MDOT LOCAL AGENCY ABC BRIDGE REPLACEMENT PROJECT

ST. CLAIR COUNTY, MI

St. Clair County Road Commission
Starville Road Bridge Replacement

PRESENTERS

Bill Hazelton, PE
Director
St. Clair County Road Commission

Guy C. Nelson PE, SE
Product Development Engineer
Valmont Structures

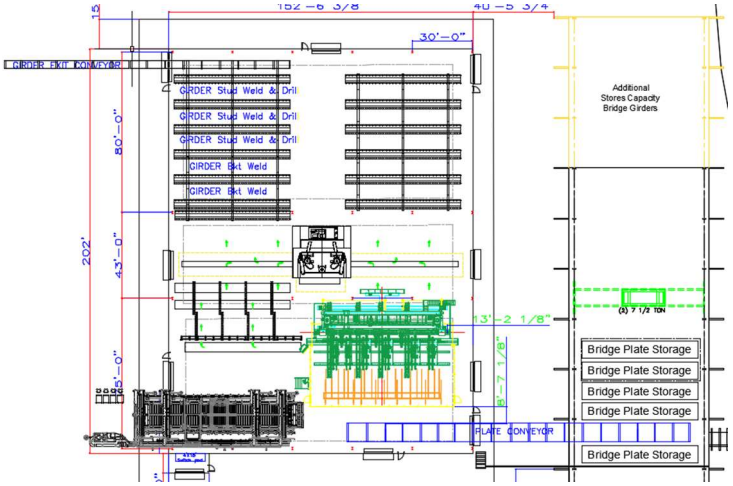
Who is Valmont Structures?

AISC INTERMEDIATE BRIDGE CERTIFIED FABRICATOR

Certified Bridge Fabricator - Intermediate (IBR) are typical bridges that do not require extraordinary measures. Typical examples might include: (1) a rolled beam bridge with field or shop splices, either straight or with a radius over 500 ft; (2) a built-up I-shaped plate girder bridge with constant web depth, with or without splices, either straight or with a radius over 500 ft;.

Who is Valmont Structures?

EXPANDED JASPER, TENNESSEE FACILITY AND CAPABILITIES



CURRENT PROGRESS:

- ✓ **Broke ground in January 2021**
- ✓ **New brake press purchased and ready to deliver**
- ✓ **Roll form camber capabilities**
- ✓ **Automated stud welding capabilities**
- ✓ **Started AISC IBR Certification process**
- ✓ **Target early production date mid-June**

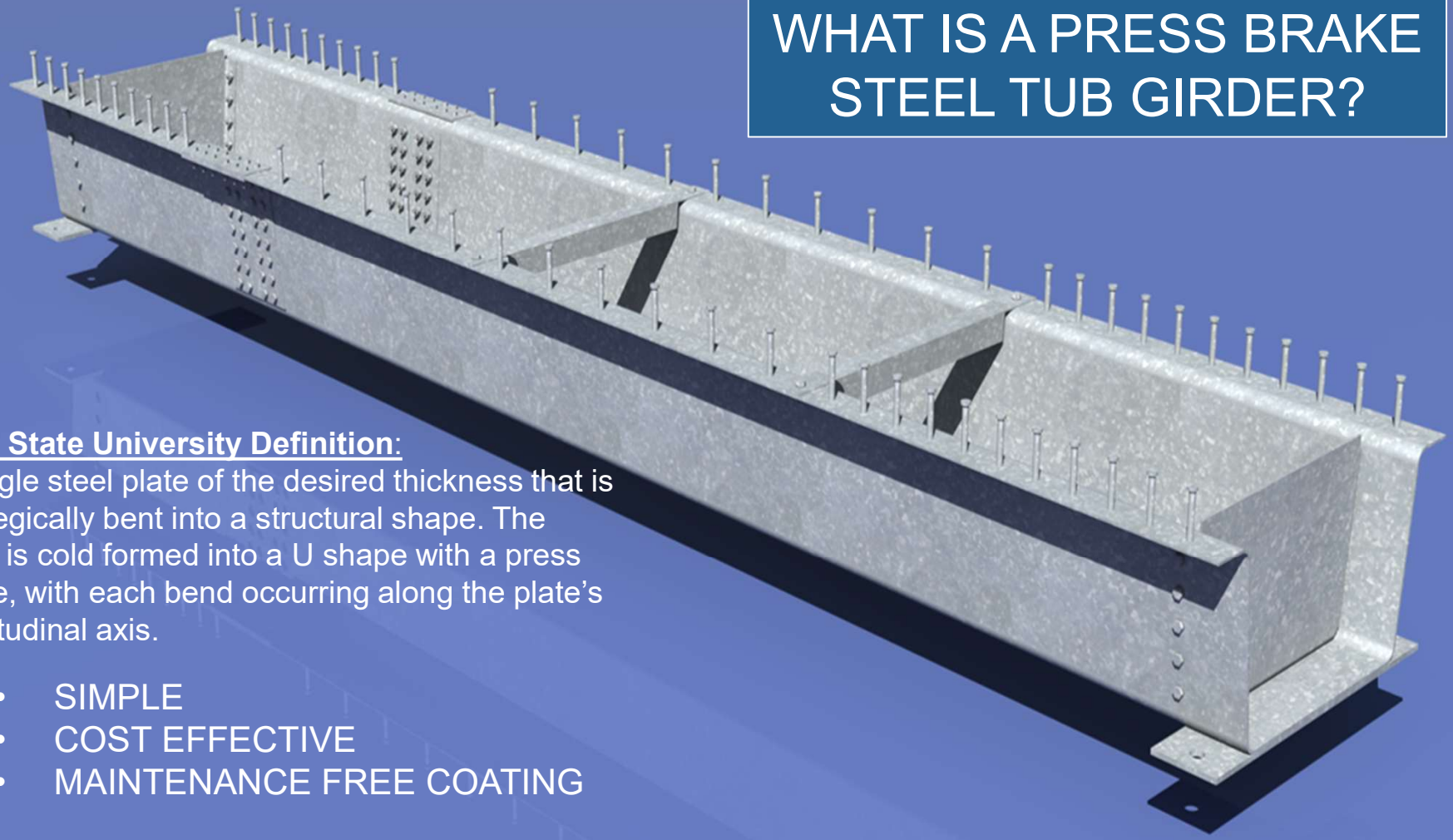
CAMBER ROLL FORMING AND AUTOMATED STUD WELDING

WHAT IS THE CON-STRUCT BRIDGE SYTEM?

