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

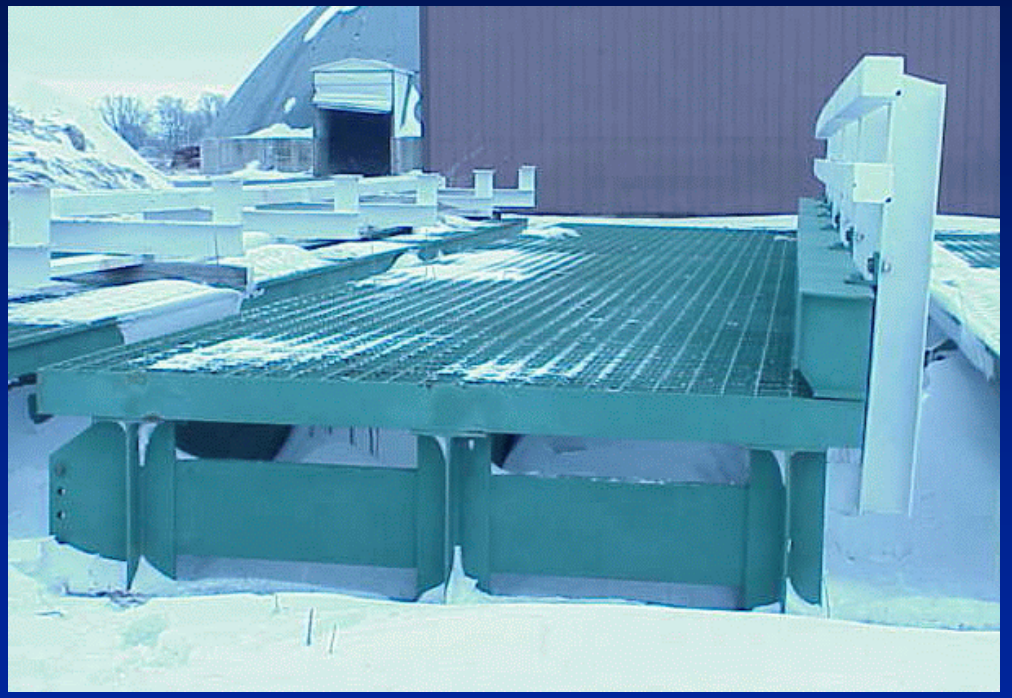
- FRP strengthened steel girders

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 - Fabrication

FRP Deck Slab Bridge - Fabrication

FRP Deck Slab Bridge - Installation

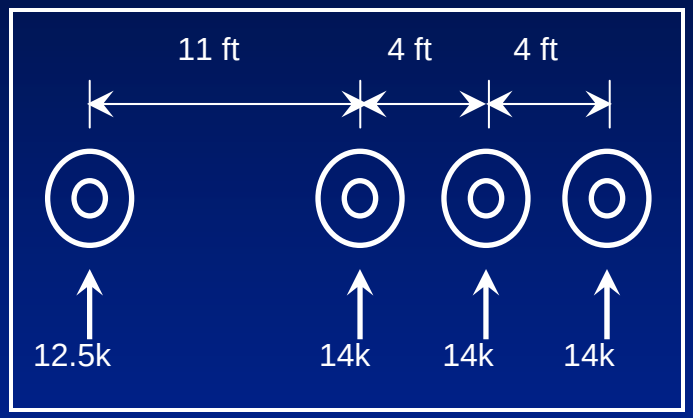
