



# Testing and Evaluation of an FRP Temporary Bypass Bridge

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August 18, 2005





# FRP Temporary Bypass Bridge

IBRC Program

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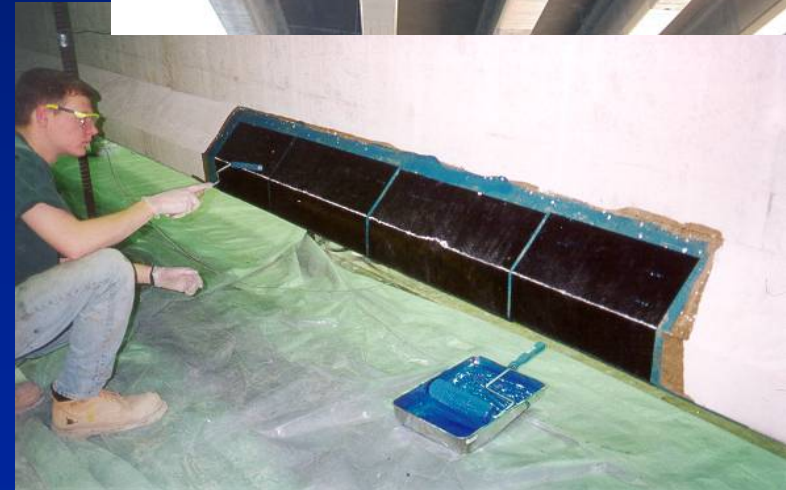
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# Background – Related FRP Work

