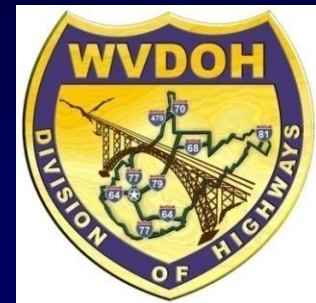


West Virginia's First Modular Press-Brake-Formed Steel Tub Girder Bridge



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**Bridge Review Unit Leader, Quality Assurance &
Project Management Section – Engineering Division**



Press-Brake-Formed Steel Tub Girder Research

- Started as a research project in 2014 - 2015
- Four (4) bridges in two (2) districts identified as suitable candidates
- Two (2) bridges, one in each district, selected
- District 2 – Fourteen Mile Bridge
- District 4 – Flat Run Bridge
- Plans were to be developed In-House with help from Marshall University & West Virginia University

Press-Brake-Formed Steel Tub Girder Research

- Due to slow start in getting construction plans completed, it was decided to get consultants
- District 2 – Fourteen Mile Bridge is designed by J.B. Turman Engineering, PLLC
- DOT Project Manager: Jonathan Clark, P.E.
- District 4 – Flat Run Bridge is designed by The Thrasher Group, Inc.
- DOT Project Manager: Steven Harris, P.E.

Fourteen Mile Bridge



Site Visit on March 31, 2015

Fourteen Mile Bridge



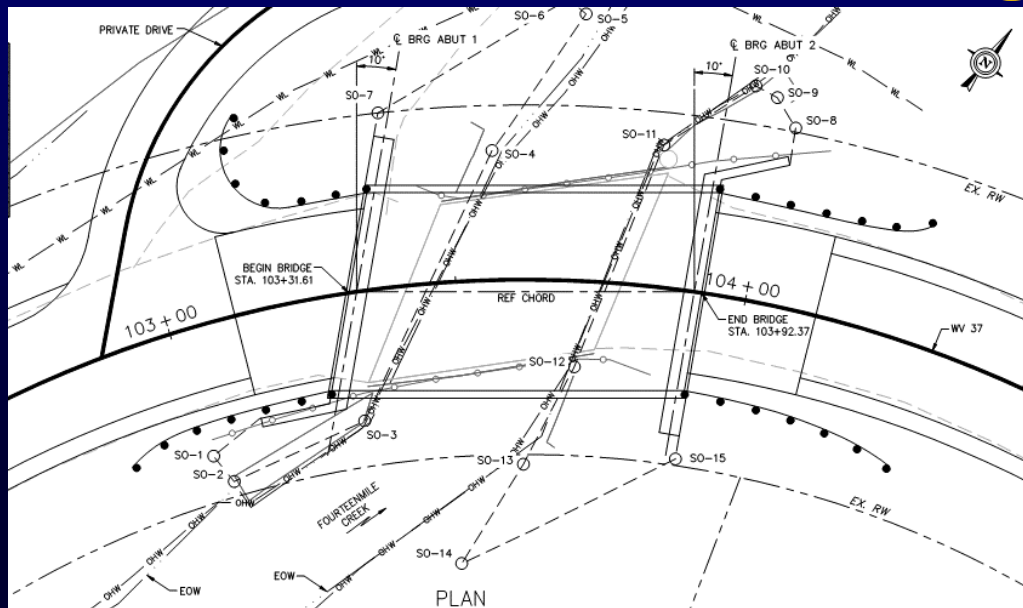
Superstructure condition of the bridge from below

