BUREAU of BRIDGES and STRUCTURES

SPANNING CONNECTING SAFELY EFFICIENTLY

Post Tensioning Timber Bridges

Bureau of Bridges & Structures
Structure Maintenance Support Unit

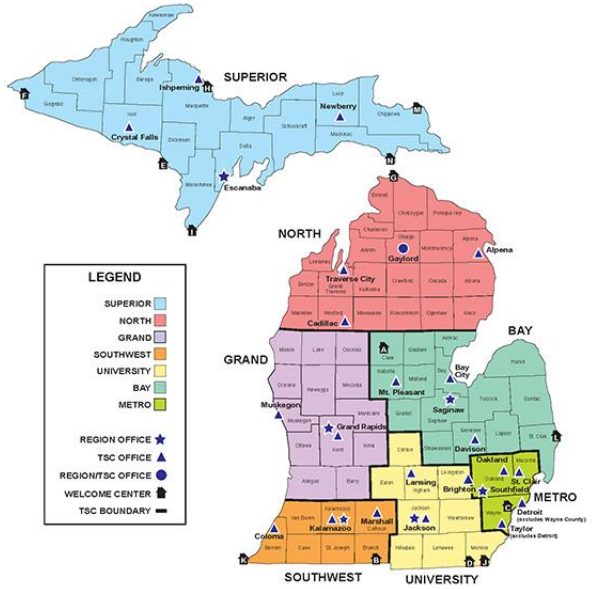
2018 National Bridge Preservation Partnership

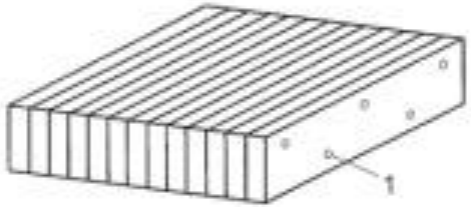
BUREAU of BRIDGES and STRUCTURES

US-2 Roadside Park in Naubinway

B05 of 49022

- **Constructed in 1990**
- **Timber Superstructure comprised of 2 x 12 timbers spanning 24 feet nailed together.**





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US-2 Roadside Park in Naubinway

2011 Bridge Inspection

- During the Inspection a large truck drove over the bridge, and it deflected more than expected.
- November 8, 2011 – Superior Region conducted a load test.
- Load test used the Engadine Garage's Water Truck with 2,000 gallons of water.

	West Fascia	4' West	8' West	Centerline	8' East	4' East	East Fascia
Baseline	N.M.	53	52 1/4	52	51 1/4	51 1/4	N.M.
Test 1	N.M	53	52 1/8	51 5/8	51 1/8	51	N.M.
Test 2	N.M.	52 1/4	51 3/4	51 1/2	51 1/8	51 1/4	N.M.
Test 3	N.M.	52 3/4	51 7/8	51 5/8	51 1/4	51 3/8	N.M.

¾" Max Deflection

How do you fix this?

3 Research Reports Consulted

***Report 1*:** Transverse Post-Tensioning of Longitudinally Laminated Timber Bridge Decks – Transportation Research Record – Issue Number 665, Publication Date 1978

***Report 2*:** Timber Bridges – Design, Construction, Inspection, and Maintenance – Case History 15.5- Rehabilitation of Nail-Laminated Timber Decks by Transverse Stressing – US Department of Agriculture Document EM 7700-8, Publication Date 1990

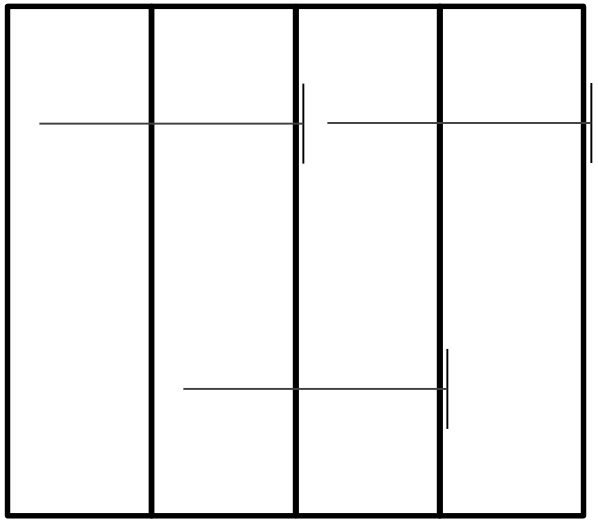
Report 3: Glue Laminated Timber Bridge Systems: A Manual to Assist in the Design of Glue Laminated Timber Bridges – American Institute of Timber Construction.