FRP Deck Slab Bridge - Installation

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

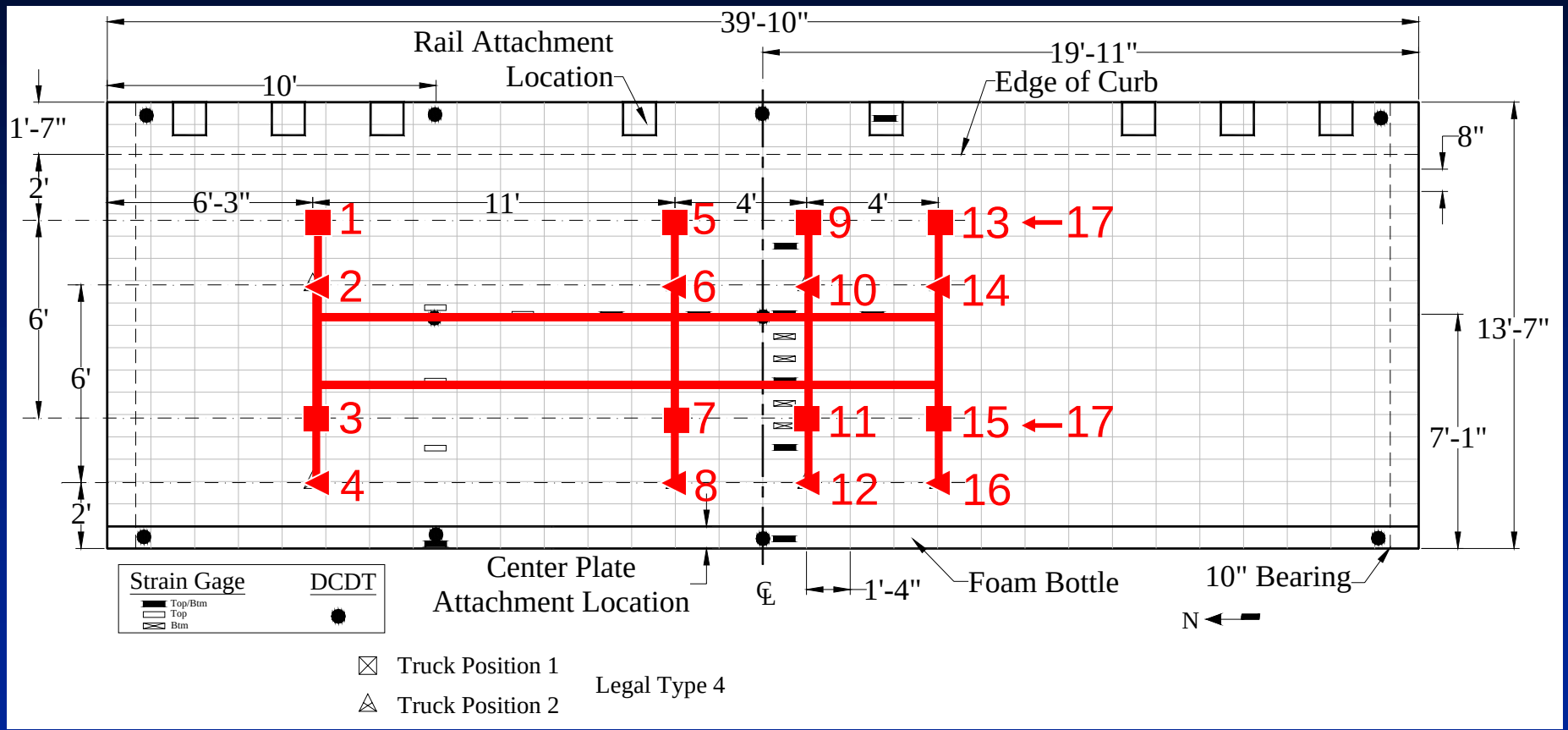
Testing

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



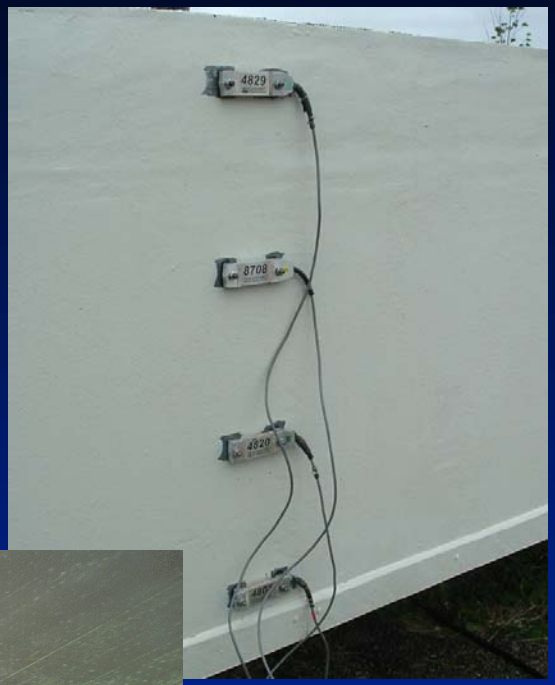
- Ind. Load Cases used 7k point load for testing => half of rear axle (wheel load)