➤ FRP repair of damaged girders

➤ Post-tensioned FRP rods



# Background – Related FRP Work



➤ FRP strengthened steel girders



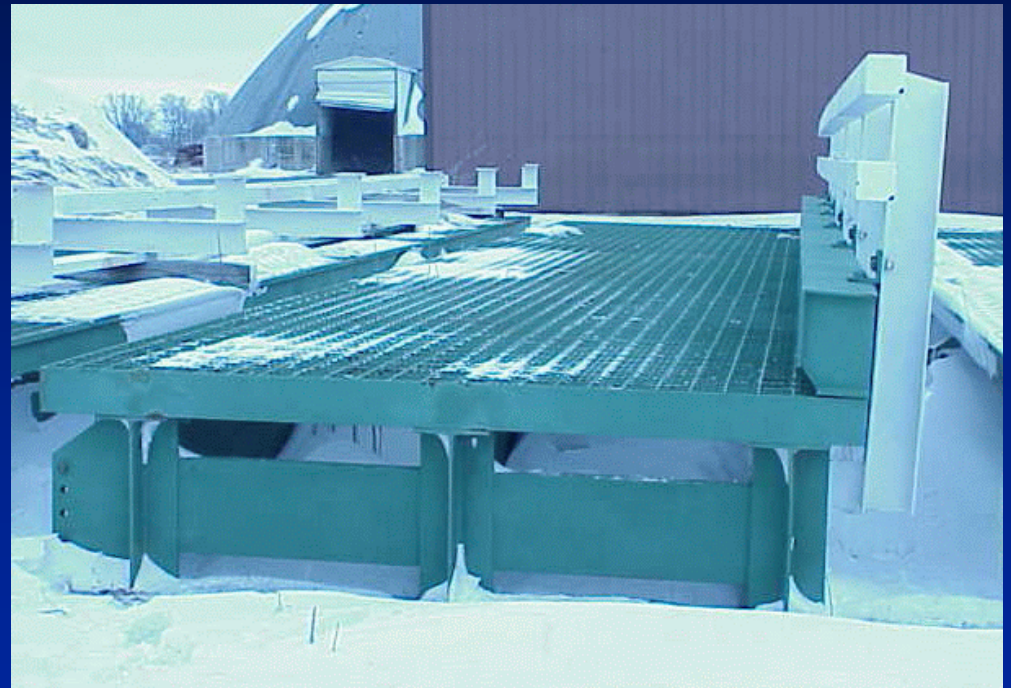
# Background – Related FRP Work

- 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

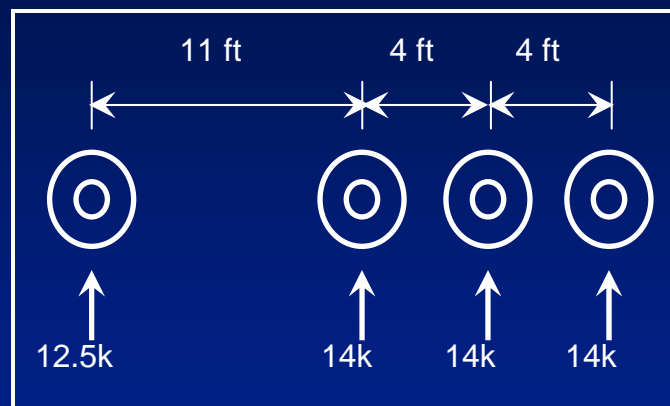
- Overall condition was good
- Variance in panel weight, QC?
- Wearing surface tapered from 3/8 in. thick at edges to > 1 in. at centerline
- Wearing surface was easily scuffed, not very durable (NY, PA, OH same results)
- Center plate and guardrail attachment holes were inconsistent and misaligned