How do you fix this?

3 Research Reports Consulted

***Report 1*:** Transverse Post-Tensioning of Longitudinally Laminated Timber Bridge Decks

- Pressure between timbers due to nailing initially allows for composite action



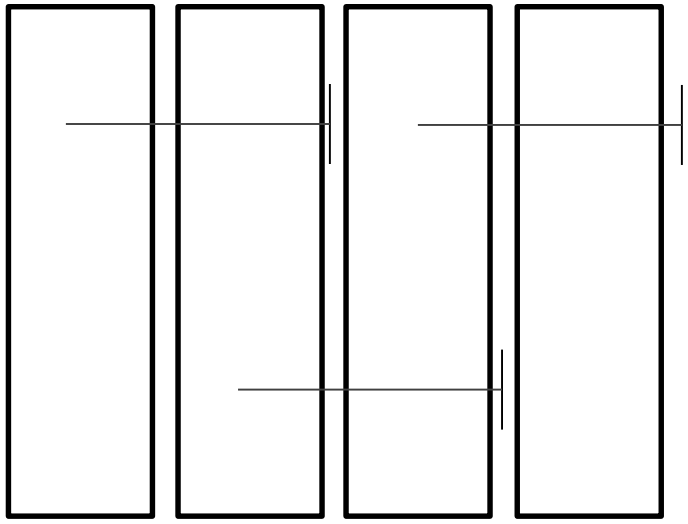
Initial Laminates

How do you fix this?

3 Research Reports Consulted

***Report 1*:** Transverse Post-Tensioning of Longitudinally Laminated Timber Bridge Decks

- Over time nails back out and timbers spread



Spread Laminates

How do you fix this?

3 Research Reports Consulted

***Report 1*:** Transverse Post-Tensioning of Longitudinally Laminated Timber Bridge Decks

Design Goals

- Completely Adjustable
- Easily Installed by Ministry of Ontario Field Staff
- Environmentally Protected

Design – After Extensive Lab Testing

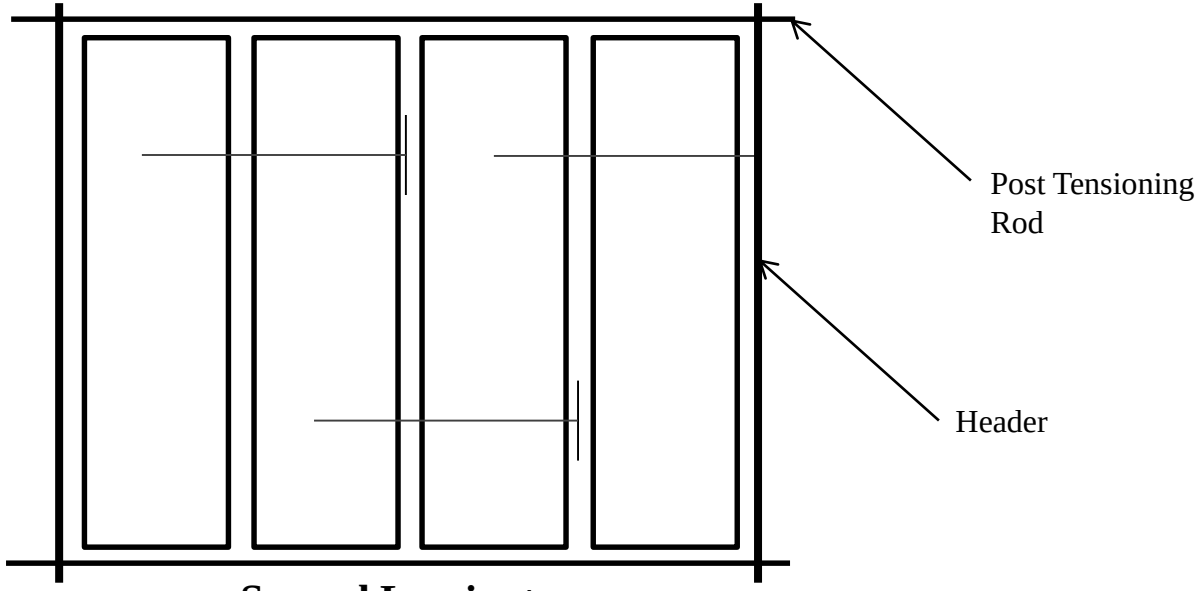
- 5/8” Diameter Threaded Post Tension Bars – Top and Bottom – 2 Feet O.C.
- 1.5” Continuous Steel Plate on Fascia

