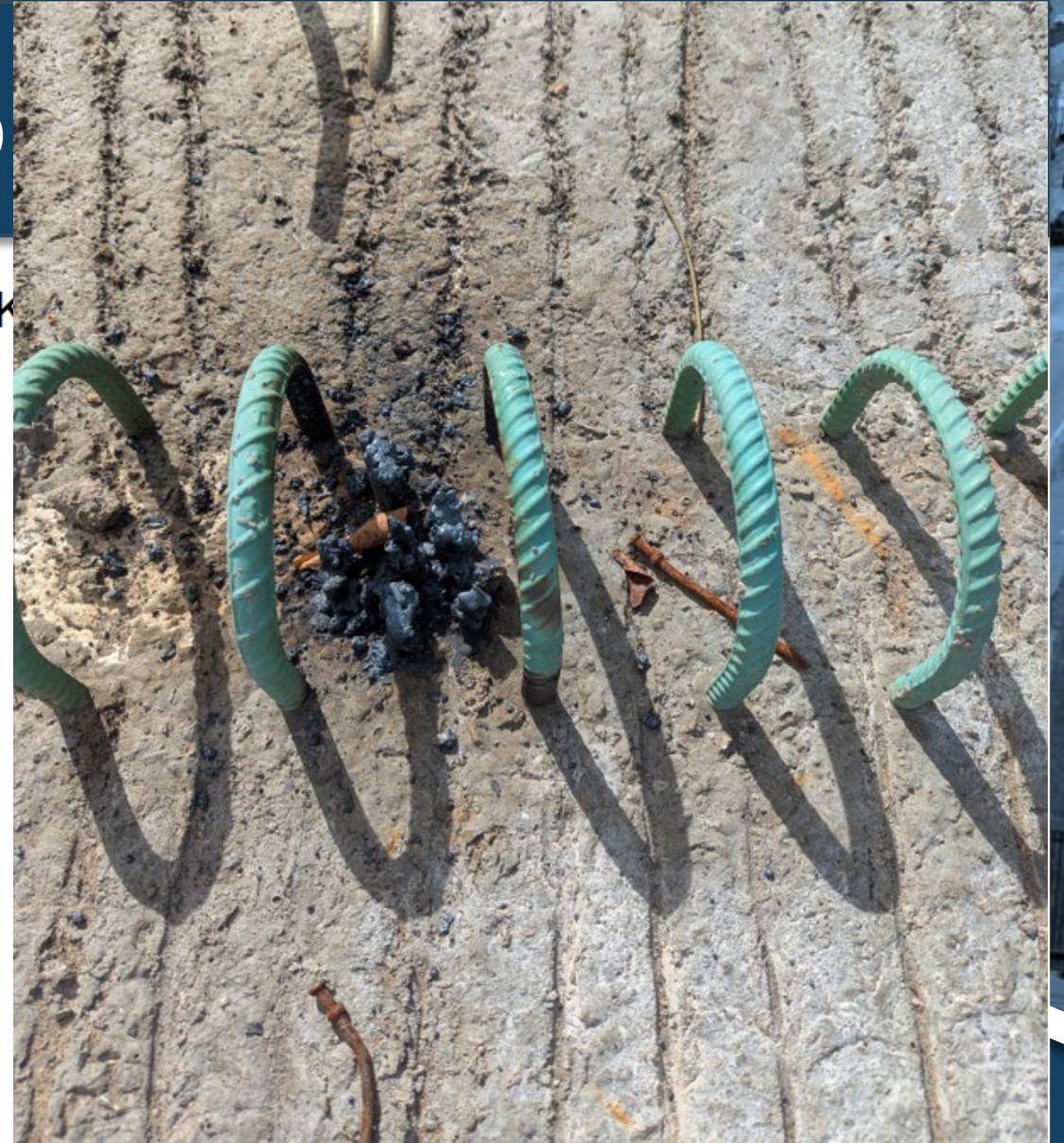


** CHECK THE STABILITY OF PRESTRESSED CONCRETE GIRDERS DURING LIFTING AND TRANSPORT. LOCATE LIFTING LOOPS TO ENSURE STABILITY AND TO KEEP THE APPLIED STRESS BELOW THE ALLOWABLE LIMITS IN AASHTO LRFD. DIMENSION TO THE SPECIFIC LOCATIONS OF THE LIFTING LOOPS USED IN THE STABILITY ANALYSIS ON THE CONTRACT PLANS; DO NOT PROVIDE A DISTANCE RANGE. SEE SECTION 7.02.18.A.9 OF THE BRIDGE DESIGN MANUAL FOR MORE INFORMATION.

Removal of Lifting Loop

Reflected in updates to:

- Bridge Design Guides
 - 6.65.14
 - 6.65.14 A.
 - 6.65.14 B.
- Special Details - Prestressed Concrete Beam Sheets
 - PC-1Q
 - PC-2L
 - PC-4J
 - PC-5D



Upcoming Standards Changes

- Bridge Design Manual
 - Updating to meet new ADA web content accessibility guidelines

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

CHAPTER 1

INTRODUCTION (12-16-2019)

The Bridge Design Manual addresses the procedures involved in preparing plans of bridges and other major structures on the interstate/freeway, arterial, collector and local road system governed by the Michigan Department of Transportation (MDOT). Incorporation of or connectivity to other modes of transportation (pedestrian, bicycle, multi-use paths, etc.) must be considered.

