Field Testing and Evaluation of a Demonstration Timber Bridge

Iowa State University

Travis K. Hosteng, P.E.

2010 ASCE Structures Congress

Session: New Perspectives on Timber Bridges

May 13, 2010

Overview

- Field Testing Project
- Lab Project
- Demonstration Bridge
- Observations/Future Work

Introduction/Background

- 2003 BEC Project
  - 8 glued-laminated timber girder bridges w/ asphalt wearing surfaces
  - ~$250,000 project
  - OR, AL, NY, WI
- Significant asphalt deterioration
- Results
  - Differential Panel Deflections
  - Deck Panel Condition

Field Tests

- **Field tested 12 timber bridges with asphalt wearing surfaces**

Elmhurst Moisture Meter w/ 2” pin

Field Tests Cont.

- **Rolling Static Tests: BDI Strain; Deflections**

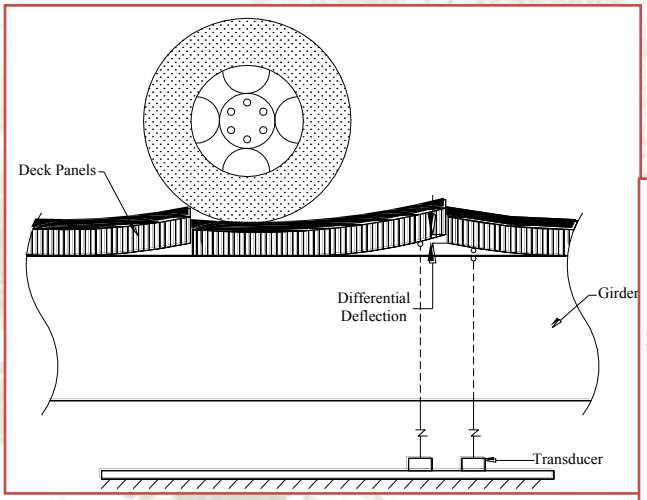
Typical Wearing Surface Performance

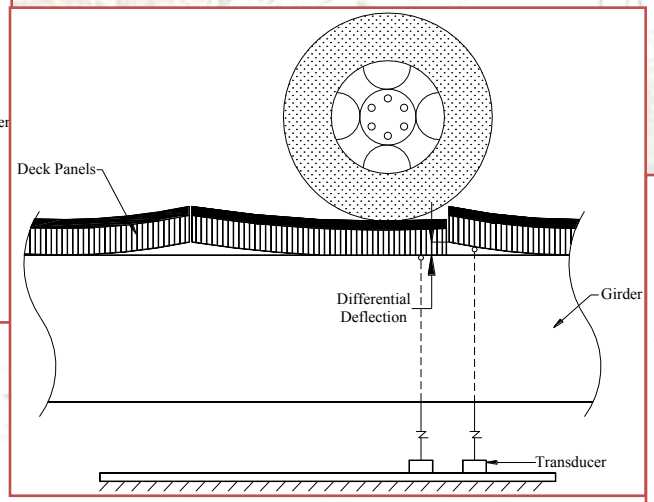
•Full-width transverse cracks located at each deck panel interface

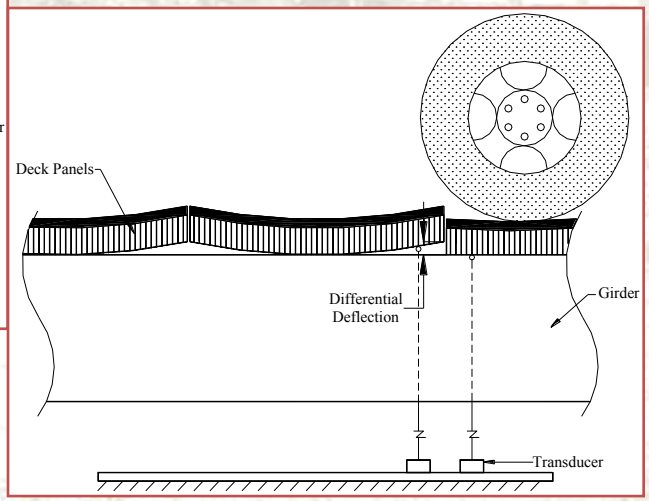
Typical Wearing Surface Performance

Field Test Observations

- **Diff. Panel Defl. – Cupped Panels**







Results – Global Defl.