Fourteen Mile Bridge

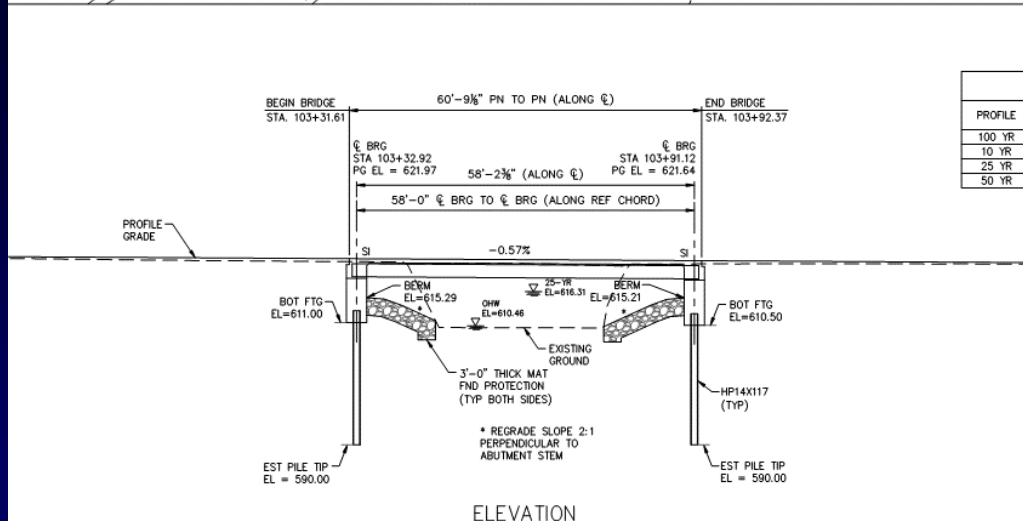


Substructure condition of the bridge from below

Fourteen Mile Bridge – GP&E

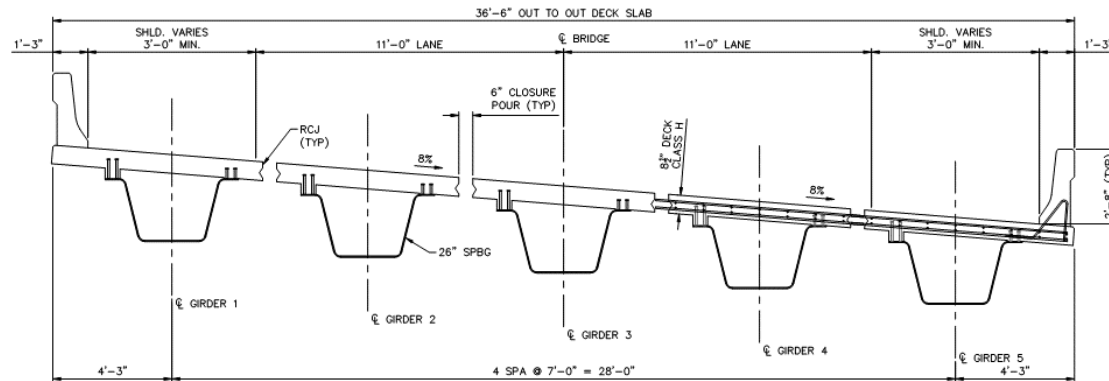


- **Span: 58' - 0"**
- **Length: 60' - 9"**
- **Width: 36' - 6"**
- **Skew: 10 deg. LFS**



ELEVATION

Fourteen Mile Bridge Typical

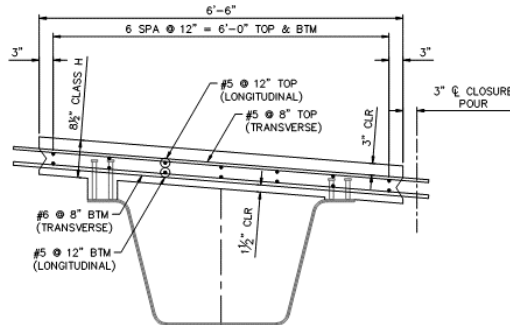


NOTES:

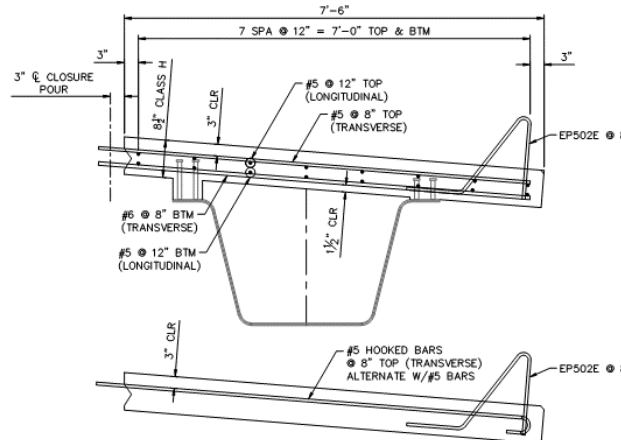
1. PRECASTING TO INCLUDE THE DECK AND CONCRETE DIAPHRAGM AT THE ABUTMENT.
2. PRECAST DECK THICKNESS TO BE 8½", ALLOWING ½" FOR DIAMOND GRINDING, SEE SHEET B4 FOR DIAMOND GRINDING NOTE.
3. FORMS FOR THE PRECAST UNIT SHALL CONSIST OF REMOVABLE FORMS FOR ANY SECTION THAT OVERHANGS THE GIRDER.
4. STAY-IN-PLACE METAL DECKING SHALL BE USED OVER THE GIRDER TO ALLOW FOR IN SERVICE INSPECTION OF THE INTERIOR OF THE GIRDER. ALTERNATIVE CLEAR SPAN FORMING METHODS MAY BE SUBMITTED TO THE PROJECT ENGINEER FOR APPROVAL. IF ANY PIECES OF THE FORM WORK NEEDS TO BE WELDED TO THE GIRDERS, ITEMS SHALL BE WELDED TO THE GIRDERS BEFORE THE GIRDERS ARE GALVANIZED. ALL FALSE WORK MUST BE STAMPED BY A LICENSED WEST VIRGINIA ENGINEER.
5. 6 INCH CLOSURE POURS WILL BE COMPLETED USING ULTRA HIGH PERFORMANCE CONCRETE.
6. PARAPET WALLS TO BE CONSTRUCTED IN THE FIELD.