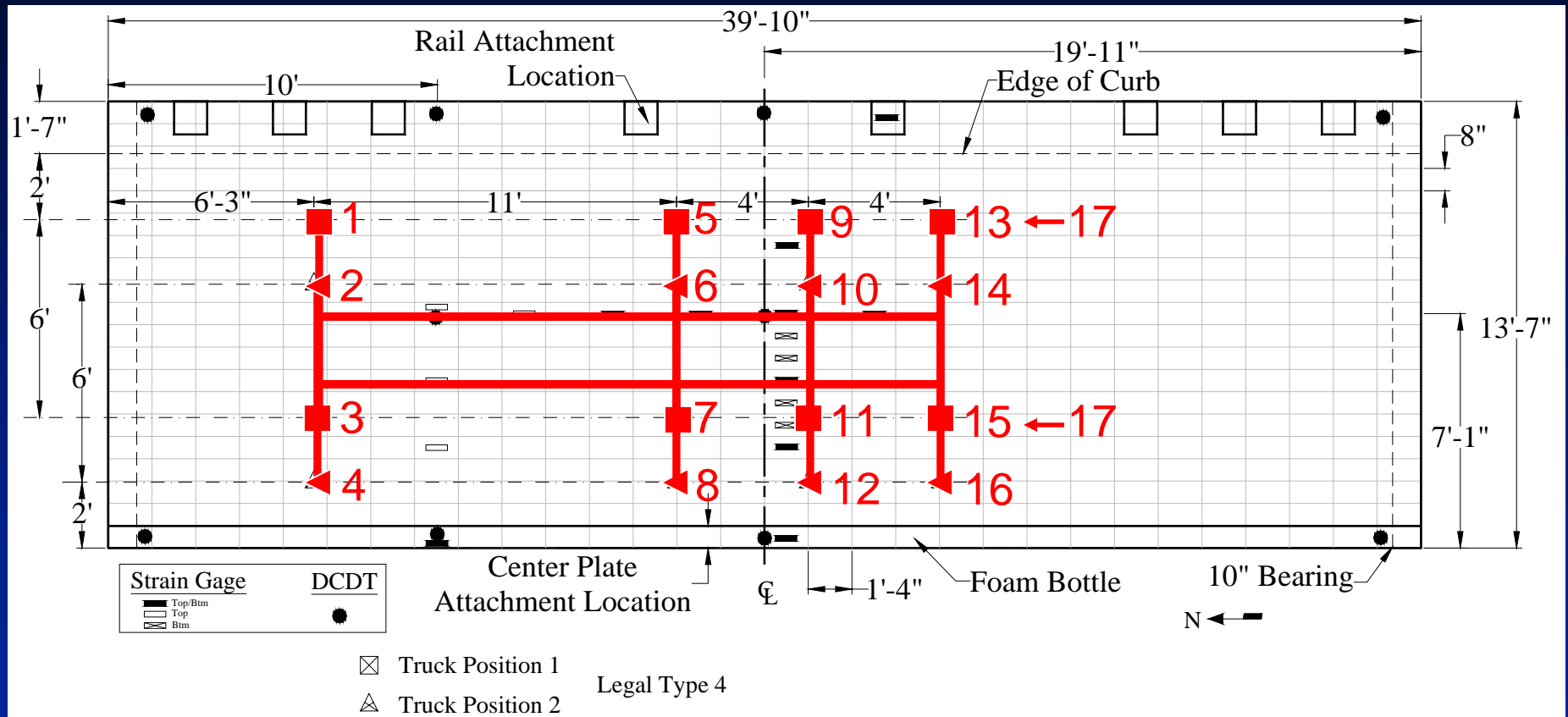
# Testing

- 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



# Testing – Strain Measurement



