Testing and Evaluation of an FRP Temporary Bypass Bridge

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FRP Temporary Bypass Bridge

IBRC Program

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Background – Related FRP Work

- Post-tensioned FRP rods

- FRP repair of damaged girders
Background – Related FRP Work

- FRP strengthened steel girders
Background – Related FRP Work

- FRP strengthened glulam girders
Background

- Previous Temporary Bypass Bridge
  - Steel construction
  - Two-sections
  - Age
  - Heavy, cumbersome
  - Maintenance
  - Corrosion
FRP Bridge Background

- Proposed replacement of steel temporary bypass bridge with FRP bridge
- Used for several years in NY, PA, OH
- Overall, bridges perform very well
- Common problems encountered:
  - Wearing surface deterioration
  - Delamination of FRP
FRP Decks

- Deck on girder
- Deck slab
FRP Deck Slab Bridge Design

- Design selected to meet the needs of Iowa DOT temporary bridges
- Designed and fabricated by Hardcore Composites, Inc.
- Iowa DOT contracted HNTB, Corp. to perform design check
FRP Deck Slab Bridge Design

- FRP Temporary Bypass Bridge
  - Two sections, connected with steel plate
  - Each section composed of:
    - 600 8in. x 16in. x 36in. Foam bottles
    - Stitch bonded TV3400 FRP (bottle wraps)
    - Stitch bonded QM6408 FRP (exterior plies)
    - Vacuum Assisted Resin Transfer Molding (VARTM)
    - Vinyl Ester Resin
    - 3/8 in. epoxy wearing surface
  - ~35% lighter than current steel bypass bridge
  - Corrosion Resistant
FRP Deck Slab Bridge

- 39ft-10in. Long
- 27ft-2in. Wide, 24ft roadway
- 3ft thick
- 16,400lb and 17,800lb panel weights; total bridge weight of approx. 34,200lb minus hardware
FRP Deck Slab Bridge - Installation
FRP Deck Slab Bridge - Evaluation

- Overall condition was good
- Variance in panel weight, QC?
- Wearing surface tapered from 3/8 in. thick at edges to > 1 in. at centerline
- Wearing surface was easily scuffed, not very durable (NY, PA, OH same results)
- Center plate and guardrail attachment holes were inconsistent and misaligned
Testing

- Type 4 Legal Truck controlled
  - 12.5k front axle, 3-14k rear axles

- Ind. Load Cases used 7k point load for testing => half of rear axle (wheel load)
Testing

Rail Attachment Location

10'

39'-10"

19'-11"

Edge of Curb

Strain Gage

DCDT

Foam Bottle

10" Bearing

Center Plate Attachment Location

1'-7"

6'-3"

11'

4'

9'

13 ← 17

14

15 ← 17

Truck Position 1

Legal Type 4

Truck Position 2

N ←

1'-7"

8"

13'-7"

7'-1"
Testing – Strain Measurement

BDI Strain Transducers
Testing

- Loading

- Uplift measurement check
Test Results - Strain

- Validation of superposition
Test Results - Strain

- Truck Position 1
- Truck Position 2
Test Results - Strain

Load Case 1

Load Case 11
Test Results - Deflection

Total Midspan Deflection - Truck Position 1

- 0.59 in.

Midspan Transverse Deflections

- LC 17
- LC 13+LC 15
Conclusions

- Overall Bridge condition was good
- Vertical hole alignment complicated erection of bridge and guardrail
- Wearing surface durability questionable
- Magnitude of strains predictable/acceptable using superposition and basic engineering principles
- Distribution of strains uncharacteristic
- Max. Defl. w/in L/800 allowable
Thank You!

Questions?