How do you fix this?

3 Research Reports Consulted

***Report 1*:** Transverse Post-Tensioning of Longitudinally Laminated Timber Bridge Decks

- Ontario Ministry of Transportation Post Tensioned the Hebert Creek Bridge to 150 psi



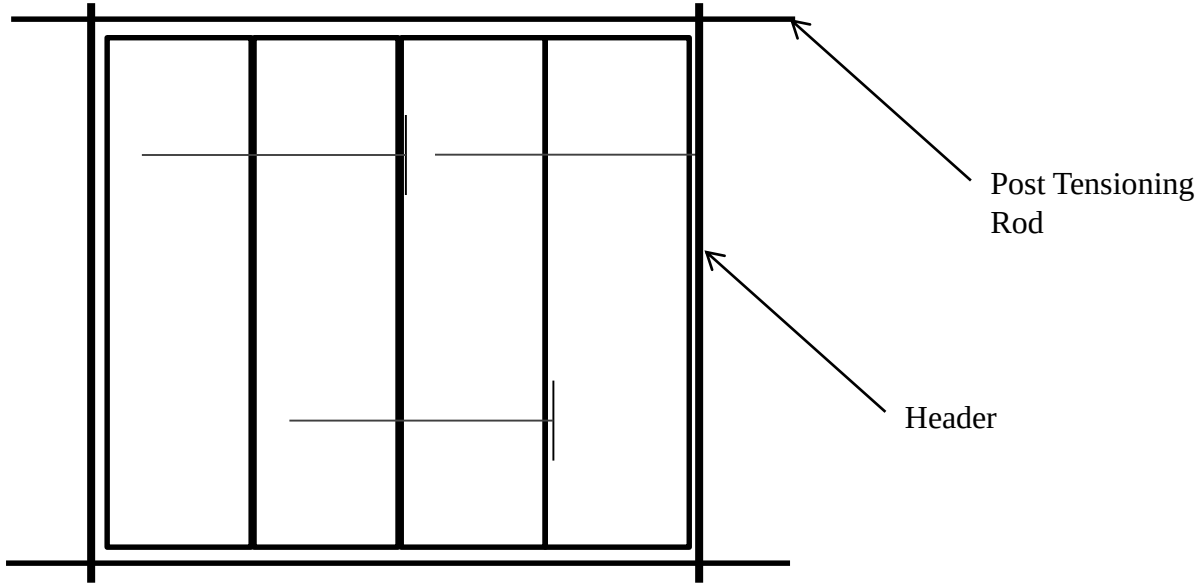
Spread Laminates

How do you fix this?

3 Research Reports Consulted

***Report 1*:** Transverse Post-Tensioning of Longitudinally Laminated Timber Bridge Decks

- Post Tensioning Force shrunk the bridge 6 to 18 inches



Laminates Pulled Back Together

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How do you fix this?