Experimental n: L/n	WS Rating*
Lost Creek = 2032	9
Camp Creek = 1380	7
Badger Creek = 1150	9
Russellville = 750	5
Chambers Co. = 675	6
Wittson = 600	5
Butler Co. = 560	2
Erfurth = 520	4

AASHTO=L/500; AASHTO LRFD=L/425;
Timber Design Manual=L/360

*Rating Scale: 1-severe; 5-moderate; 9-minor

Results Cont. – Diff. Panel Defl.

Experimental (in.): Limit <0.1 in.		WS Rating*
• Camp Creek	= N/A	7
• Lost Creek	= N/A	9
• Badger Creek	= 0.022	9
• Chambers Co.	= 0.027	6
• Russellville	= 0.034	5
• Wittson	= 0.054	5
• Erfurth	= 0.127	4
• Butler Co.	= 0.176	2

*Rating Scale: 1-severe; 5-moderate; 9-minor

Field Test Observations

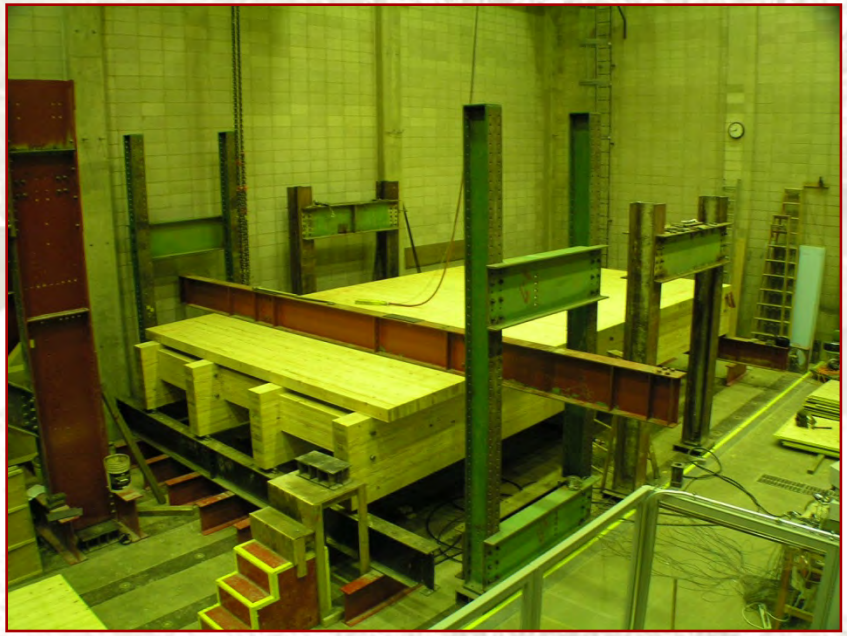
- Bridges with higher n-values generally performed better
- The condition of the deck panels was a significant factor affecting wearing surface deterioration
- Research methods to reduce and remediate diff. panel defl. on both new and existing bridges
- Further research into the design of asphalt mixes for wearing surfaces on timber bridges