TWO COMPONENTS:

- PRESS BRAKE TUB GIRDER
- CONCRETE DRIVING SURFACE

WHAT IS A PRESS BRAKE STEEL TUB GIRDER?



Iowa State University Definition:
A single steel plate of the desired thickness that is strategically bent into a structural shape. The plate is cold formed into a U shape with a press brake, with each bend occurring along the plate's longitudinal axis.

- SIMPLE
- COST EFFECTIVE
- MAINTENANCE FREE COATING

AASHTO INNOVATION INNITIATIVE

PRESS BRAKE FORMED TUB GIRDERS SELECTED AS AASHTO "BEST-IN-CLASS" PRODUCT

AII BACKGROUND

Many new and emerging technologies, offering improved performance/effectiveness, are continually becoming ready for operational implementation. Some of these technologies have been developed through rigorous research and may have been demonstrated in "real world" applications. In support of that mission, several strategic goals have been identified:

1. Develop mechanisms to solicit **ready-to-implement technologies**.

2. Identify and mobilize technology champions within the AASHTO member departments who are committed to the deployment of chosen technologies.

AASHTO

Victoria F. Sheehan, *President*
Commissioner, New Hampshire Department of Transportation
Jim Tymon, *Executive Director*

November 19, 2020

Mr. Matthew J. Chynoweth
Chief Bridge Engineer and Director
Bureau of Bridges & Structures
Michigan Department of Transportation
425 W. Ottawa
Lansing, Michigan, 48909.

Subject: AASHTO Innovation Initiative Nomination

Dear Mr. Chynoweth,

On behalf of the AASHTO Innovation Initiative (A.I.I.), I would like to thank you for the submission of your innovation *Steel Press-Brake-Formed Tub Girder*.

The A.I.I. Executive Committee has approved your proposal for a Focus Technology. Dr. Suri Sadasivam from WSP USA, our program consultant, will reach out to you to discuss the next steps in the following weeks.

Again, we appreciate the effort you have taken to assist the A.I.I. in identifying best-in-class products.

Sincerely,

G R Page

Glenn Page
Associate Program Director, Project Delivery
American Association of State Highway and Transportation Officials
555 12th Street NW, Suite 1000
Washington, DC 20004
Phone: (202) 624-5265
Email: gpage@aashto.org

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SSSBA & Press Brake Tub Girders

*A group of **bridge** and **buried soil structure** industry leaders who have joined together to provide **educational information** on the design and construction of short span steel bridges in installations up to **140 feet in length.***

- Education (webinars, workshops, forums, conferences)
- Technical Resources (standards, guidelines, best practices)
- Case Studies (economics: steel is cost-effective)
- Innovative & ABC Design
- Press Brake Formed Tub Girder (PBFTG) Research Reports
  - Development and Experimental Testing of Press Brake Tub Girders (PBFTG)
  - 10 Years, 7 Volume Research Report
  - https://www.shortspansteelbridges.org/testing-of-press-brake-tub-girders/

SHORT SPAN STEEL BRIDGE ALLIANCE™

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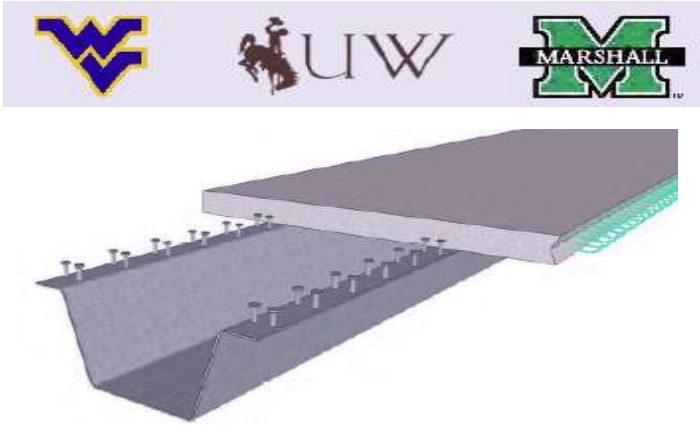
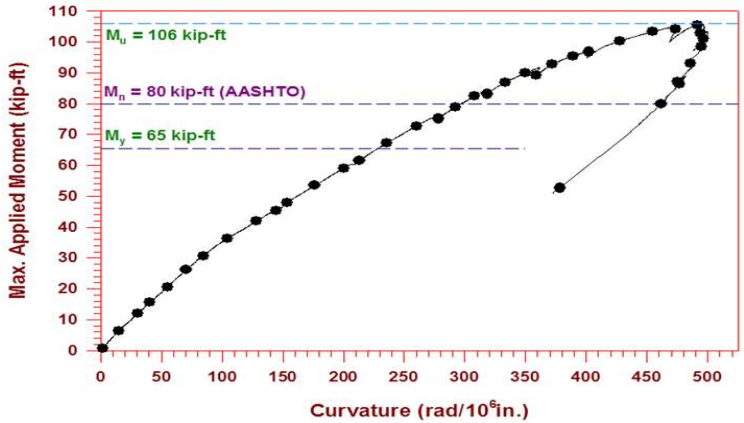
Valmont Con-Struct PBTG Testing

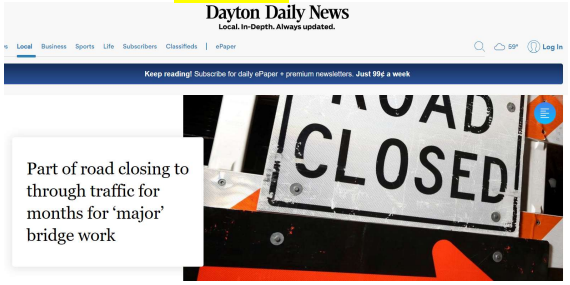
- 2006 Research by MDOT
- Research Funded by SSSBA
  - IBC-16-95 Evaluation of Modular Press-Brake-Formed Steel Tub Girders
- Both determined AASHTO LRFD is applicable design method





Why do we need a “new” solution?