BDI Strain Transducers



# Testing

➤ Loading

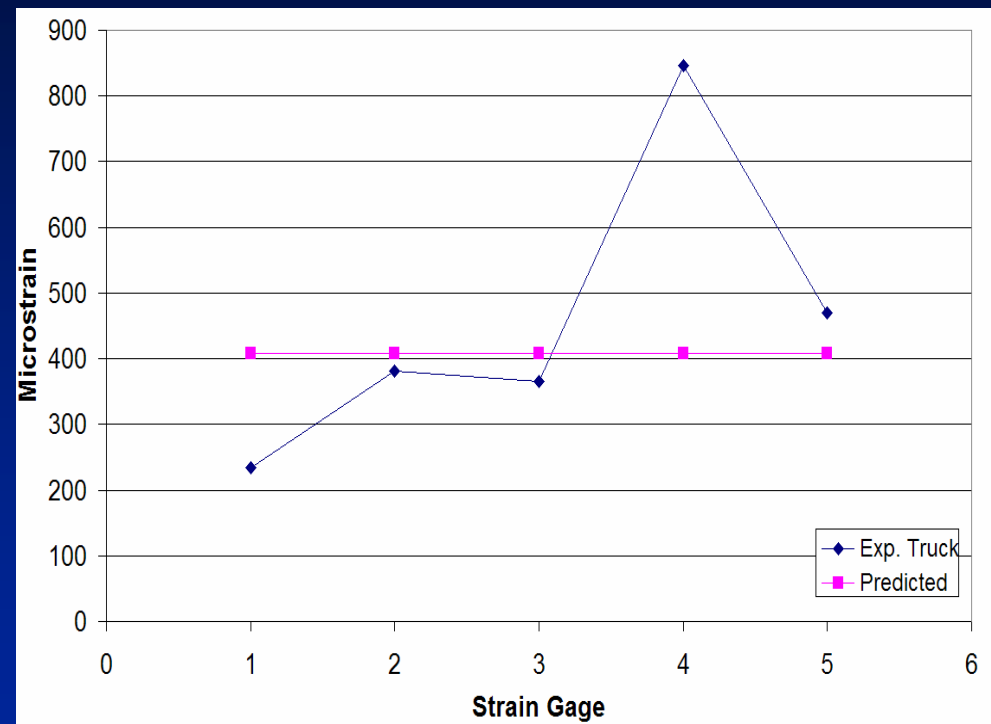
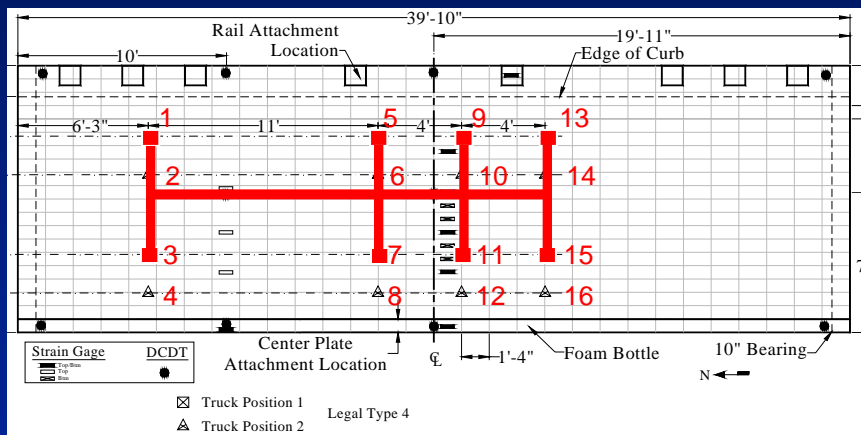