Testing


39'-10"
Rail Attachment Location
19'-11"
Edge of Curb
10'
1'-7"
2'
6'-3"
11'
4'
4'
8"
6'
6'
2'
13'-7"
7'-1"
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
17
Strain Gage
Top/Btm
Top
Btm
DCDT
Center Plate Attachment Location
℄
1'-4"
Foam Bottle
10" Bearing
N
Truck Position 1
Truck Position 2
Legal Type 4

Testing – Strain Measurement

BDI Strain Transducers



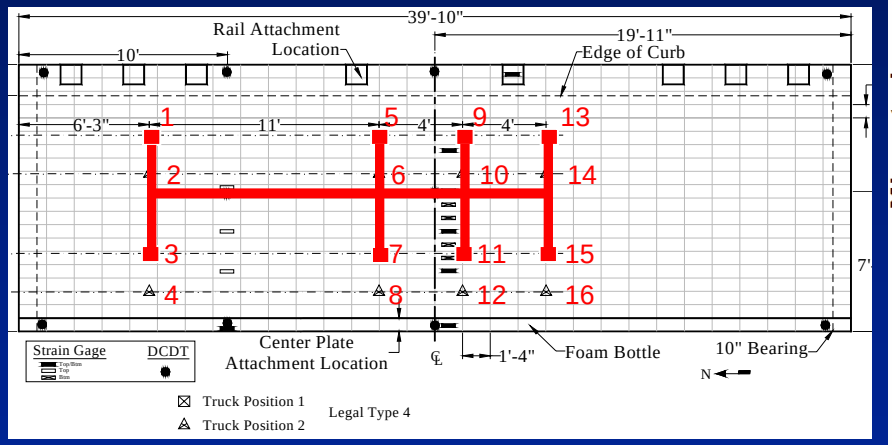
Testing

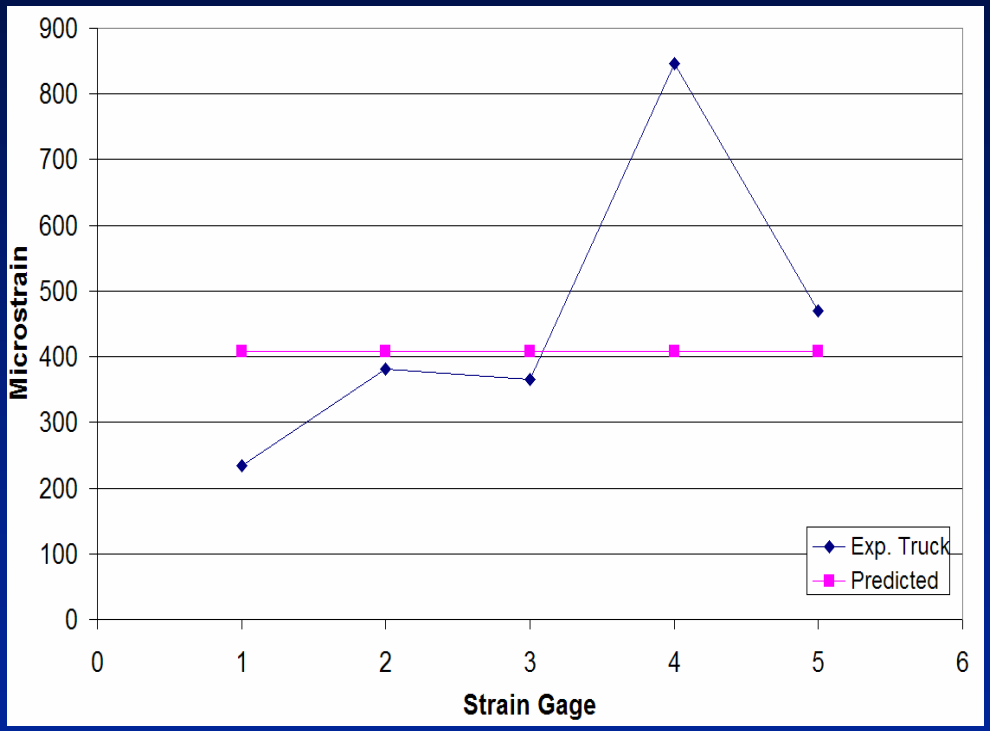
- Loading