3 Research Reports Consulted

***Report 1*:** Transverse Post-Tensioning of Longitudinally Laminated Timber Bridge Decks

Results

- Deflections reduced by 50%
- Strength increased by 100%

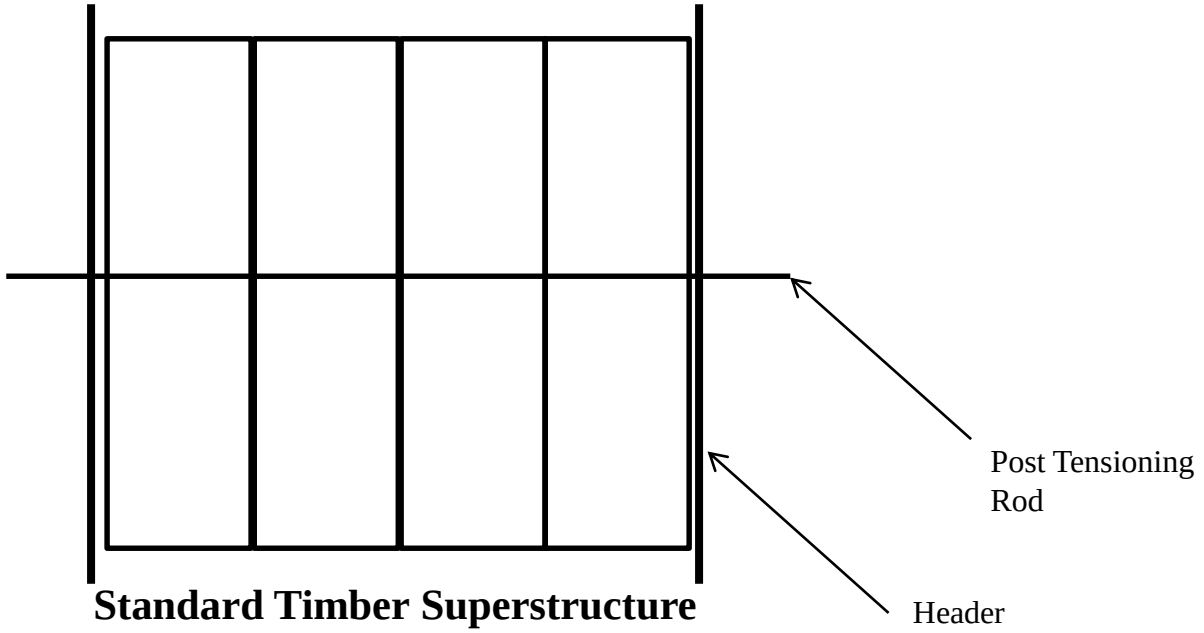
Follow-up

- Measure post tensioning force every 3 months for first year
- Tighten as needed
- Measure post tensioning force every inspection thereafter

How do you fix this?

3 Research Reports Consulted

***Report 2*:** Timber Bridges – Design, Construction, Inspection, and Maintenance – Case History 15.5- Rehabilitation of Nail-Laminated Timber Decks by Transverse Stressing – Referenced Report 1 as the beginning changing timber deck design to include post tensioning.