OHIO



The side-by-side box-beam bridge was the bridge of choice for short to medium span bridges due to **ease of construction, favorable span-to-depth ratios, aesthetic appeal**, and high torsional stiffness. The bridge can be **constructed in an accelerated fashion**, and classified among the systems that qualify accelerated bridge construction (ABC).

<u>This bridge is losing favor primarily because of persisting performance issues.</u>

MICHIGAN

By: Candese Charles
Posted at 5:52 PM, Jun 20, 2019 and last updated 5:53 PM, Jun 20, 2019

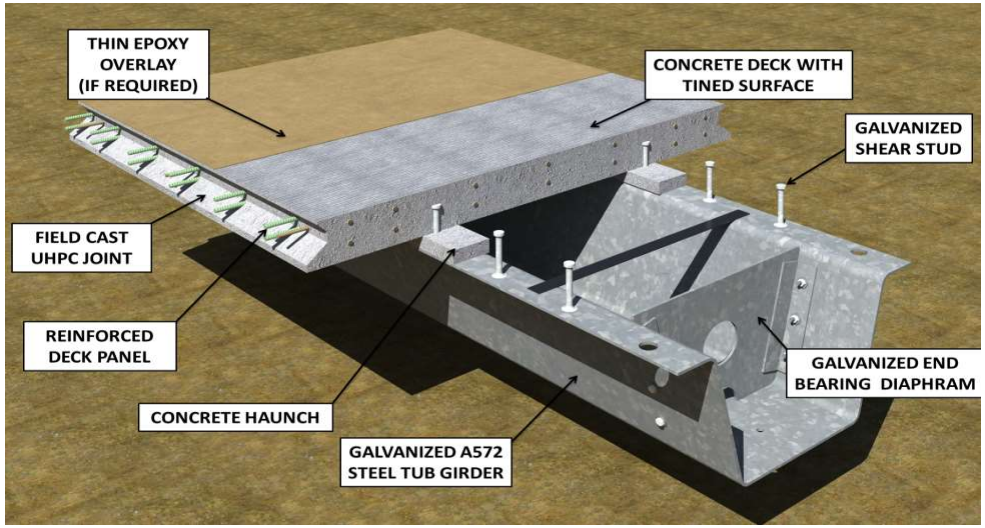
FERRYSBURG, Mich. — A historic bridge in Ferrysburg is closing and causing concerns for residents who say emergency response vehicles use it regularly.

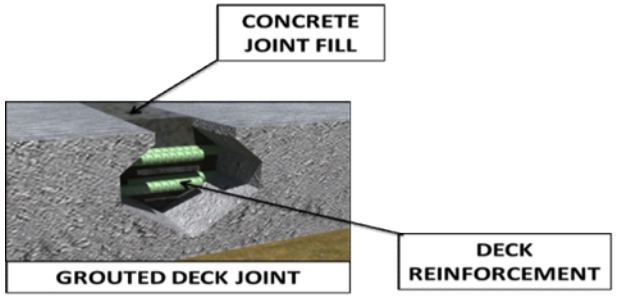
But after years of upgrades and no money to pay for them, the city says closing the bridge is a matter of safety.

Ferrysburg’s busy Smith bridge closing due to safety concern:
“Concrete box beams are deteriorating, so if something goes heavy over a box beam, there's a chance that it could sink," says Craig Bessinger, Ferrysburg city manager.

Valmont Con-Struct PBTG Bridge Solution

- **Increased durability**: 60 year maintenance free galvanized coating
- **Save money**: competitive installation pricing with concrete box beams gives PBTG a Life Cycle Cost advantage
- **Save time**: ABC option can be installed in a single day
- AASHTO LRFD Design
- Valmont provides PBTG design support