- Uplift measurement check

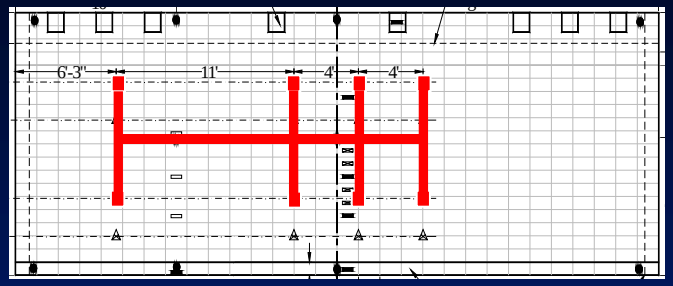
Test Results - Strain

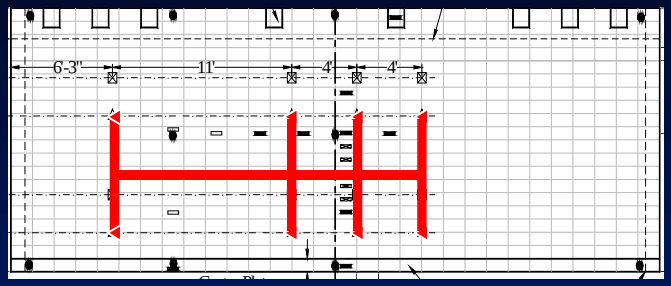
- Validation of superposition



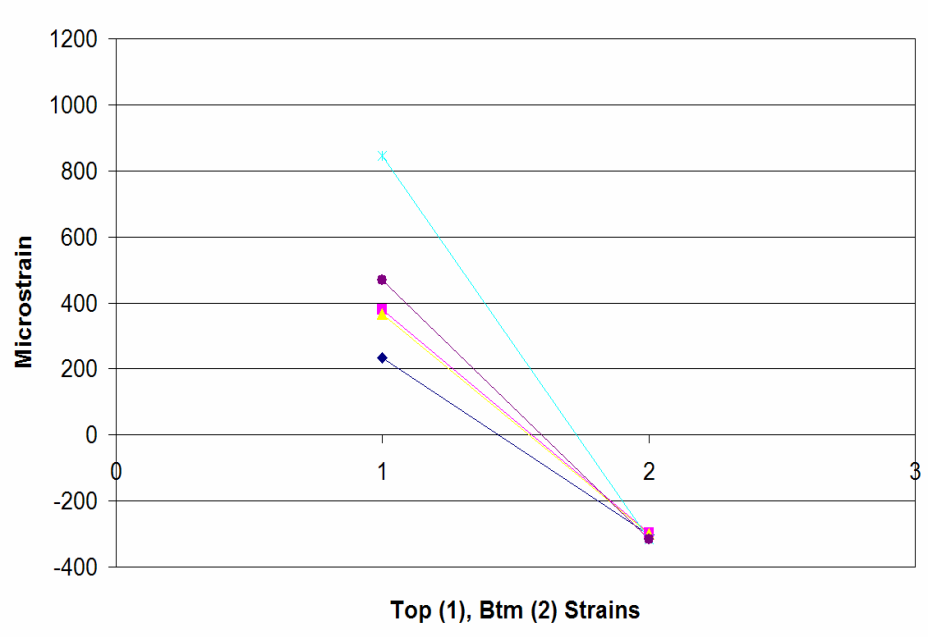


Test Results - Strain

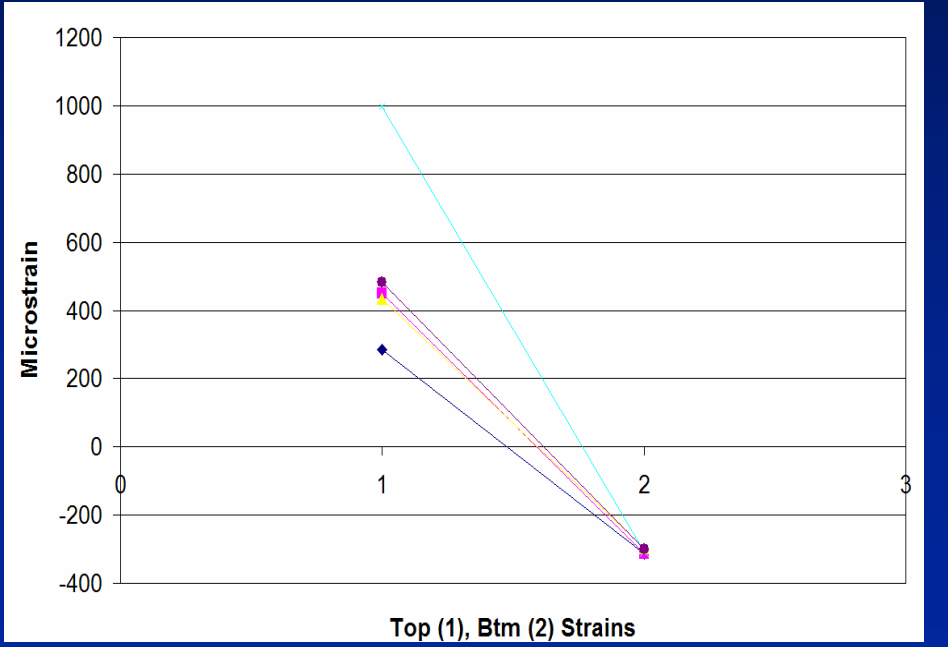