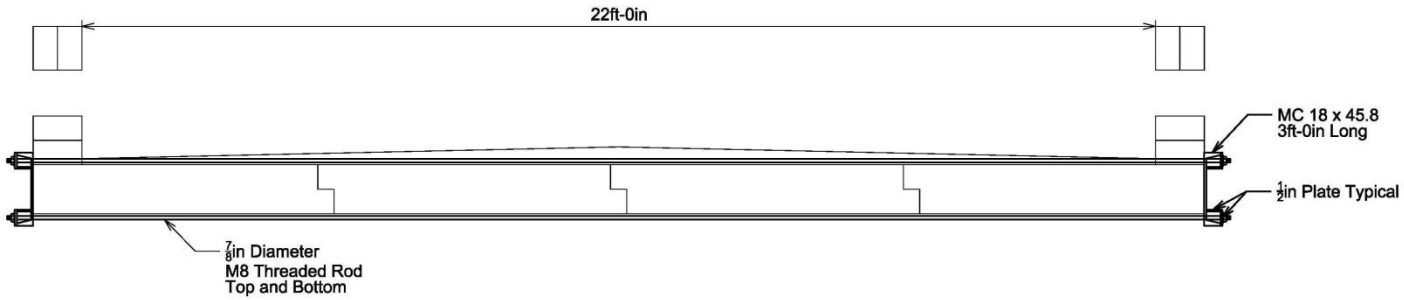


Standard Timber Superstructure

Design of Naubinway Structure

Post Tensioning

- Hebert Creek Bridge shrunk 6 to 18 inches when post tensioned to 150 psi
- Ontario Ministry determined later that only 40 psi was needed to achieve composite action.
- Naubinway Bridge Measured 24’-2” Wide (Only 2” wider than As-Built)
- Tighten to between 40 psi and 150 psi, with goal of squeezing bridge back to 24’-0” Width



SECTION A–A

Section at
MC 18x45.8 and
M8 Threaded Rod

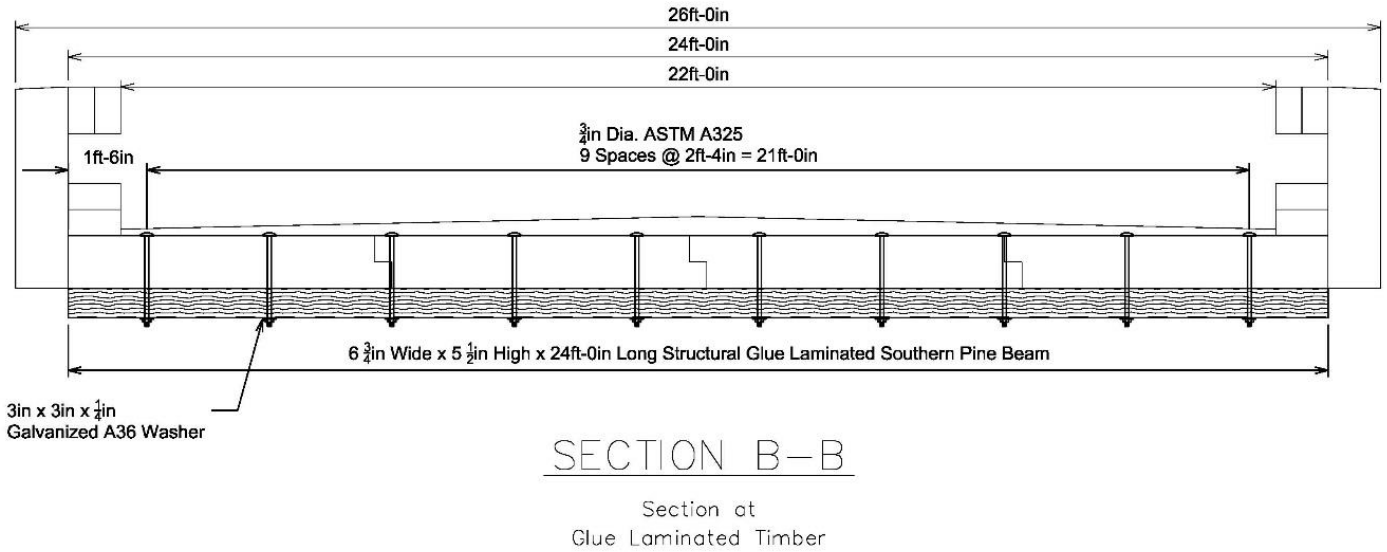
Design

3 Research Reports Consulted

Report 3: Glue Laminated Timber Bridge Systems: A Manual to Assist in the Design of Glue Lamina