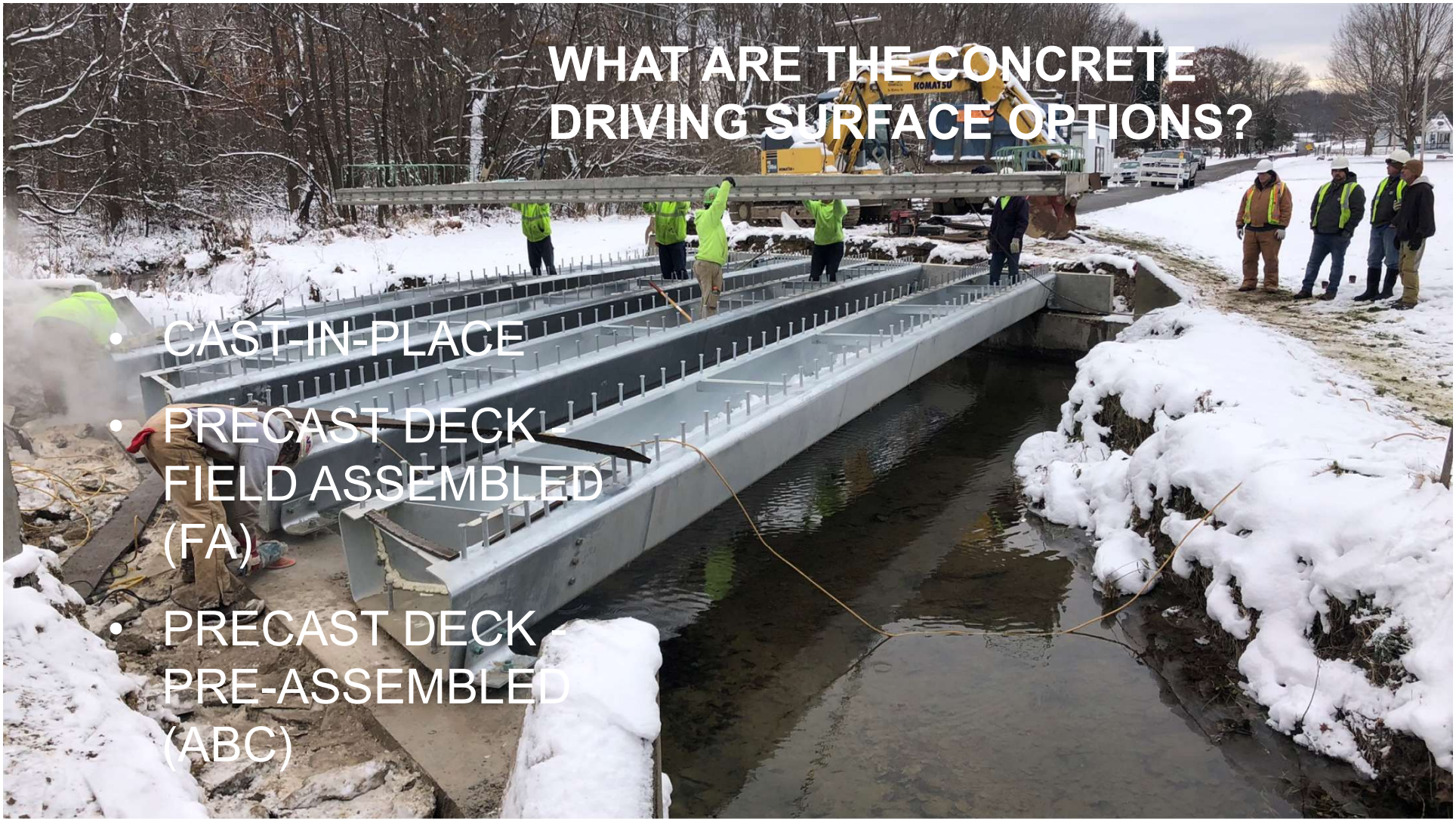




History of Con-Struct PBFTG System

- First county installation in Monroe County, MI in 2004.
  - Inspected every 2 years. No signs of deterioration of concrete driving surface or corrosion in steel girders
- Bridge locations in Missouri, Michigan, Texas, Alabama, Pennsylvania, Oregon, Minnesota and Colfax, SK
- Bridge funding by FHWA, DOT's A.I.D. Grant, EDC-3

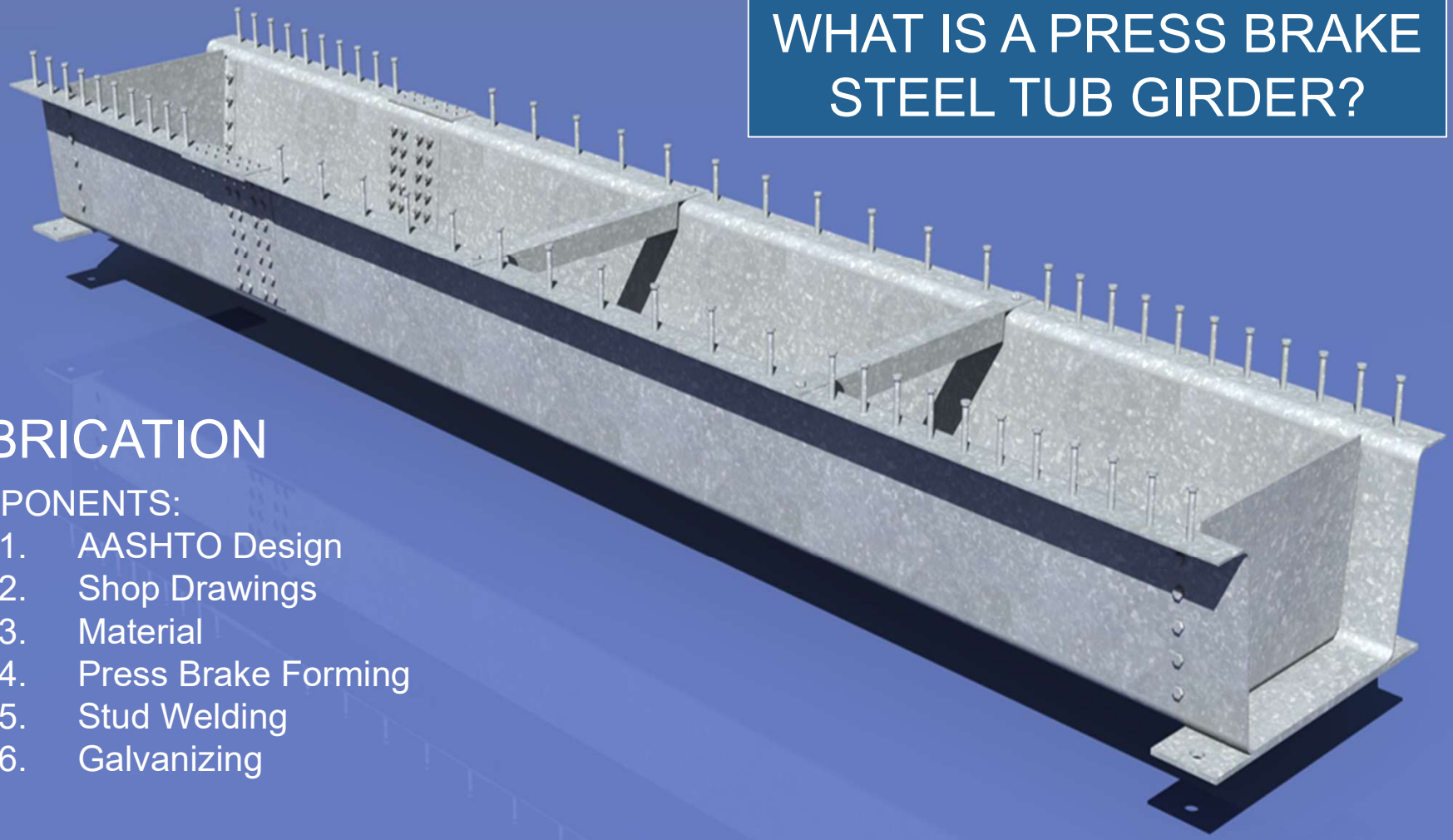
Current Condition (2019)



WHAT ARE THE CONCRETE DRIVING SURFACE OPTIONS?