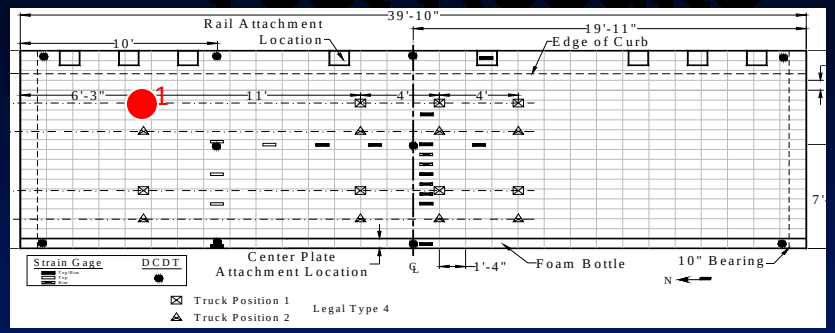
- Truck Position 1



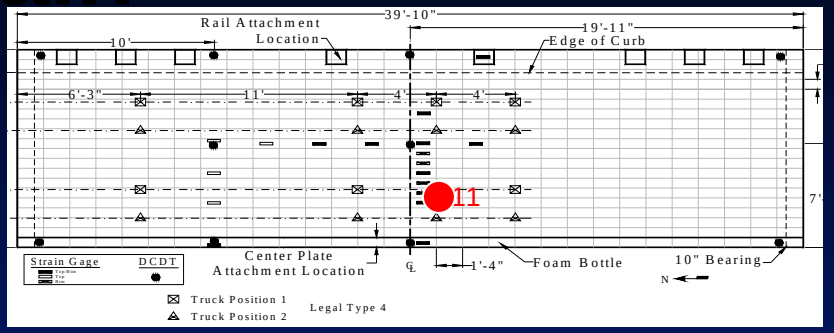
- Truck Position 2



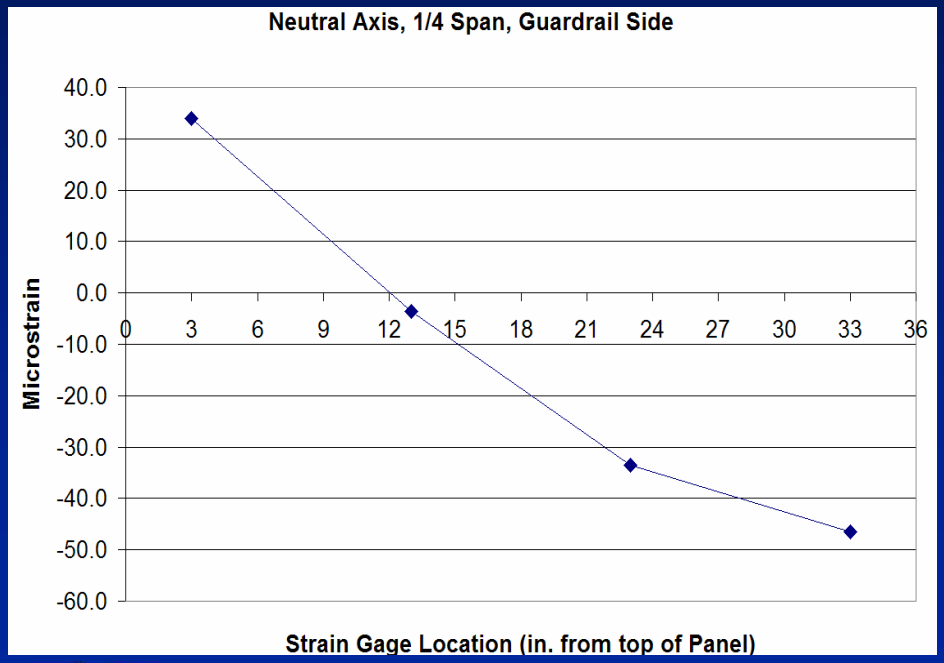
Test Results - Strain

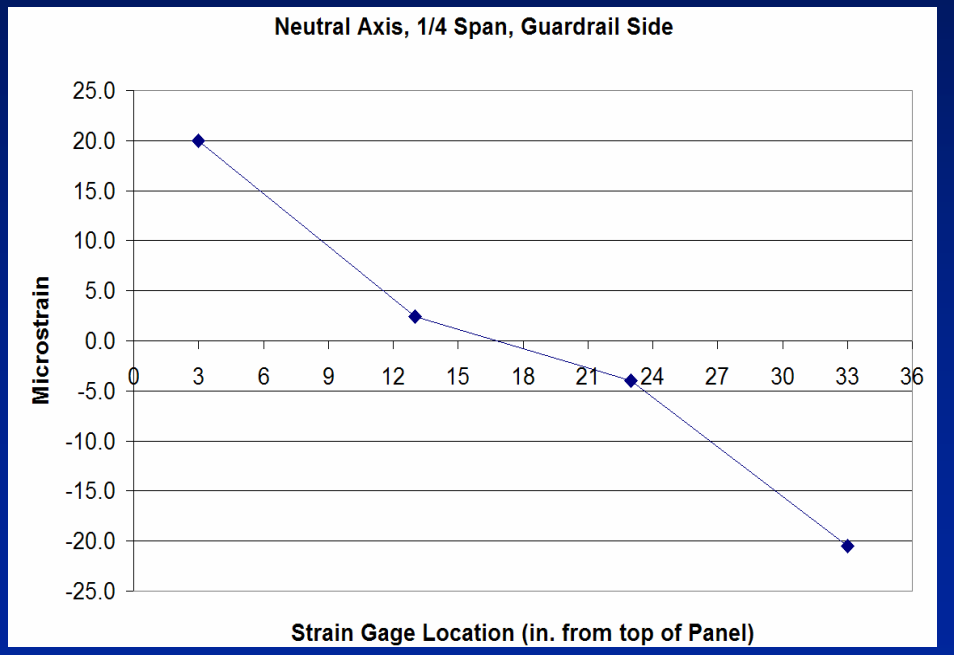