➤ Uplift measurement check

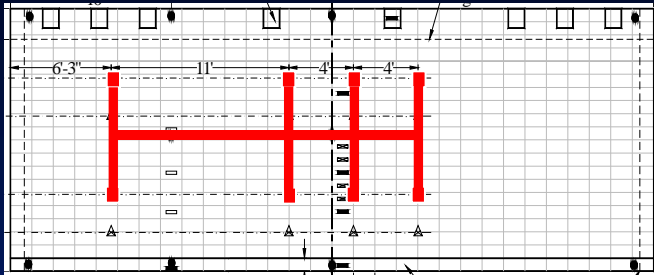


# Test Results - Strain

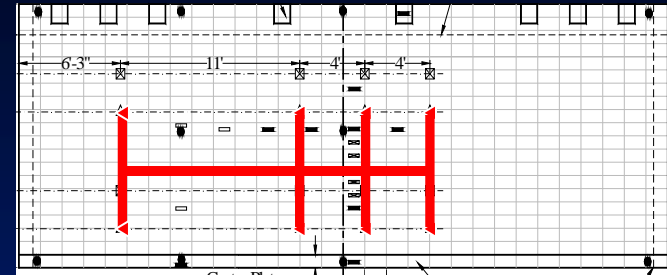
- Validation of superposition



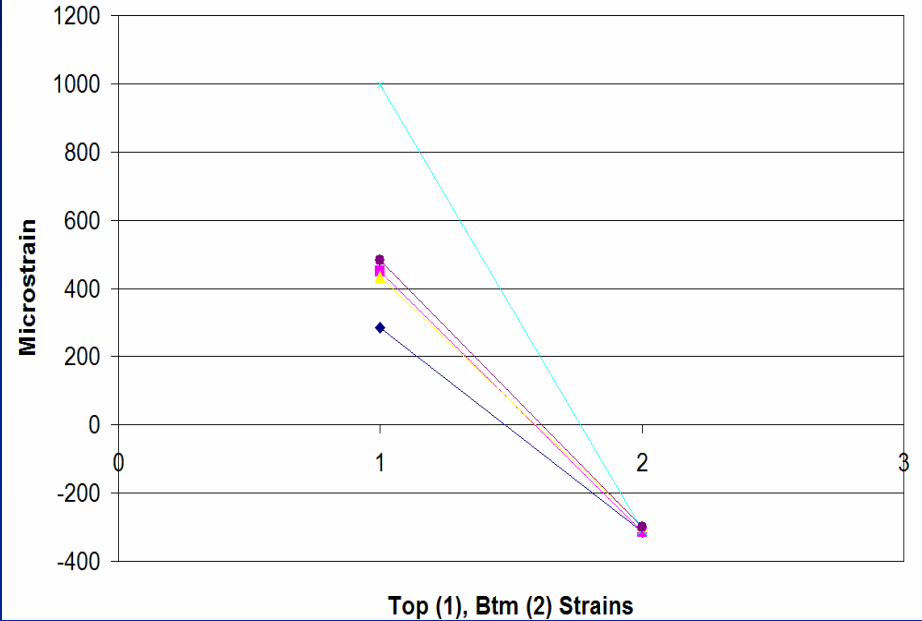
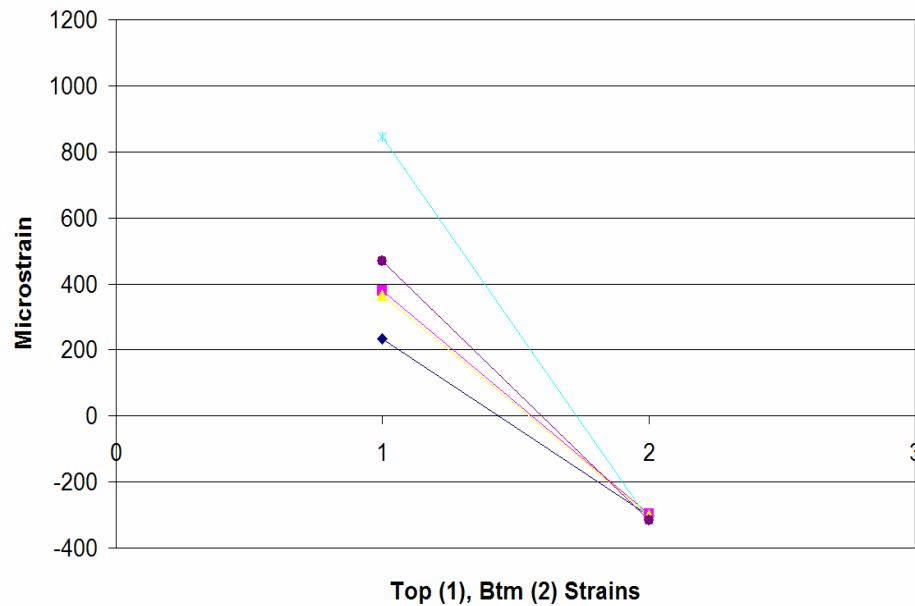
# Test Results - Strain