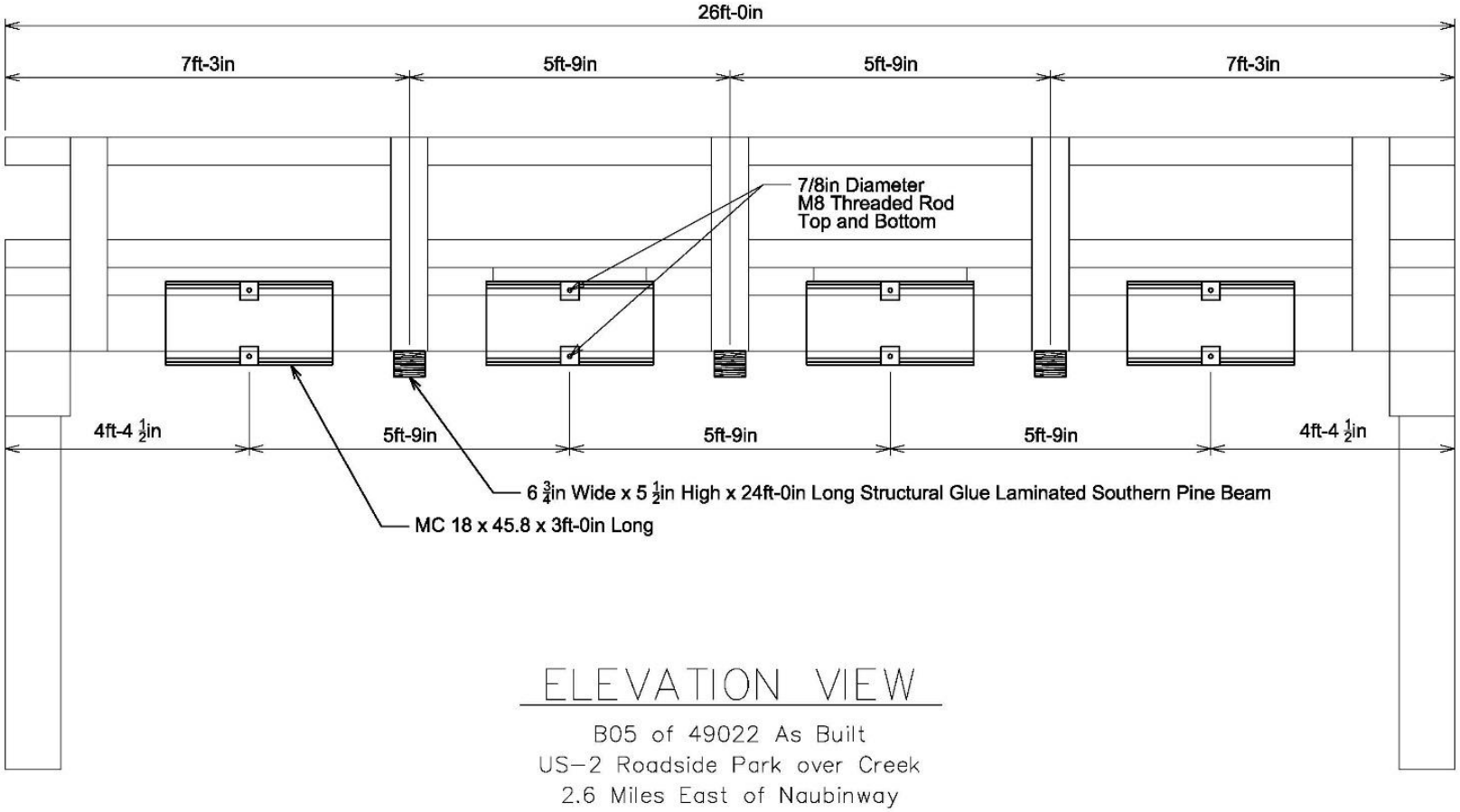
Construction.

- Belt and Suspenders



Design

Final Design Elevation



Construction

Construction Team

- Structure Maintenance Support Unit
- Statewide Steel Bridge Repair Crew
- St. Ignace Bridge Maintenance Garage