- CAST-IN-PLACE
- PRECAST DECK - FIELD ASSEMBLED (FA)
- PRECAST DECK - PRE-ASSEMBLED (ABC)

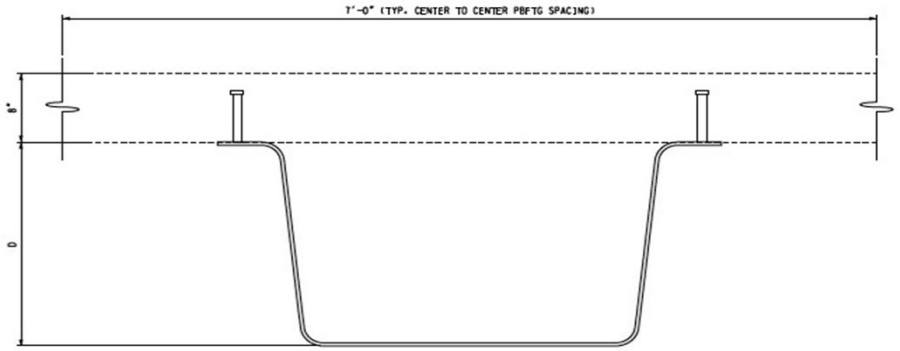
WHAT IS A PRESS BRAKE STEEL TUB GIRDER?



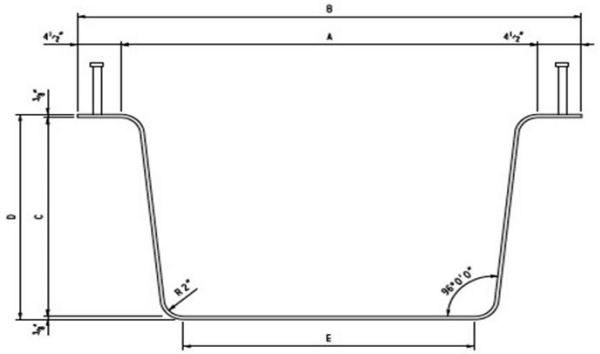
FABRICATION

COMPONENTS:

1. AASHTO Design
2. Shop Drawings
3. Material
4. Press Brake Forming
5. Stud Welding
6. Galvanizing

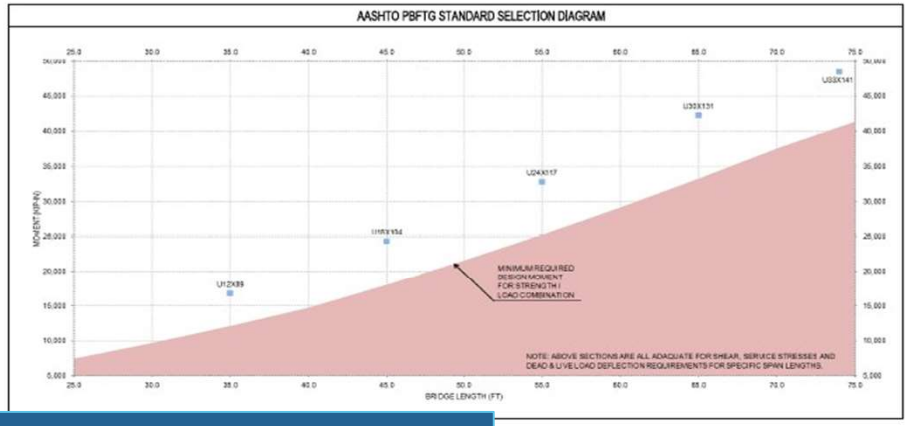


AASHTO PBFTG STANDARD COMPOSITE GIRDER CROSS SECTION



AASHTO PBFTG STANDARD TUB GIRDER CROSS SECTION

Designation	A	B	C	D	E
U12x89	43"	52"	11 1/4"	12"	325/8"
U18x104	43"	52"	17 1/4"	18"	313/8"
U24x117	43"	52"	23 1/4"	24"	301/8"
U30x131	43"	52"	29 1/4"	30"	287/8"
U33x141	45"	54"	32 1/4"	33"	301/4"



AASHTO PBFTG DEFLECTIONS											
Beam Length (ft)	25	30	35	40	45	50	55	60	65	70	74
Section	U12x89	U12x89	U12x89	U18x104	U18x104	U24x117	U24x117	U30x131	U30x131	U33x141	U33x141
Dead Load Deflection (in)	-0.48	-1.01	-1.86	-1.31	-2.10	-1.71	-2.50	-2.17	-2.98	-3.19	-3.38
Live Load Deflection (in)	-0.16	-0.28	-0.45	-0.37	-0.57	-0.50	-0.69	-0.61	-0.79	-0.82	0.98

DESIGN

AASHTO LRFD Bridge Design Specifications 8th Edition (2017) Section 6.11.
Steel Structures. Box Section Flexural Members

PBFTG STANDARD SECTIONS

MANUFACTURING PROCESS.

valmont
Valley,NE 68064
(402) 359-2201

ORDER NUMBER: -
PAGE NUMBER: 2 OF 11
DRAWING NUMBER -
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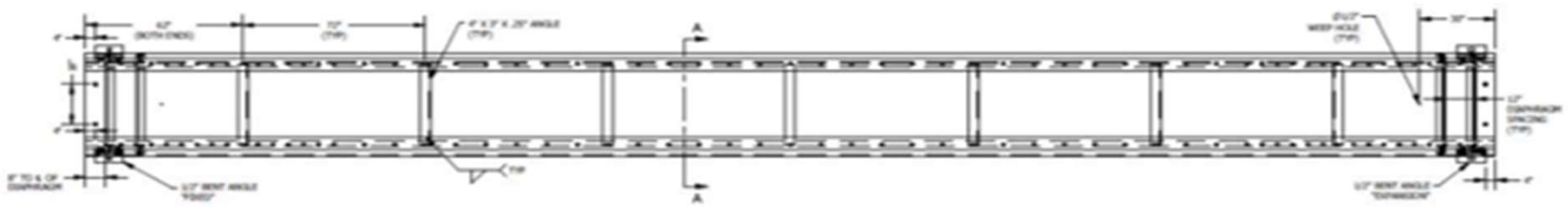
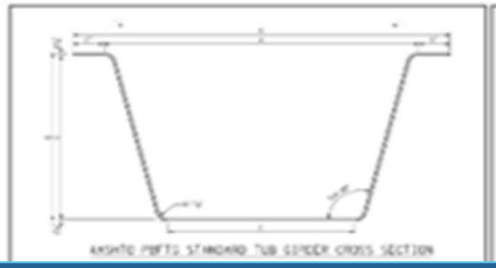
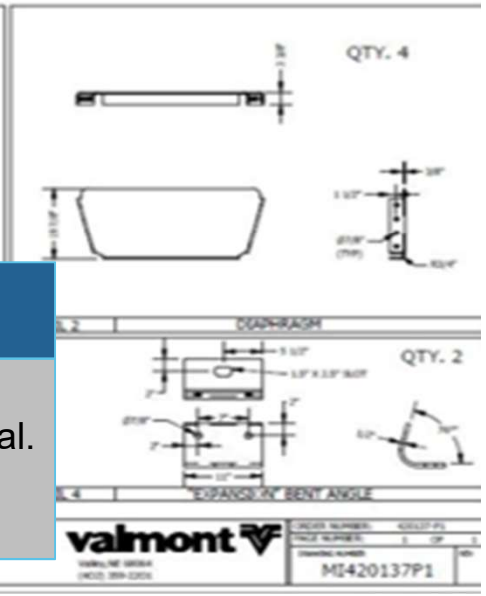