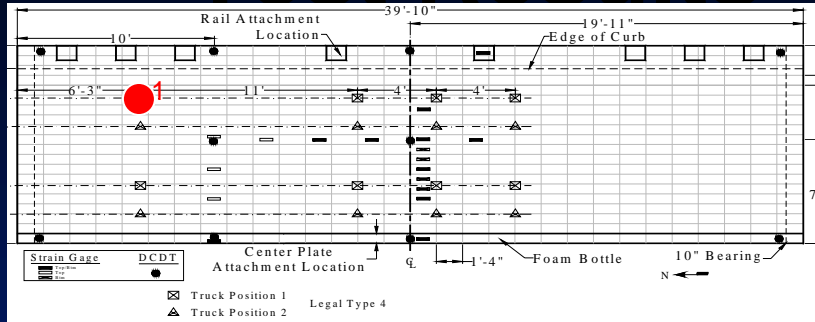
➤ Truck Position 1



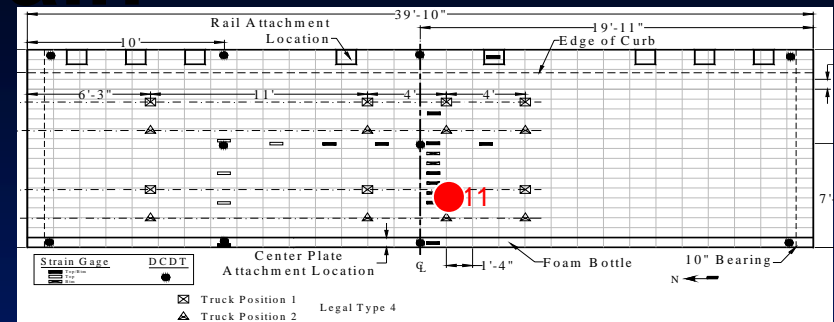
➤ Truck Position 2



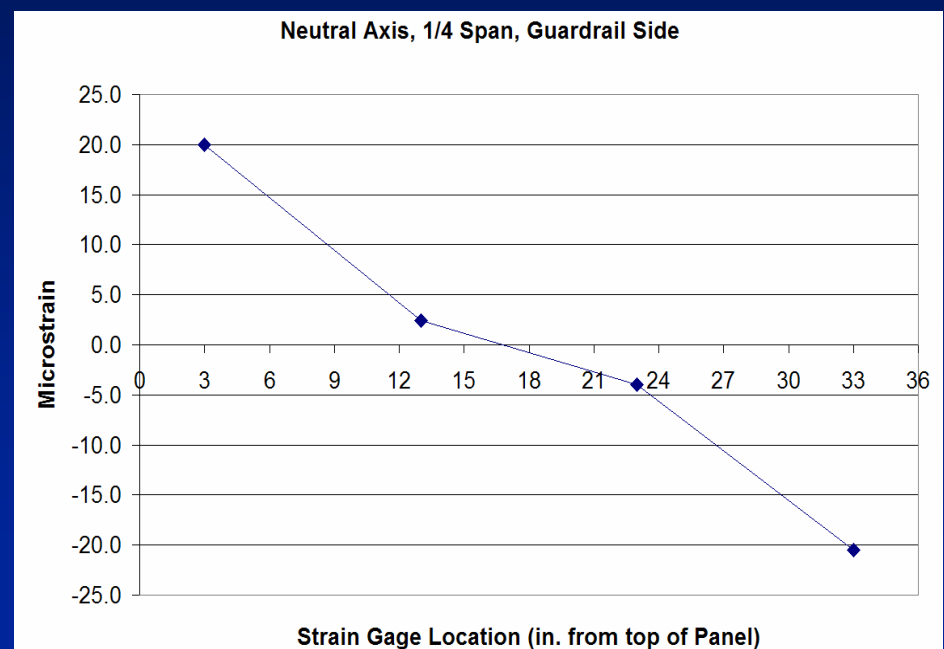
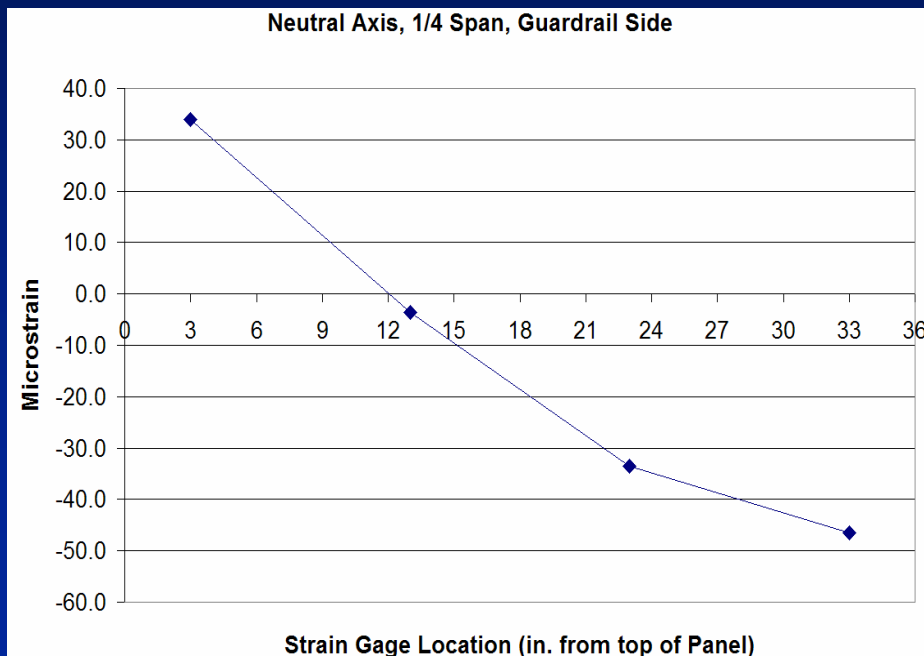
# Test Results - Strain