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Construction

Monday, September 24th

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Construction

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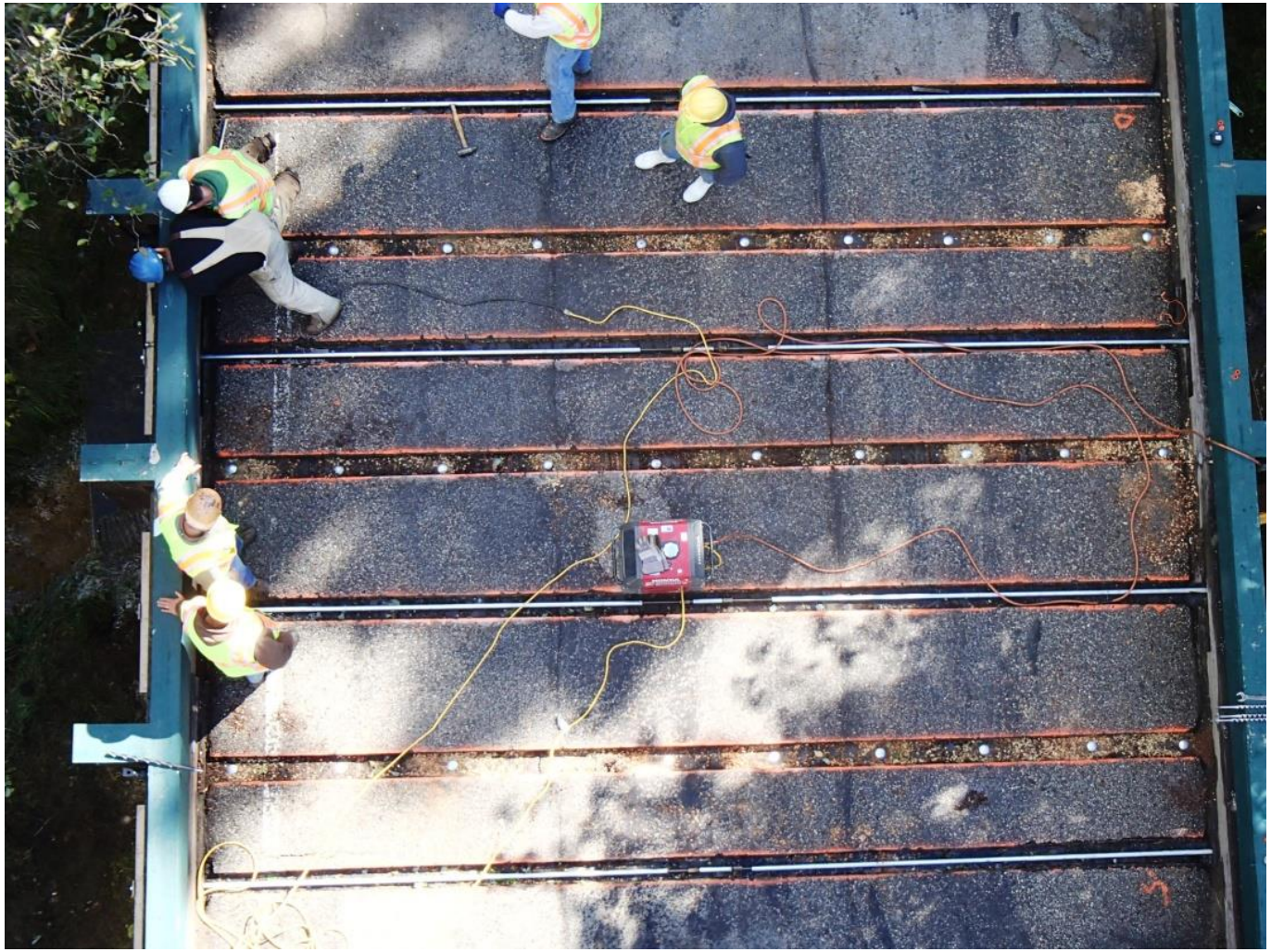

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Construction

Tuesday, September 25th

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SPANNING CONNECTING SAFELY EFFICIENTLY

Construction

BUREAU of BRIDGES and STRUCTURES

Construction

Tuesday, September 25th

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Load Test

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Load Test

Tuesday, September 25th

	West Fascia	4' West	8' West	Centerline	8' East	4' East	East Fascia
Baseline	34 1/4	33 5/8	32 3/4	32 1/8	31 5/8	31 1/4	30 5/8
Test 1	34 1/8	33 5/8	32 3/4	32 1/8	31 1/2	31	30 1/2
Test 2	34 1/8	33 5/8	32 1/2	31 7/8	31 3/8	31 1/4	30 5/8
Test 3	34	33 3/8	32 1/2	32 1/8	31 1/2	31 3/8	30 5/8