SHOP DRAWINGS

AASHTO 11.2.1 - Shop Drawings

Contractor shall submit copies of detailed shop drawings to the Engineer for Approval.

AASHTO 11.2.3 - Camber Diagram

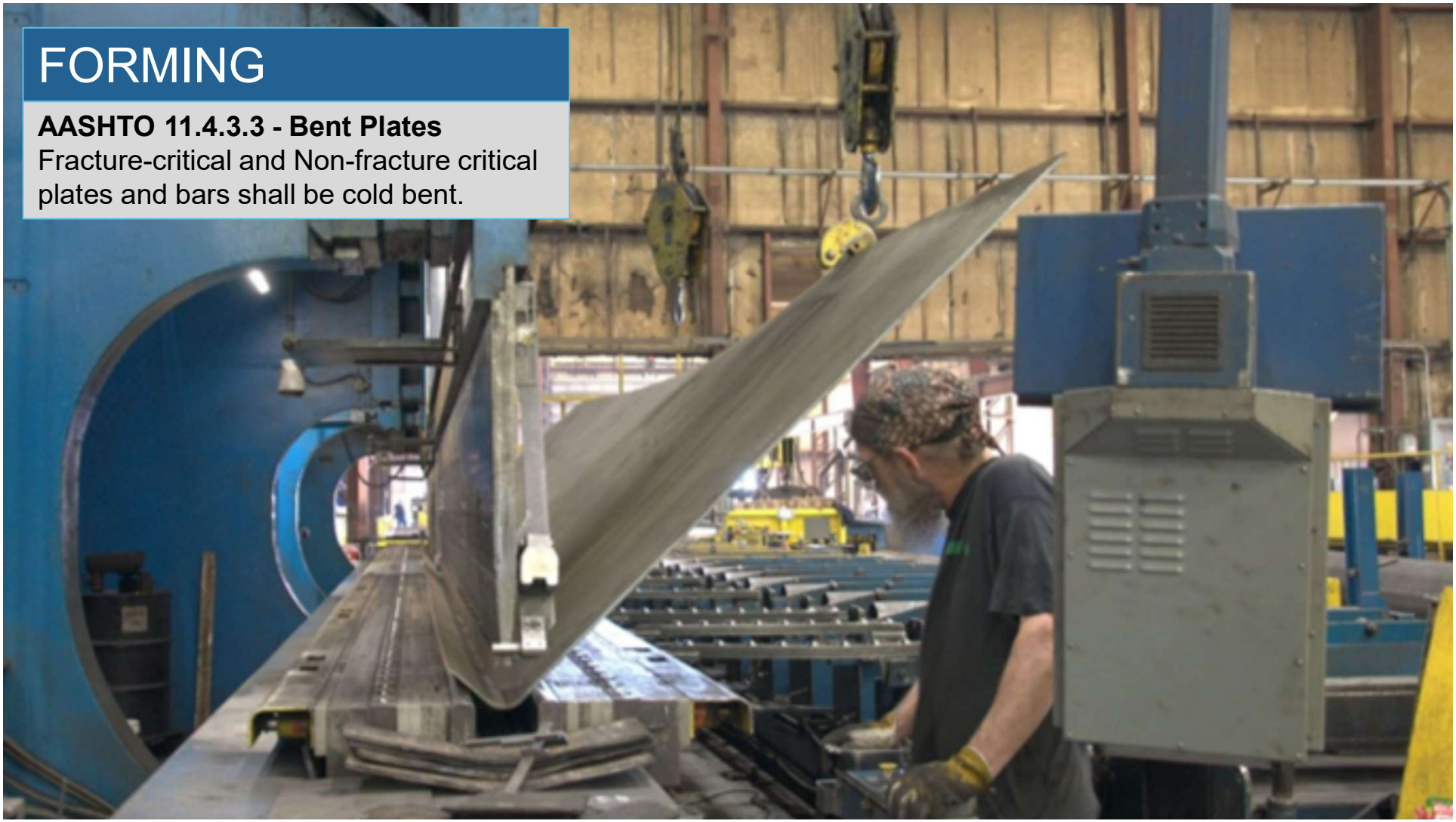
A camber diagram shall be furnished to the Engineer by the fabricator.

MATERIAL

AASHTO 11.3.1.2
Plates and Structural Shapes Steel plates shall conform to ASTM A709/A709M

