

Rte. 123 Bridge over Occoquan River

Fairfax and Prince William Counties, Virginia



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moffatt & nichol *Creative People – Practical Solutions*

Rte. 123 Bridge over the Occoquan River

- Project Background
 - Location
 - Site Characteristics
 - Bridge Requirements
- Concept Development
 - Public Involvement
 - Aesthetics
- Final Bridge Design
 - Substructure
 - Superstructure
- Construction
- Conclusion

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Project Background

Location




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Project Background

Town of Occoquan



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Project Background

Town of Occoquan



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Project Background

Site Characteristics



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Project Background

Existing Bridge

- 10 Spans – 120' Steel Plate Girders
- 3 Traffic Lanes (1 NBL & 2 SBL)
- Functionally Obsolete
- Spans Mill St., Parking Lot & Occoquan River



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Concept Development

Proposed Bridge Requirements

- 7 Traffic Lanes (3 NBL, 3 SBL & 1 SBL Turn)
- Appropriate Shoulder Widths for Safety
- Pedestrian Walkway
- Raise Profile of the Roadway and Bridge
- Use Existing Bridge Alignment & ROW
- Parking Area during and after construction
- Functional and Economical Bridge Solution
- Approval of Bridge Concept by Town



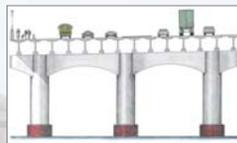
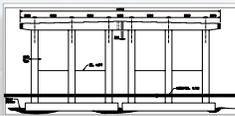
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Concept Development

Concept Study



Public Involvement

- Bridge Selection Committee
 - Citizens and Elected Officials from Town of Occoquan, Fairfax and Prince William Counties
 - Provide community input into the bridge selection process

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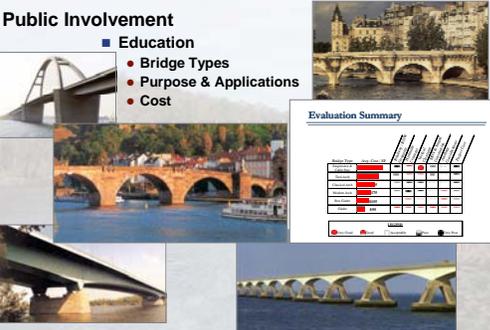
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Concept Development

Public Involvement

- Education
 - Bridge Types
 - Purpose & Applications
 - Cost



Evaluation Summary

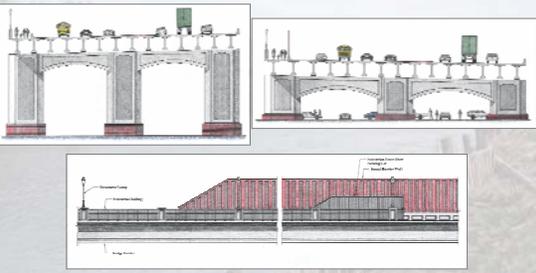
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Concept Development

Public Involvement

- Approved Bridge Concept



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Concept Development

Public Involvement



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Concept Development

Public Involvement



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Concept Development

Public Involvement



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Concept Development

■ Brickwork Formliners

- Bases of Pier Columns
- Base of Abutment A MSE Wall



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Concept Development

- Fractured Rib Formliners
 - Faces of Pier Columns
 - Faces of MSE Wall Panels

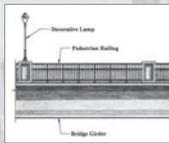
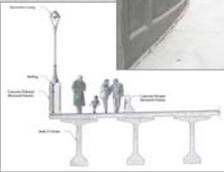


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Concept Development

- Pedestrian Walkway
 - Recessed Panels
 - Pedestals with Lighting
 - FRP Railing Panels