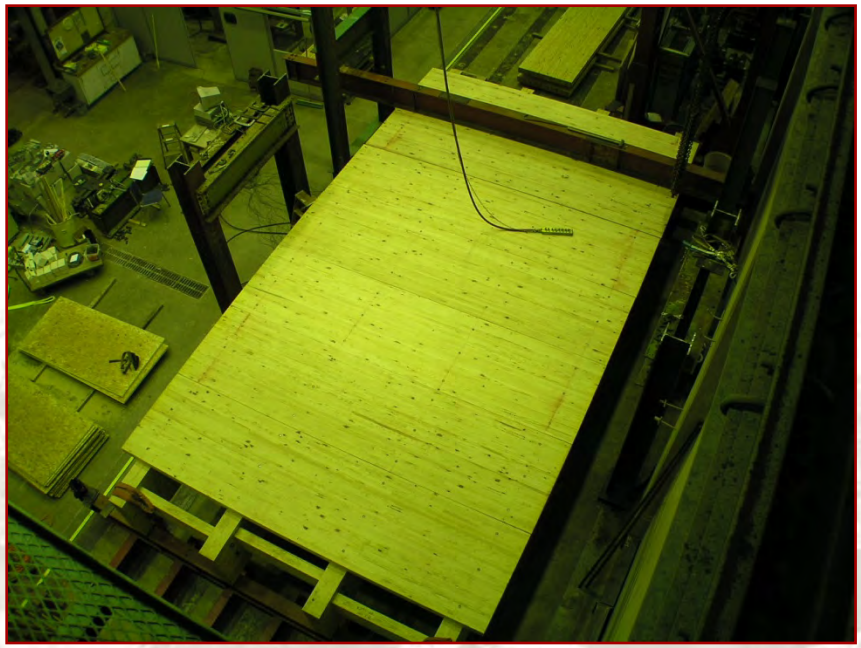
Introduction/Background Cont.

- 2005 BEC Project
  - Constructed full-scale timber bridge
  - ~$150,000 project
  - ISU Structures Laboratory
- Single span, 16ft wide
- Reduce Differential Panel Deflections
  - Deck Modification Alternatives
- Test Alternative in the field