➤ Load Case 1

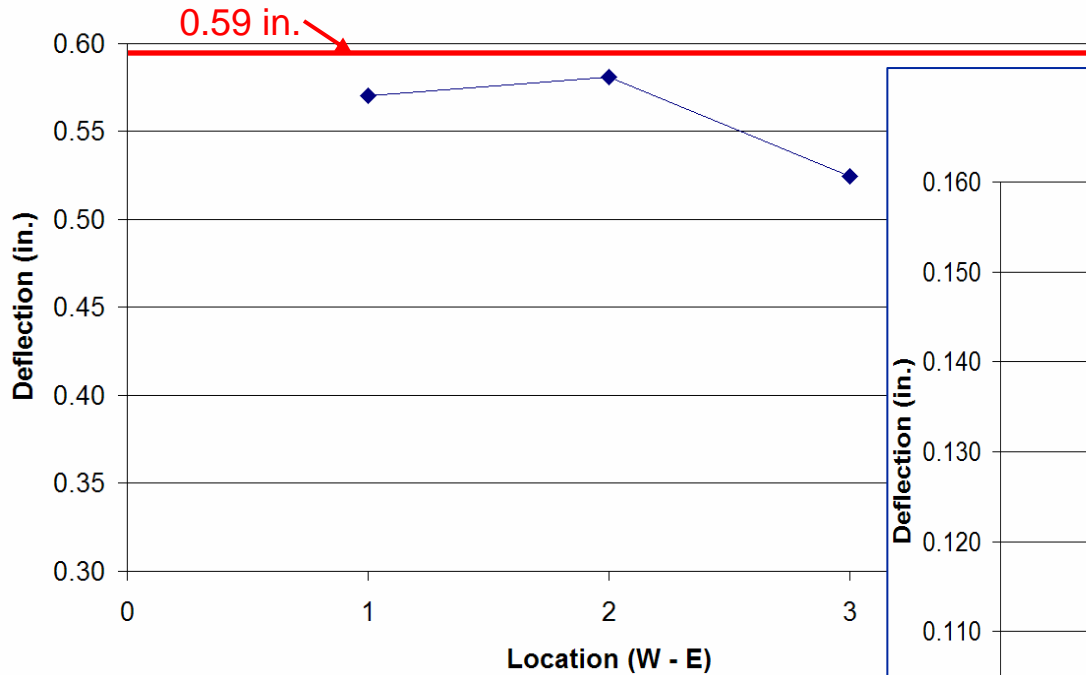


➤ Load Case 11

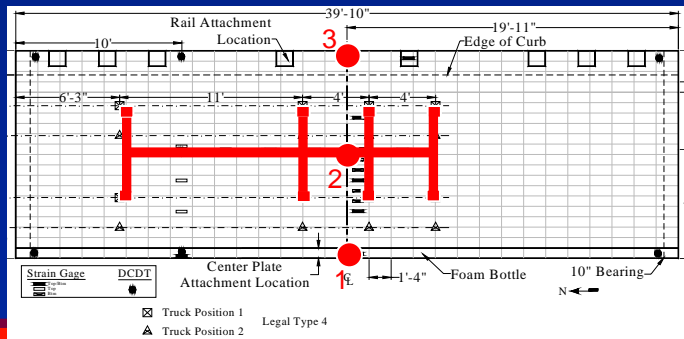
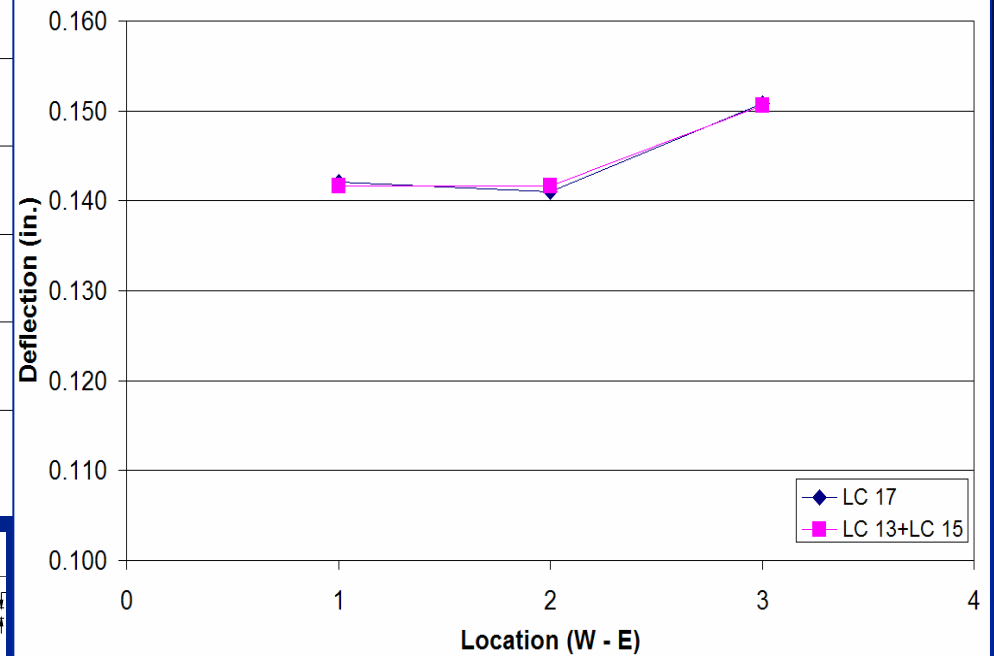


# Test Results - Deflection

Total Midspan Deflection - Truck Position 1



Midspan Transverse Deflections





## 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?