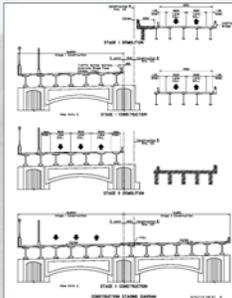


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Final Bridge Design

Sequence of Construction



Stage I Construction



Stage II Construction

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Final Bridge Design

Summary of Concrete Strengths

Beams and Beam Segments	55 MPa (8,000 psi)
Deck Slab	40 MPa (5,800 psi)
Parapets, Medians & Railing Pedestals	30 MPa (4,300 psi)
Pier Caps & Columns	35 MPa (5,100 psi)
Pier Footings	25 MPa (3,600 psi)
Abutments & MSE walls	25 MPa (3,600 psi)



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Final Bridge Design

Summary of Reinforcing Steel

All mild reinforcing steel – ASTM A615 Gr. 60	420 MPa (60 ksi)
MMFX 2 (Stage II Deck Slab Only) - ASTM A615 Gr. 75	520 MPa (75 ksi)
Prestressing Steel - 0.6" Ø, Low-Relaxation ASTM A416 Gr. 270	1860 MPa (270 ksi)
Post-tensioning Steel - 0.6" Ø, Low-Relaxation ASTM A416 Gr. 270	1860 MPa (270 ksi)



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Final Bridge Design

Abutments

- Single Row of Steel Piles
- Socketed into Rock
- MSE Walls



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Final Bridge Design

MSE Walls

- Support of Abutment Fills
- Retaining Wall for SBL Approach
 - Support for Roadway Fill (Rte 123 & Rte 722)
 - Reduced ROW
 - Greater than 350' long (107 m)
 - Maximum Height of 43.5' (13.25 m)



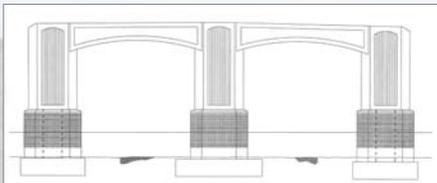
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Final Bridge Design

Piers



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Final Bridge Design

Piers



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Final Bridge Design

Deck Slab

- 8.5" (220mm) Slab Thickness
- Epoxy Coated Reinforcing Steel (SBL)
- MMFX 2 Reinforcing Steel (NBL)



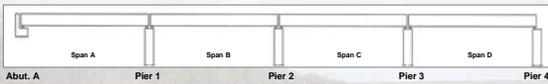
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Final Bridge Design

Approach Spans – (144'-4" Each)



- 4 Simple Spans – 140' (42.7m) each
- Made Continuous for Live Load



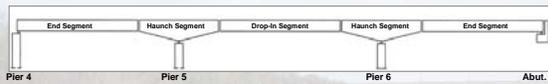
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Final Bridge Design

Main Span Unit – (180'-240'-180')



- 2 End Segments – 128' (39m) each
- 2 Haunch Segments – 98' (30m) each
- 1 Drop-In Segment – 137' (41.8m)



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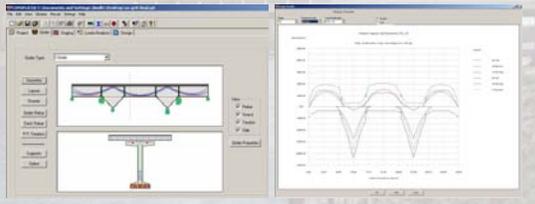
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Final Bridge Design

Analysis and Design Software

- Consplix PT by LEAP Software
- Girder Line Analysis
- Time Dependent Analysis



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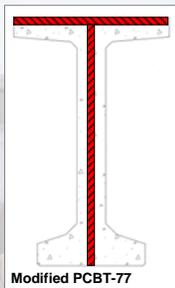
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Final Bridge Design

Girder Section

- Approach Spans
 - Standard VDOT 77" Bulb-T (PCBT-77)
- Main Span Unit
 - Modified PCBT-77
 - ◆ 2" added to top flange thickness (from 4" to 6" thick)
 - ◆ 2" added to overall section width (from 7" web to 9" web)