TYPICAL SECTION
LOOKING STATION AHEAD
NTS

- 5 Sections
- 8% SE
- Interior: 6.5'
- Exterior: 7.5'



INTERIOR MODULE



EXTERIOR MODULE

Fourteen Mile Bridge

- Letting date: February 26, 2019
- Low bid contractor: Orders Construction Company (OCC)
- Low bid: \$2.269 Million
- Bridge Cost: \$1.057 Million
- Bridge Unit Cost: \$477/sq. ft.
- Superstructure Unit Cost: \$320/sq. ft.
- Single bid

Fourteen Mile Bridge – Items of Note

- Proprietary UHPC by LaFarge was specified
- Quantity of UHPC = 5 CY
- Unit Bid Price for UHPC = \$22,000/CY
- Project Cost for UHPC = \$110,000
- Quantity of Prefabricated Modules = 5 Units
- Unit Bid Price of Modules = \$120,000
- Project Cost for Modules = \$600,000
- Steel tub girders are hot-dip galvanized

Fourteen Mile Bridge



Tub girders at Carr Concrete for deck placement – 07/18/2019

Fourteen Mile Bridge



Construction of the substructures – 08/01/2019

Fourteen Mile Bridge



Delivery and lifting of the modular units – 08/22/2019

Fourteen Mile Bridge



Lifting and setting of the modular units – 08/22/2019

Fourteen Mile Bridge



Lifting and setting of the modular units – 08/22/2019

Fourteen Mile Bridge



Placement of UHPC in the longitudinal closure joints – 09/05/2019

Fourteen Mile Bridge



- Use of UHPC allowed 6" closure joints
- Minimum amount of reinforcement used
- Exposed aggregate surface finish specified

Fourteen Mile Bridge



- Press-brake-formed steel tub girders have sealed inspection holes
- Press-brake-formed steel tub girders have drain holes

Fourteen Mile Bridge



- **Water-tight forms specified for UHPC placement**
- **Superelevation presented challenges in UHPC placement**

Fourteen Mile Bridge



- Plywood forms were nailed onto the deck to contain UHPC
- UHPC placement was done in one day

Fourteen Mile Bridge



- Longitudinal joints of UHPC were diamond ground
- Entire deck received longitudinal profiling