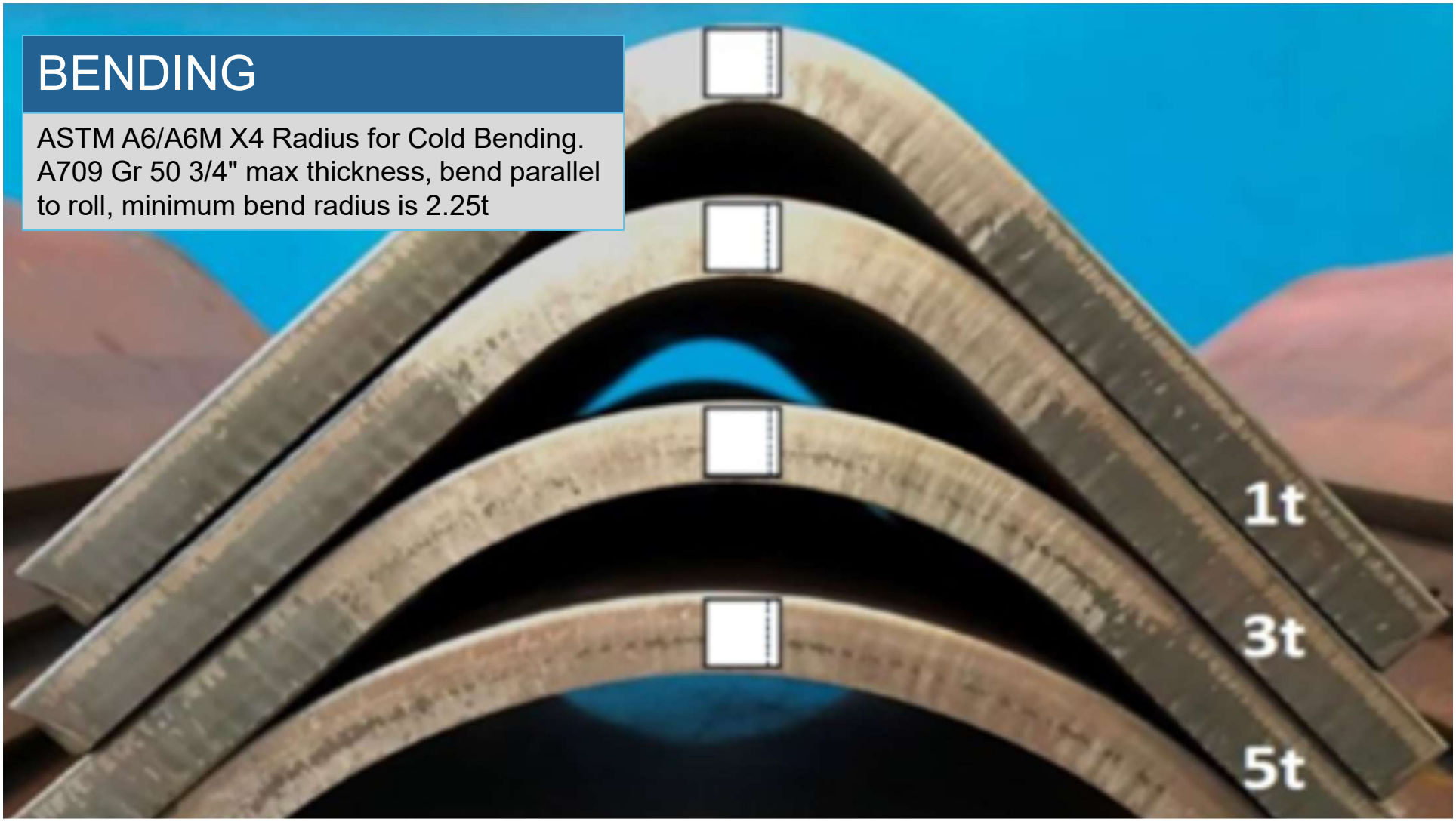
FORMING

AASHTO 11.4.3.3 - Bent Plates
Fracture-critical and Non-fracture critical plates and bars shall be cold bent.



BENDING

ASTM A6/A6M X4 Radius for Cold Bending. A709 Gr 50 3/4" max thickness, bend parallel to roll, minimum bend radius is 2.25t

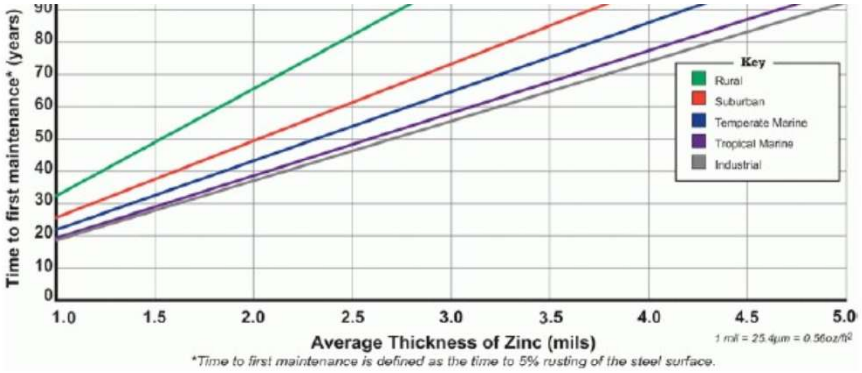


SHEAR STUDS

AASHTO 11.3.3
Welded Stud Shear Connectors shall satisfy all requirements of the AASHTO/AWS D1.5M/D1.5 Bridge Welding Code related to material, manufacturing, physical properties, certification, and welding.

GALVANIZING

AASHTO 11.3.7
Galvanizing shall be in accordance with AASHTO M 111M/M 111 (ASTM A123/A123M)



*Time to first maintenance is defined as the time to 5% rusting of the steel surface.

Valmont Coatings has the Largest Galvanizing Capacity in North America

"If you can design it, Valmont Coatings can Galvanize It!"

• Length in excess of 94 feet • Lifting Capacity of 100 Tons

Case Studies find Steel Bridges Saves 25% Over Concrete Precast Bridges

- Steel bridges do not require the heavier equipment that's needed for heavier concrete bridge girders.
- Galvanized steel I-beam bridges have the lowest initial cost and life cycle cost compared to concrete bridges.
- Galvanized steel bridges offer accelerated fabrication, 40% LESS construction time, reducing expensive down time for residents and business.

eSPAN140

Complimentary Web-Based Design Tool provides customized steel solutions for bridges up to 140 feet.

www.eSpan140.com

Duplex System is formed by painting or powder-coating over hot-dip galvanized steel. This process not only enhances the aesthetic value of the bridge, but also increases the corrosion protection by 1.5-2.3 times the sum of the expected life of each system.

Case Study:

Sterns Bayou Bridge

Ottawa County, MI United States

This is believed to be the first fully galvanized bridge in the United States. Galvanized and installed in 1966, this county bridge measures 420 ft. (128 m) long with a 30-foot clear roadway and a five-foot walkway along each side. All the steel was galvanized including the handrail, diaphragms, fasteners, shear connectors, and beams - some with 30-inch wide flanges, weighing between 99 and 108 pounds per foot. All steel used to erect the Stearns Bayou Bridge has no signs of rusting or staining, and is in excellent shape. The average mil thickness is 4.7 (160µm). Projected life expectancy to first maintenance is 106 years for the principal steel and 44 years for the handrail.