➢Load Case 1

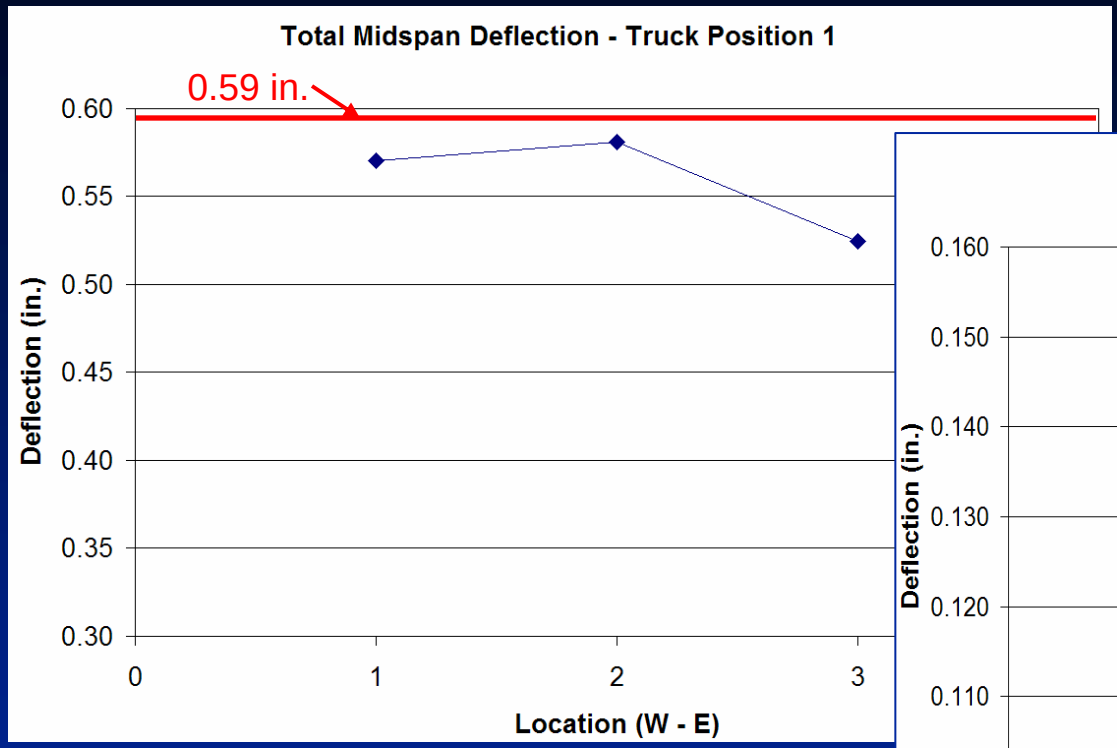


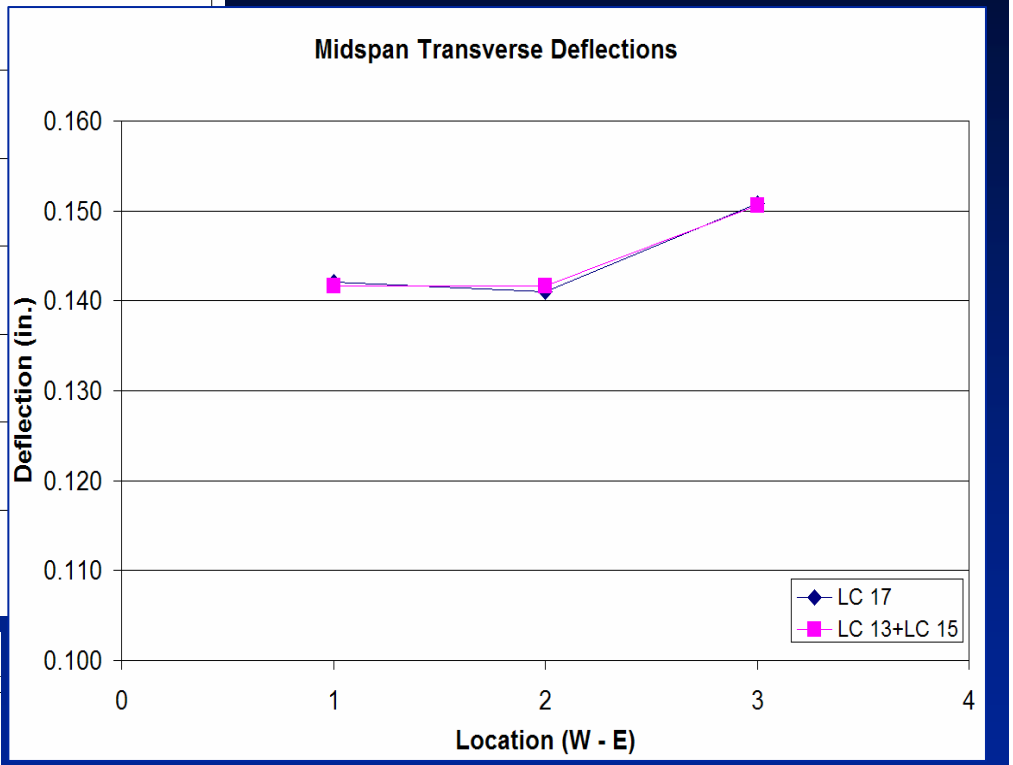
➢Load Case 11

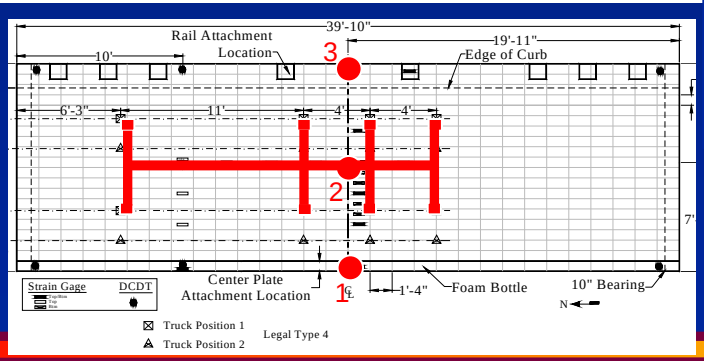




Test Results - Deflection







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?