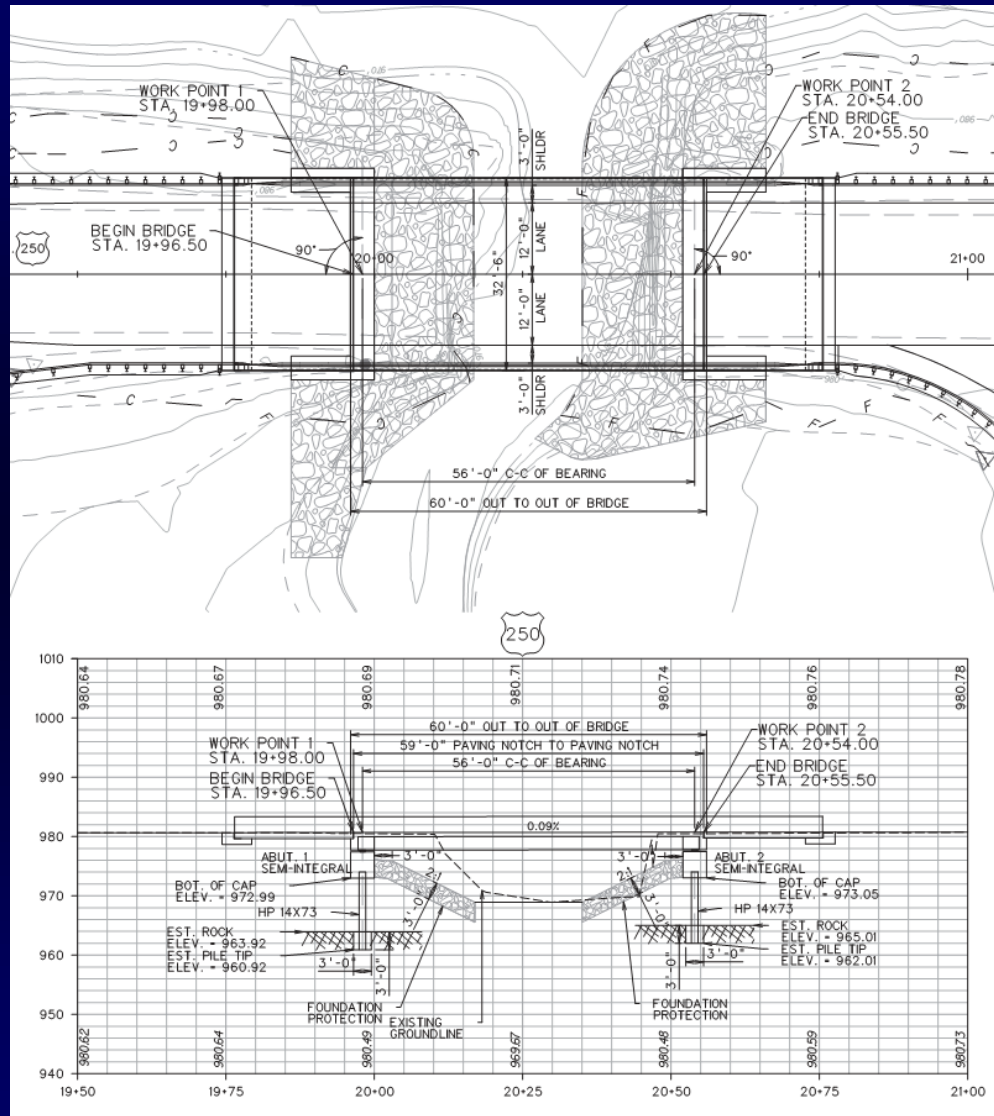
Fourteen Mile Bridge – Lessons Learned

- Use Non-Proprietary UHPC Specifications
- Cost of Proprietary UHPC is too high
- Avoid superelevation and steep longitudinal grades; complicated forming and placement of the deck and UHPC
- Avoid skewed ends of the press-brake-formed steel tub girder; caused problems during fabrication and construction.

Flat Run T-Beam Bridge

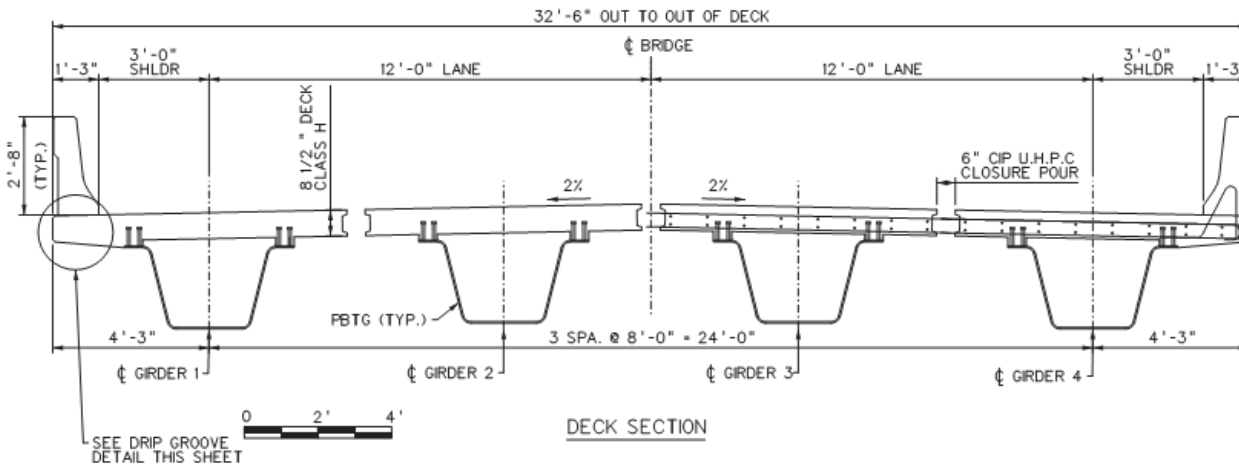
- Letting date: October 22, 2019
- Low bid contractor: Clearwater Construction, Inc.
- Low bid: \$1.313 Million
- Bridge Cost: \$0.581 Million
- Bridge Unit Cost: \$298/sq. ft.
- Superstructure Unit Cost: \$184/sq. ft.
- Seven (7) bids