In compiling these procedures, an effort was made to include all information related to plan preparation. The major portion of the manual is devoted to design criteria and the presentation of plan information. But other chapters deal with the routines of processing the work, the source material supporting design considerations, and the involvement of other agencies affected by the project. In general, the Bridge Design Manual is intended to be a single source reference for the MDOT Design Engineers and consultants assigned the responsibility of producing bridge plans.

Much of the information presented originates from the Bridge Design Manual, Notes for

this manual. In some cases, however, the AASHTO specifications are vague or leave a decision to the judgment of the Engineer.

LRFD Guide Specifications for the Design of Pedestrian Bridges and Guide for the Development of Bicycle Facilities will aid in the design of other modes of transportation.

Guidelines in the Bridge Design Manual are provided as clarification and thus supplement the provision of AASHTO. Some minimum requirements in the AASHTO specifications have been found through experience to be insufficient. In these instances, the Design Manual supersedes AASHTO with more rigorous controls.

Procedures and guidelines continually change. The material in the Bridge Design Manual is continually updated and every attempt is made to keep the Manual as current as possible. When the need for an addition or change arises, the Manual is updated on a monthly basis. These updates will describe the revision, explain the reason

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

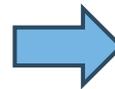
CHAPTER 1 • INTRODUCTION

1.00 INTRODUCTION

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In this manual a bridge is defined by the National Bridge Inspection Standards Federal Code of Regulations (23 CFR 650) as a structure that spans over a waterway, highway, or railway with an opening measured along the center of roadway of more than 20'. Structures that span distances under 20' are considered culverts.

In compiling these procedures, an effort was made to include all information related to plan preparation. The major portion of the manual is devoted to design criteria and the presentation of plan information. But other chapters deal with the routines of processing the work, the source material supporting design considerations, and the involvement of other agencies affected by the project. In general, the Bridge Design Manual is intended to be a single source reference for the MDOT Design Engineers and consultants assigned the responsibility of producing bridge plans. It is assumed that this manual is to be used in conjunction with the MDOT Road Design Manual. The Road Design Manual contains relative/pertinent information and procedures for both road designers and bridge designers. In general, the Bridge Design Manual is intended to be a reference for the MDOT Design Engineers and consultants assigned the responsibility of producing bridge plans of the requirements specific to structure design beyond those detailed in the Road Design Manual.



Upcoming Changes

- Bridge Design Manual
 - Updating to meet new ada web content accessibility guidelines
 - Single column
 - Single spacing
 - Left alignment
 - Increased font size
 - Reduced number of headings
 - Updating tables
 - Updating links
 - Updating images
 - More on ADA.gov

MICHIGAN DESIGN MANUAL BRIDGE DESIGN

CHAPTER 1 • INTRODUCTION

1.00 INTRODUCTION

The Bridge Design Manual addresses the procedures involved in preparing plans of bridges and other major structures on the interstate/freeway, arterial, collector and local road system governed by the Michigan Department of Transportation (MDOT). Incorporation of or connectivity to other modes of transportation (pedestrian, bicycle, multi-use paths, etc.) must be considered.

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Bridge Design Manual Overhaul

Current BDM Chapter		New BDM Chapter
Chapter 1 - Introduction	★	Chapter 1 – Introduction (additional information added)
Chapter 2 - Steps in Producing Plans		Chapter 2 - Steps in Producing Plans
Chapter 3 - Plan Composition New and Reconstruction Projects		Chapter 3 - Plan Composition New and Reconstruction Projects
Chapter 4 - Plan Composition Rehabilitation Projects		Chapter 4 - Plan Composition Rehabilitation Projects
Chapter 5 - Consultant Contracts		Chapter 5 - Consultant Contracts
Chapter 6 - Plan Sheet Examples	★	Removed (content moved to chapter 1)
Chapter 7 - LRFD Design Criteria New and Reconstruction Projects		Chapter 7 - LRFD Design Criteria New and Reconstruction Projects
Chapter 7 - LFD Design Criteria New and Reconstruction Projects	★	Archived (will remain available for viewing)

Bridge Design Manual Overhaul continued

Current BDM Chapter		New BDM Chapter
Chapter 8 - Plan Notes		Chapter 8 - Plan Notes
Chapter 9 - Detailing Practices	★	Removed (content moved to chapter 1)
Chapter 10 - Shop Drawing Review	★	Chapter 9 - Shop Drawing Review
Chapter 11 - Plan Revisions	★	Chapter 10 - Plan Revisions
Chapter 12 - Rehabilitation Projects	★	Chapter 6 - Rehabilitation Projects
Chapter 13 - Railroad Crossings	★	Chapter 11 - Railroad Crossings
Chapter 14 - Permit Applications and Environmental Issues	★	Chapter 12 - Permit Applications and Environmental Issues
Chapter 15 - Specifications	★	Removed (content moved to chapter 1)

Other Standards Updates

- Bridge design guides
 - New details
 - Active voice
 - New fonts and linetypes
- Special details/
standard plans
 - New details
 - Active voice
 - New fonts and linetypes
- And more!



Monthly Updates

Road & Bridge Design Publications

[Home](#) > [Business](#) > [Design](#) > Road & Bridge Design Publications

The Design Standards Unit issues revisions to the Bridge Design Guides, Bridge Design Manual, Road Design Manual, and Road & Bridge special details on a monthly basis.

The monthly update consists of a single PDF file for download that is comprised of the revisions to each publication for the month.

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Questions?

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MDOT-Bridge-Design-Standards@Michigan.gov

