2017 Virginia Concrete Conference
Inverted T-Beam Update - Next Phase

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Outline

Past Research

2015 Presentation by Professor Carin L. Roberts-Wollmann, PhD, P.E.

Background

Fabrication & Construction

Production
Erection
Post Construction

Future Research

Concrete Mixes to control shrinkage
 Longer beams to increase spans
Background

Virginia Inverted T-Beam

Cast-in-Place Deck

Prestressed Inverted T-Beam
Background

VDOT Standard Voided Slab

Shear Key w/ Non-Shrink, High Strength Grout
Background

Shear Key failures cause leaks!
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Background

Shear Key failures cause leaks!
Background

History of the Inverted T-Beam

• FHWA scanning tour
• Minnesota DOT (MNDOT)
• VDOT

Benefits

• Accelerate construction
• Improved performance of connection between adjacent beams.

Poutre-Dalle System (Ralls et al., 2005)
Background
History of the Inverted T-Beam (MNDOT)

- Developed a similar system with minor changes
- Implemented on 12 bridges between 2005 and 2011 w/ numerous modifications to improve performance
- Experienced reflective cracks and shrinkage cracks
Crack Map for Bridge No. 33008, Inspection No. 3 (Dimaculangan and Lesch, 2010)
Background

History of the Inverted T-Beam (VDOT)

• Lessons learned from MNDOT
• Applied for FHWA Innovative Bridge Research and Deployment (IBRD) funds
• Invited precast industry for input
• Research (VTRC)
• Design (VDOT)
• Implementation
Background
Route 360 Project

- 6 lanes divided over the Chickahominy River (no additional capacity)
- 4 bridges structurally deficient
- 2 are identical in size and type
- Maintain existing profile grade line
- Maintain low chord for hydraulics
Fabrication & Construction

Test Slab/beam acting monolithically
Fabrication & Construction

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Test beam flexure crack in CIP deck
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Test beam flexure crack in CIP deck
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Inverted T-Beam formwork
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LIDAR Scan
Fabrication & Construction

Welded Flange Connection

SECTION C-C
Fabrication & Construction

Post Construction

Voided Slabs
• Longitudinal cracking evident in B601 & B606

Inverted T-beams
• No visible cracks detected upon recent visual inspection
Post Construction

Deck crack on B606
Post Construction

Deck crack on B606
Post Construction

Deck cracks on B601
Post Construction

Deck cracks on B601
Future Research

Concrete Deck Mix Design

Reduce Shrinkage Strains

• Control (regular A4)
• Fly Ash
• Slag
• Shrinkage Reducing Admixture
• Lightweight Coarse Aggregate
• Lightweight Fine Aggregate w/ Normal weight Coarse Aggregate
Future Research

Concrete Deck Mix Design

Goals

- Control Deck Cracking
  - Reduce/eliminate shrinkage cracks
  - Reduce restrained shrinkage with a high creep mix
  - Cost effective
Future Research

Concrete Beam Design

Extend Span Length w/ existing 18” section

Use lightweight beam and deck

Focus on ease of fabrication/construction

• Eliminating horizontal shear reinforcing
• Lightweight beams (smaller cranes)
• Custom bridge widths
  – Currently, 6n+2 (14’, 20’, 26’, 30’...
Future Research

Ability to Customize Beam Widths
Developing Standards

Concrete Beam Design

Goals

- Determine max. Span length using same 18” deep beam
  - Deflection limited conditions
- Customize bridge widths
- Extend details to bridges with low skew angles (less than 30 deg)
- Finalize LL distribution factors
Future Research

Concrete Beam Design

Goals

- Eliminate the welded flange connection
- Eliminate horizontal shear reinforcing by optimizing interface shear surface roughening
- Optimize lightweight concrete mix to minimize cracking (deck and beam)
- Extend details to bridges with high skew angles (greater than 30 deg.)
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