Laboratory Bridge

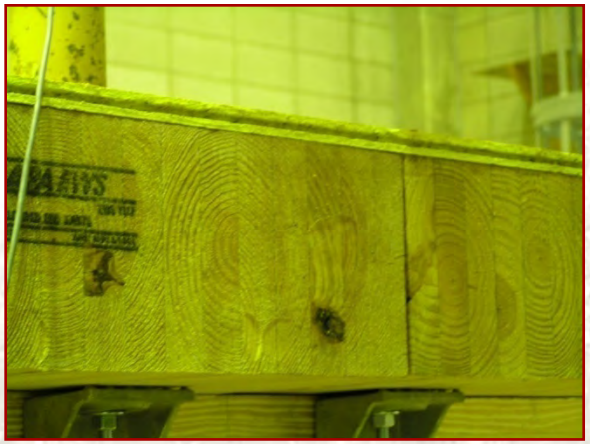
- 31-ft single span
- Four Girders





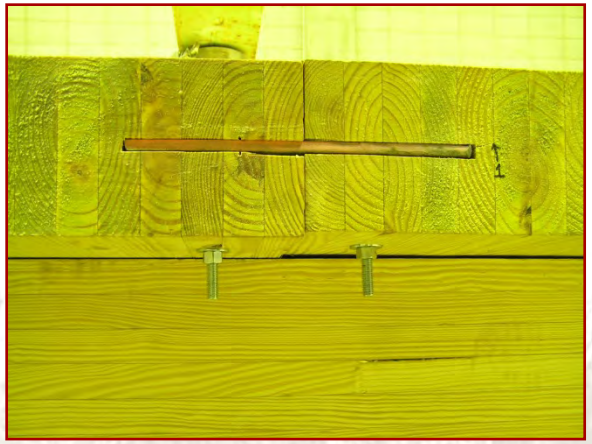
- 16-ft wide
- 4’ x 5 1/8” Deck Panels

Deck Panel Joint Alternatives



Plywood

Steel Plate

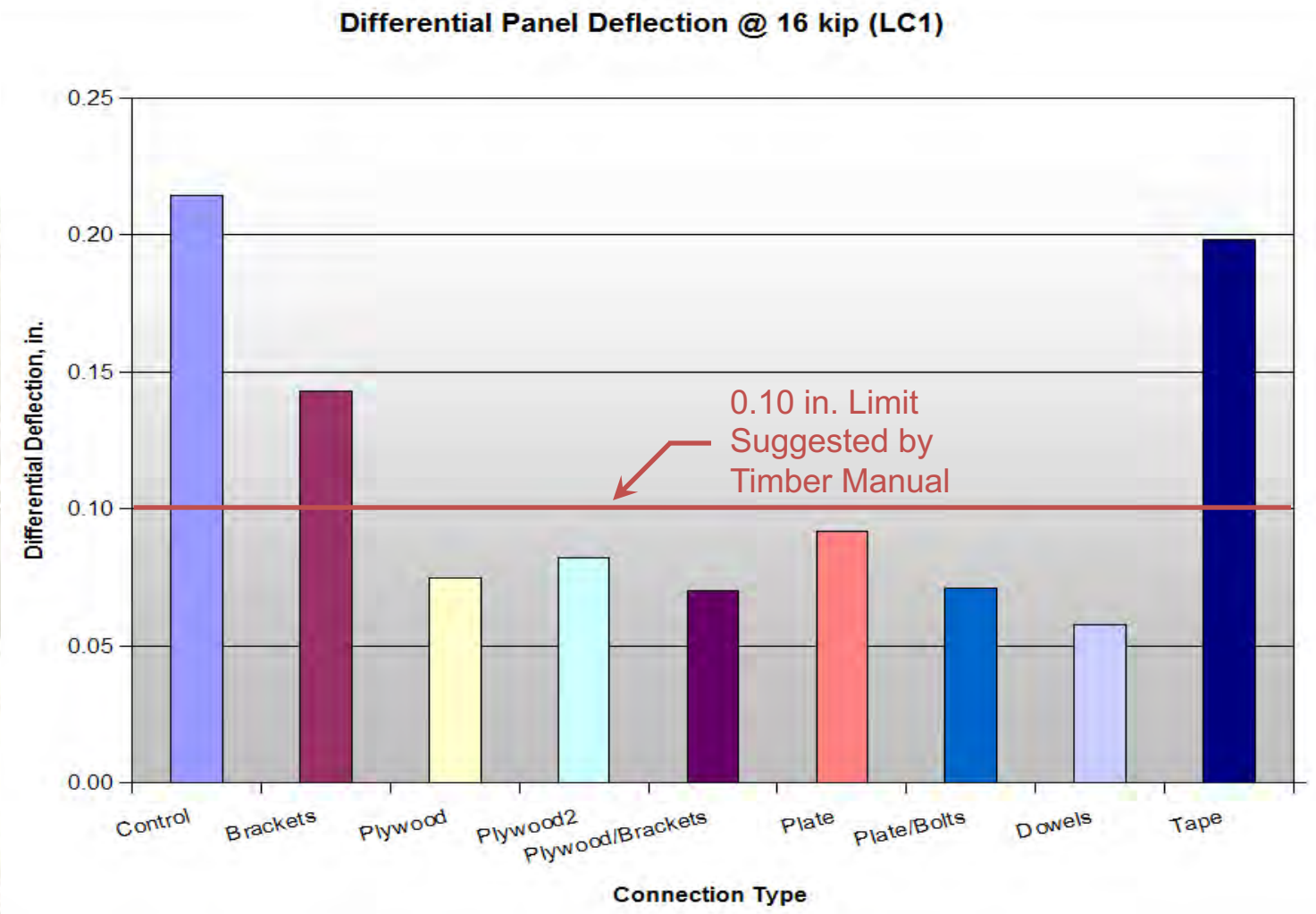


Steel Plate w/ Bolts

FRP Dowels

Mastic Tape

Test Results



Lab Bridge Results

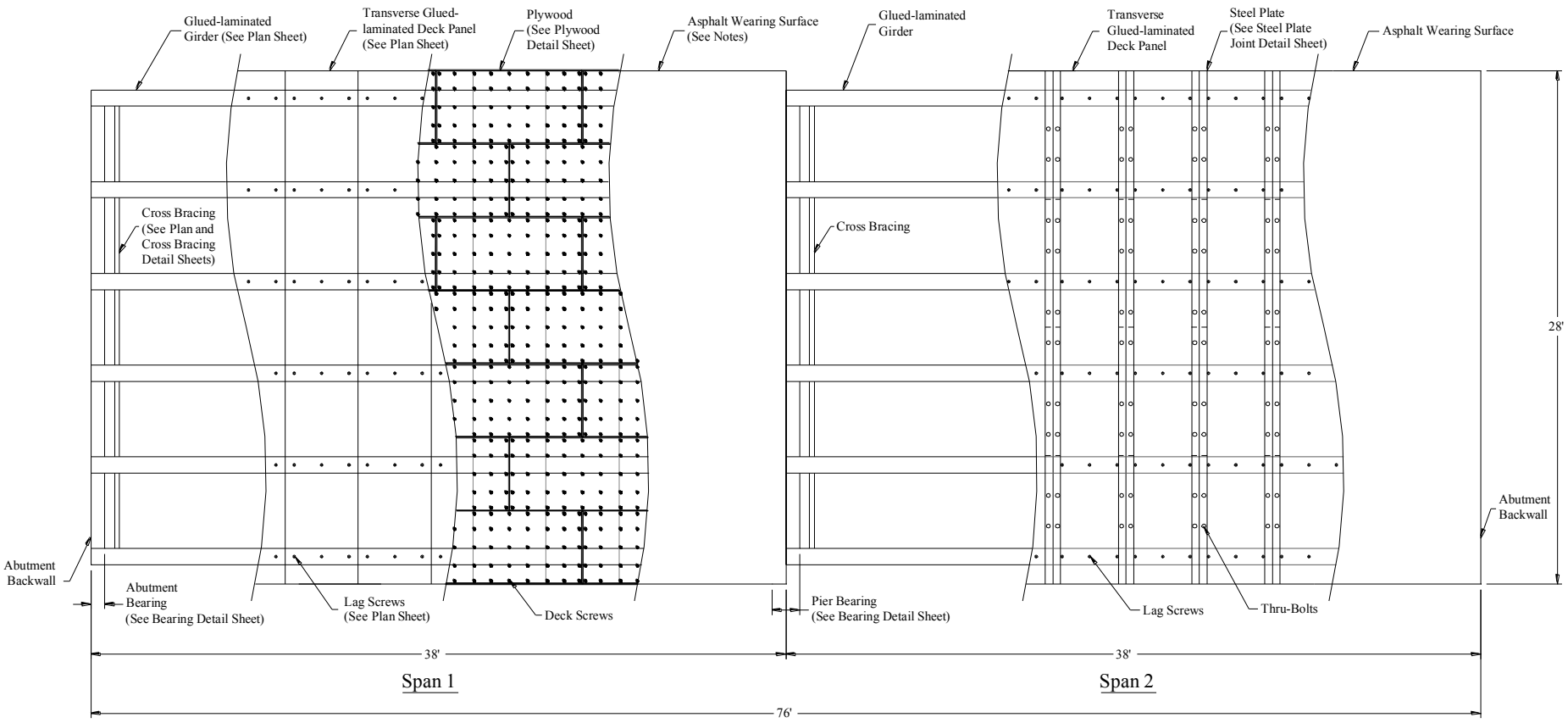
- Alternatives Reduced Diff/Defl.
- Important Alt. Qualities
  - Effectiveness
  - Cost
  - Constructability!
- Top Three: Dowels, Steel Plate, Plywood
- Selected Alternative: Plywood

Demonstration Timber Bridge Project

Objective

- Design Full-scale Glued-laminated Timber Bridge
- Utilize Selected Alternative
- Document:
  - Design
  - Construction
  - Serviceability Performance
  - Live Load Performance
- Final report