Flat Run T-Beam Bridge – GP&E



- **Span: 56' - 0"**
- **Length: 59' - 0"**
- **Width: 32' - 6"**
- **Skew: 0 deg.**

Flat Run T-Beam Bridge Typical



CLASS H
(C)
EPOXY
REINFORCING
UHF

- 4 Sections
- 2% NC
- Interior: 7.5'
- Exterior: 8.0'

NOTES:

1. PRECASTING TO INCLUDE THE DECK AND CONCRETE DIAPHRAGM AT THE ABUTMENT. CONCRETE SHALL BE CLASS H.
2. PRECAST DECK THICKNESS TO BE 8 1/2", ALLOWING 1/2" FOR DIAMOND GRINDING, SEE SHEET S04 FOR DIAMOND GRINDING NOTE.
3. FORMS FOR THE PRECAST UNIT SHALL CONSIST OF REMOVABLE FORMS FOR ANY SECTION THAT OVERHANGS THE GIRDERS.
4. STAY-IN-PLACE METAL DECKING SHALL BE USED OVER THE GIRDER TO ALLOW FOR IN SERVICE INSPECTION OF THE INTERIOR OF THE GIRDER. ALTERNATIVE CLEAR SPAN FORMING METHODS MAY BE SUBMITTED TO THE PROJECT ENGINEER FOR APPROVAL. IF ANY PIECES OF THE FORM WORK NEEDS TO BE WELDED TO THE GIRDERS, ITEMS SHALL BE WELDED TO THE GIRDERS BEFORE THE GIRDERS ARE GALVANIZED. ALL FALSE WORK MUST BE STAMPED BY A LICENSED WEST VIRGINIA ENGINEER.
5. 6 INCH CLOSURE POURS WILL BE COMPLETED USING ULTRA HIGH PERFORMANCE CONCRETE.
6. PARAPET WALL TO BE CONSTRUCTED IN THE FIELD.
7. CONTRACTOR SHALL USE CAUTION WHEN SETTING PRECAST MODULES AS TO NOT CAUSE DAMAGE TO THE MODULES.
8. TYPE AND LOCATION OF LIFTING LOOPS ON THE PRECAST MODULES SHALL BE SELECTED AND PLACED AT THE DISCRETION OF THE CONTRACTOR. THERE SHALL BE A MINIMUM OF FOUR PICK POINTS FOR EACH MODULE. THE WEIGHT CAPACITY OF THE LIFTING LOOPS SHALL HAVE A MINIMUM FACTOR OF SAFETY OF TWO. LIFTING LOOPS AND THEIR LOCATION SHALL BE SUBMITTED WITH THE SHOP DRAWINGS.
9. WELDED STUD SHEAR CONNECTOR SHALL BE INSTALLED ON THE FLANGES OF THE PRESS BRAKE TUB GIRDER IN THE SHOP PRIOR TO THE PLACEMENT OF THE DECK PANELS.

Flat Run T-Beam Bridge – Items of Note

- Proprietary UHPC by LaFarge was specified
- Quantity of UHPC = 6 CY
- Unit Bid Price for UHPC = \$12,000/CY
- Project Cost for UHPC = \$72,000
- Quantity of Prefabricated Modules = 4 Units
- Unit Bid Price of Modules = \$70,000
- Project Cost for Modules = \$280,000
- Steel tub girders are hot-dip galvanized

Questions?



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Special Thanks



- 2019 International ABC Conference
- American Iron and Steel Institute (AISI)
- Orders Construction & J.B. Turman Engineering