Innovative Bridge Research and Deployment

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How:

How an Idea became a project-

Douglas R. Davis, P.E., P.S.
Muskingum County Engineer
Karl Barth from West Virginia University

• Proposed System Details & Design Methodology
• Experimental Testing
  – Single Composite Girders
  – Modular Composite Units
• Assessment of Composite Flexural Capacity
• Implementation & Field Investigations
Proposed System

- Bridge Technology Center:
  - Modules with steel press-brake tub girders
    - Galvanized or weathering
  - Modules are joined using UHPC longitudinal closure pours
  - Modules can be shipped to site pre-topped or with a variety of deck options
Design Methodology (cont’d)

• Resulting girder depths:
  – 60” plate: \( d = 12” \)
  – 72” plate: \( d = 17” \)
  – 84” plate: \( d = 23” \)
  – 96” plate: \( d = 26” \)
  – 108” plate: \( d = 30” \)
  – 120” plate: \( d = 34” \)

• All composite section properties are available upon request.
Experimental Testing

- Testing was conducted on composite, noncomposite, and modular flexural specimens:
  - 84” × 7/16” PL
  - Dimensions shown below:
Experimental Testing
Modular Unit Specimen Construction
Modular Unit Specimen Construction (cont’d)
Modular Unit Specimen Construction (cont’d)
Modular Unit Fatigue Loading (67.43 kip, 0.75 Hz Frequency)
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What:
Accelerated construction using SPS Panels on Break-Formed Steel Tub Girders

Cannelville Road Bridge Replacement – MUS-C.R.7-0.27

Width: 24’-0” F/F Rail
Length: 52’-0”

Douglas R. Davis, P.E., P.S.
Muskingum County Engineer
Decided to go with half-width prefabricated assembly
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Where:

Fabricated by: Maiko Industries Ellsworth Kansas
Erected by Ohio Bridge Cambridge Ohio

Douglas R. Davis, P.E., P.S.
Muskingum County Engineer
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When:

12/23/2014 Introduced to the IBRD/Every Day Counts initiative and Buchanan County Project.
4/22/2015 Started conversations with ODOT about Project funding and how to apply.
6/09/2015 ODOT verified project to be a good fit for AID Program and informed us about the required narrative document. ODOT will need to submit application on our behalf.
6/29/2015 Submitted narrative document to ODOT.
8/04/2015 ODOT approval (including Tim Keller) to submit application to FHWA.
8/12/2015 Application officially submitted to FHWA (Grants.gov).
11/02/2015 FHWA request additional information about project.
11/16/2016 MCEO submit requested information to FHWA.
2/03/2016 ODOT informs us of FHWA approval of the project funding.

Douglas R. Davis, P.E., P.S.
Muskingum County Engineer
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When:

2/09/2016  MCEO begin preliminary site design for environmental.
2/19/2016  MCEO begin design and start correspondence with Rolando.
2/23/2016  Project is identified in ELLIS as PID 102574 - MUS-CR7-0.27 Cannelville Aid per ODOT.
3/21/2016  Floodplain permit.
3/30/2016  Environmental clearance.
4/06/2016  Stage 3 Plan Submittal.
4/15/2016  Conversations with potential fabricator.
4/25/2016  decided to change from ODOT Item 513 to Item 530 for fabrication.
5/25/2016  Advertise for Bid.
7/11/2016  Re-Bid with addendums due to choice of Metalizing and overall bid over threshold.
7/28/2016  Bid awarded to US Bridge (now using Maico as fabricator).

Douglas R. Davis, P.E., P.S.
Muskingum County Engineer
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Why:

Evaluate new materials to reduce decking dead loads.
Reduce construction duration and roadway closures.

Develop design standards and load rating equations to permit the implementation of this structure type.

The overall design, information, and various stakeholder insight shall made available for future use, as other begin to implement this structure type.

Douglas R. Davis, P.E., P.S.
Muskingum County Engineer
- No issues with Roadway Design
- No issues with Foundation Design
- Designed to handle 10 YR storm event (Tub partially underwater during higher storm events)
• No issues with Abutment Design
• Oversized Bearing Pads required due to width of tub
• Bearing plates oversized to accommodate anchor rods (Fixed Bearings due to possible flooding)
• No issues with Foundation Design
• No issues with Abutment Design
• No issues with Wingwall Design
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Accelerated construction using SPS Panels on Break-Formed Steel Tub Girders

Cannelville Road Bridge Replacement – MUS-C.R.7-0.27

Width: 24′-0″ F/F Rail
Length: 52′-0″

Douglas R. Davis, P.E., P.S.
Muskingum County Engineer
Had to get creative with Expansion Joint in order to provide seamless Asphalt Surface

Combine Two ODOT standards (Compression Seal Joint under Polymer Modified Asphalt Joint)

Must avoid standard Heat Lance (3000 Deg. F) near SPS Panels as it will damage the core.
• Superstructure plans provided by another firm. Requires collaboration to meet submittal deadlines.
• Cannot Hot Dip Galvanize the SPS Panels, so we decided to use Metalized Coating System for panels
• SPS Panels prevented us from including camber in the tub girders (alignment issues with bolt holes)
• Additional interior stiffeners provided to prevent tub from warping during hot dip galvanizing
• Access hatches moved further away from abutment to gain vertical access clearance
- End diaphragms need to be sealed to prevent floodwater from entering tub.
- Temporary holes required in end diaphragms to allow drainage during the galvanizing process.
- Threaded drain holes provided near midspan in order to drain any water trapped in tub girder.
• Since deck is flat, intermediate asphalt cannot be performed continuously with the roadway paving
• Surface course can be performed continuously with the roadway paving
• We are confident that the Type III waterproofing with bond with the metalized panels, but no examples
Conclusion

- First bridge in US with the combination of SPS Panels used on Break-Formed Steel Tub Girders
- Overall design and implementation will continue to improve as more projects are completed
- May become a competitive Superstructure Alternative once it becomes mainstream and price is competitive
- At this time construction time saving not translating into overall construction cost savings

**Buchanan County - 2015 AID**
- Galvanized Tub Girder With Concrete Deck
- Length - 52'-0" Width - 24'-0"
- Concrete Abutment on Reinforced Soil (GRS)
- $398,960

**MCEO- Cannelville Rd Bridge – 2016 AID**
- Galvanized Tub Girder with Metalized SPS Panels
- Length - 52'-0" Width - 24'-0"
- Concrete Abutment on Steel H-Piles
- $706,234

To be erected April 17th 2017

Douglas R. Davis, P.E., P.S.
Muskingum County Engineer