Demonstration Bridge Design

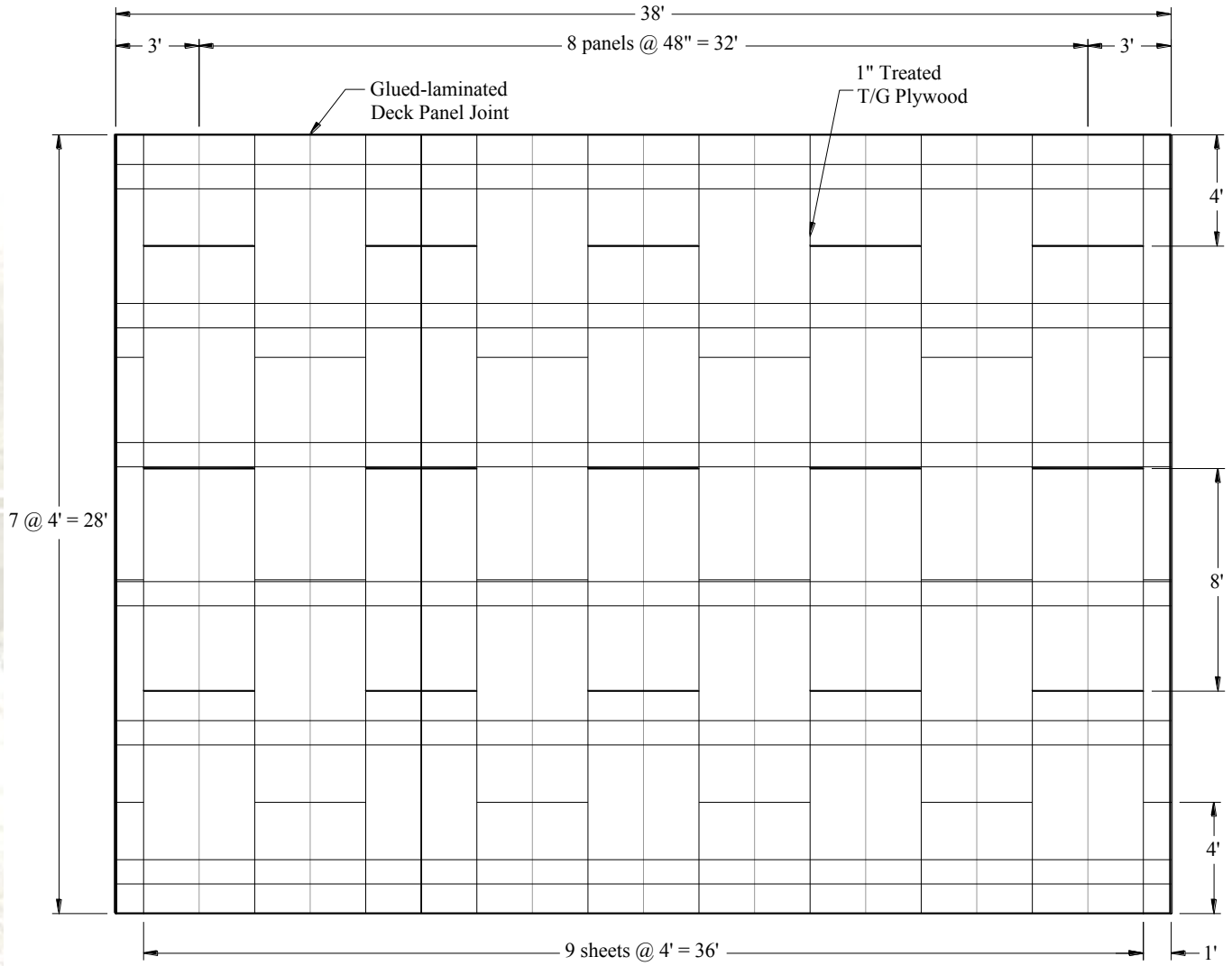


Overall Superstructure Layout

(Guardrail omitted for clarity, see Guardrail Detail Sheets)