Details:

Year Galvanized	***1966***
Sectors	***Bridge & Highway***
Location	***Ottawa County, MI United States***
Environment	***Rural***

The majority of the steelwork is six feet above a fresh water river in a rural location. Traffic is light to moderate. The entire bridge is subject to winter salting.

At the 2016 inspection, all beams and diaphragms were in very good shape and showed no signs of rusting or staining. The average mil thickness was 4.7. All bolted connections looked good and showed no signs of rust. Bearing pads and expansion areas subject to salt and standing water had an average coating of 2.9 mils.

Projected life expectancy was 106 years for the principal steel.

INSPECTION

No fatigue critical details. Inspect only to ensure no deterioration of the galvanized coating by:

1. Camera video scope through the 2” diameter weep holes
2. 12” diameter inspection ports, allow for visual inspection of the interior galvanized coating

FINISHED PRODUCT

COMPONENT REVIEW

1. Design – AASHTO 6.11
2. Shop Drawings
3. Material – M270 (ASTM A709)
4. Press Brake Forming
5. Welding – AWS D1.5
6. Galvanizing – ASTM A123

ST. CLAIR COUNTY ROAD COMMISSION STARVILLE ROAD

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STRUCTURES

MDOT LOCAL AGENCY ABC REPLACEMENT

Location: St. Clair County, MI Starville Road

FHWA Grant Information:

- FHWA – AID Grant (Accelerated Innovation Deployment)
- Application coordination with the Michigan Department of Transportation

MDOT Michigan Department of Transportation

St. Clair County Road Commission Since 1913

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MDOT LOCAL AGENCY ABC REPLACEMENT

Location: St. Clair County, MI Starville Road

Critical Deficiencies of Existing Bridge:

Primary
- Steel Beam Deterioration

Secondary
- Scour Critical Foundations

MDOT ACCELERATED BRIDGE CONSTRUCTION

St. Clair County Road Commission

- 50’ SPAN STARVILLE ROAD BRIDGE
- 35 DAYS FOR COMPLETE RECONSTRUCTION
- PRECAST T-WALL SPREAD FOOTING ABUTMENTS
- PREFABRICATED CON-STRUCT SUPERSTRUCTURE
- UHPC JOINT POURS

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St. Clair County Road Commission SINCE 1913

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PRECAST CONCRETE T-WALLS

Prior To Road Closure: Precast Concrete T-Wall Abutment Units

- DESINED BY SCCRC
- T-WALLS CAST AT ADL SYSTEMS, PORTLAND, MI (80 miles away)

MDOT Michigan Department of Transportation

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CON-STRUCT PBFTG BRIDGE SYSTEM

Assemble Con-Struct Bridge Units at ADL Systems

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BRIDGE DEMO

October 10, 2019 Road Closure and Site Work Begins (Day 1)

Example bridge demo video from Monroe County

COFFERAM INSTALLATION

October 11, 2019 Foundation Removal and Sheet Pile Cofferdam (Day 2-10)

- HECRAS model increased span length and reduced scour depth
- New spill through type abutment included bury depth of footing to scour depth

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PRECAST CONCRETE T-WALL INSTALLATION

October 21, 2019 Delivered and Install 7 Units for S. Abutment (Day 11)

- LIGHT WEIGHT SUPERSTRUCTURE ALLOWED FOR SPREAD FOOTING ABUTMENTS (FASTER, CHEAPER)

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PRECAST CONCRETE T-WALL INSTALLATION

October 22, 2019 Delivered and Install 7 Units for N. Abutment (Day 12)

- PRECAST ABUTEMENTS PLACED IN 2 DAYS

PRECAST CONCRETE T-WALL INSTALLATION

November 2 , 2019 Abutment UHPC Joint Pour S. Abutment (Day 23)

- UHPC trial Batch was cast on October 28.

- FHWA AID GRANT FOR UHPC
- UHPC JOINT POUR MADE INDIVIDUAL UNITS HORIZONTALLY CONTINUOUS

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PRECAST CONCRETE T-WALL INSTALLATION

November 4, 2019 Abutment UHPC Joint Pour (Day 25-26)

- Additional time was given to contractor due to use of UHPC in unseasonably cold conditions.

- COLD WEATHER REQUIRED HEATING AND HOUSING FOR UHPC JOINT CURING

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CON-STRUCT PFTG BRIDGE INSTALLATION

November 14, 2019 Deliver and Install 3 Con-Struct Bridge Units (Day 35)

- EACH BRIDGE UNIT WAS PRECAST WITH A 5’-10” WIDE DECK, WITH 8” CIP DECK JOINTS MADE A TOTAL WIDTH OF 37’-2”

- Actual contractual end date. Extension of 14 days granted due to weather conditions and limited availability of U.S. made steel fiber.

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CON-STRUCT PBFTG BRIDGE INSTALLATION

November 15, 2019 Delivered and Install 3 Con-Struct Bridge Units (Day 36)

- RAILING BRUSHBLOCK WAS PRECAST WITH BRIDGE UNITS
- EACH UNIT WEIGHED ONLY 40,500 POUNDS (WITHOUT BRUSHBLOCK)

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CON-STRUCT PBFTG BRIDGE INSTALLATION

November 16, 2019 Formwork for UHPC deck joint pour (Day 37-38)

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CON-STRUCT PBFTG BRIDGE INSTALLATION

November 18, 2019 UHPC deck joint pour (Day 39-42)

- Another extension granted due to weather conditions.

- DECK JOINT REQUIRED PRE-HEATING AND INSULATED BLANKETS TO MAINTAIN TEMPERATURE DURING CURING

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CON-STRUCT BRIDGE INSTALLATION

November 20, 2019 Cast wingwalls and barrier end walls (Day 43-55)

- At this time it was determined the asphalt approach slabs would not be placed due to availability of asphalt

CON-STRUCT BRIDGE INSTALLATION

December 3, 2019 Install bridge railing (Day 56)

- Once railings were installed project was left for roadway approaches to be installed the spring of 2020

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Time-Lapse Video

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Completed Bridge

May 2020

Asphalt Approaches and Epoxy Overlay applied spring 2020

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Completed Con-Struct PBFTG Bridge

Project Completion May 2020

Asphalt Approaches and Epoxy Overlay applied spring 2020