¼" Max Deflection (Greater than 50% Reduction)

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Construction

Wednesday, September 26th

BUREAU of BRIDGES and STRUCTURES

SPANNING CONNECTING SAFELY EFFICIENTLY

Construction

Wednesday, September 26th

BUREAU of BRIDGES and STRUCTURES

SPANNING CONNECTING SAFELY EFFICIENTLY

Construction

Wednesday, September 26th

BUREAU of BRIDGES and STRUCTURES

Construction

Wednesday, September 26th

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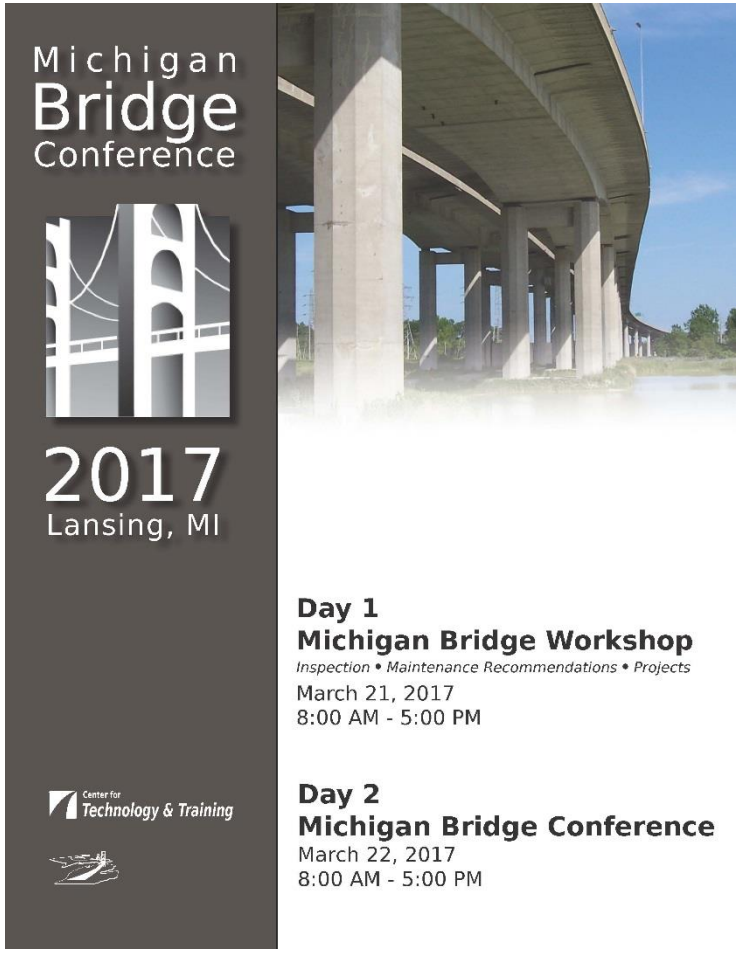
Local Agency Training

- Annual LTAP Bridge Conference



Local Agency Trial Projects

- St Joe County Road Commission
  - Attended Michigan LTAP Bridge Conference
  - Reached out to Region Support
  - 55 Nail Laminated Timber Bridges

Local Agency Trial Projects

- St Joe County Road Commission
  - Heimbach Road Load Test
    - ¾” Deflection
    - Lamination Separation developing cracking in spreader beams

Local Agency Trial Projects

- Design Change
  - Naubinway used Short M7 Bars coupled together
  - Heimbach Rd used Continuous Grade 36 Threaded Reinforcing Bars
  - Remove Asphalt overlay up front.

Local Agency Trial Projects

- Results
  - Heimbach Road Load Test
    - ¾” Deflection - Before
    - Bridge Width Shrunk 6”
    - 1/8” Deflection - After

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Questions?