Modified PCBT-77

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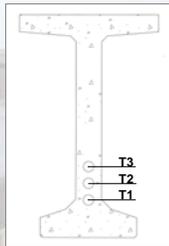
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Final Bridge Design

Post-Tensioning Tendons

- 3 Tendons (T1, T2 & T3)
- 12 - 0.6" Diameter Strands Per Tendon



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Final Bridge Design

Post-Tensioning Ducts

- 3" Diameter HDPE Round Ducts
- 6" (150mm) Vertical Duct Spacing



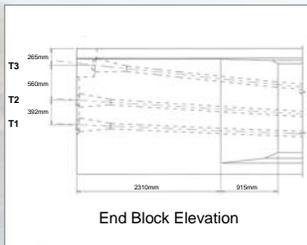
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Final Bridge Design

End Segment End Block



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Final Bridge Design

Haunch Segments

- Variable Web Depth
- Constant Bottom Bulb Thickness
- Overall Depth Varies from 6.58' (2007mm) to 12.5' (3810mm)



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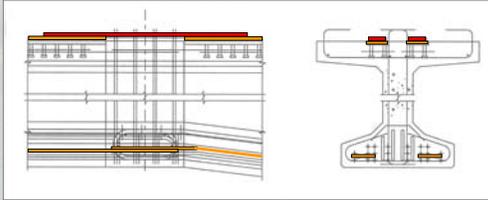
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Final Bridge Design

Girder Splices

- 2' (600mm) Splice Length
- Lapped & Interlocking Reinforcing Steel
- Welded Steel Plates



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Final Bridge Design

Girder Splices

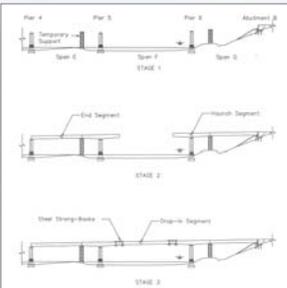


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Final Bridge Design

Erection Sequence

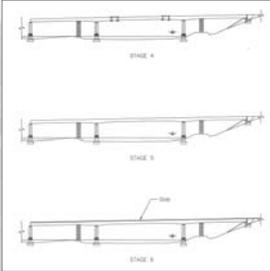


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Final Bridge Design

Erection Sequence



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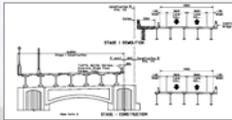
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Construction

Sequence of Construction

- Eliminate Stage I Demolition of Existing Fascia Girder
- Non-Parallel Bridges



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Construction

Transverse Deck Cracking

- Full Depth Shrinkage Cracks
- Full Width Cracks Spaced at 3'-10'
- Extent of Cracking Varies with Span Location



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Construction

Web Cracking of Beam Segments – Casting Yard



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Construction

Web Cracking of Beam Segments - Testing



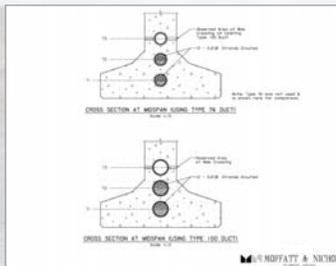
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Construction

Web Cracking of Beam Segments – Impact of Duct Size



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Construction

Web Cracking of Beam Segments – Re-Cast



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Construction

Web Cracking of Approach Girders



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Conclusion

Notable and Innovative Features

- High Strength Concrete in Superstructure
- Spliced and Post-tensioned Bulb-T Girder Segments
- MMFX2 Reinforcing Steel (NBL Deck)
- FRP Railings
- Public Involvement
- Cost Effective Aesthetic Features
 - Formliners for Rustication
 - Recessed Panels
 - Stamped Concrete

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Conclusion

Application of state-of-the-art technology with cost effective architectural enhancements to provide a bridge structure that meets requirements of function and overall aesthetic goals.



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Conclusion

Comparison



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Conclusion

Comparison



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Conclusion

Comparison



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