N

Plywood Layout

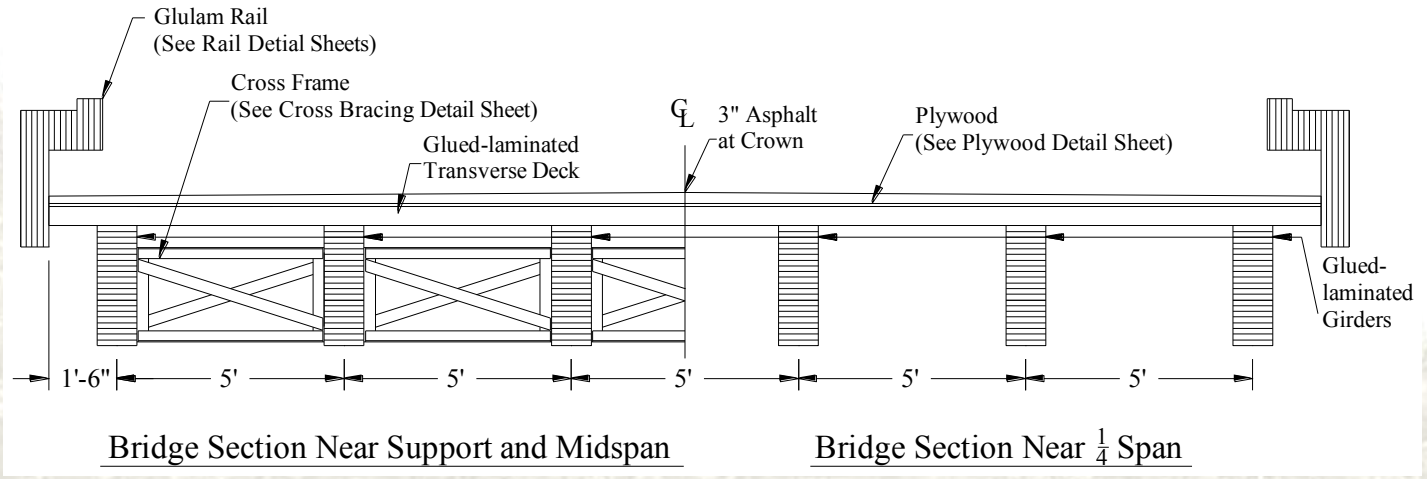


Plan Layout of 1" T/G Treated Plywood

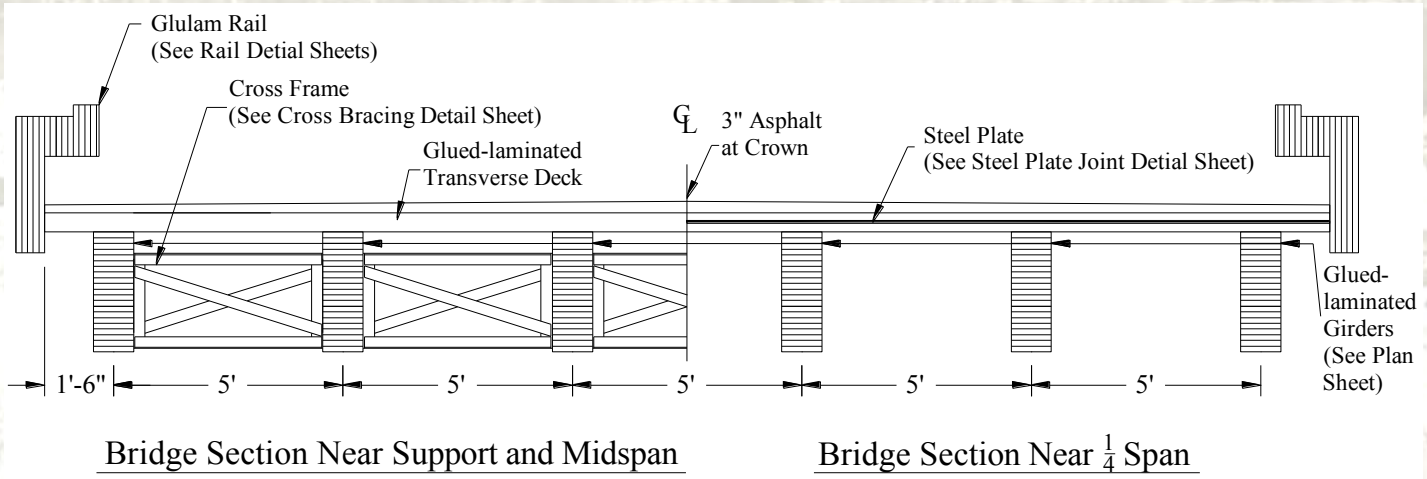
Span 1 Only

Demonstration Bridge Design

Span 1



Span 2



Demonstration Bridge Construction

Demonstration Bridge Construction

Demonstration Bridge Construction

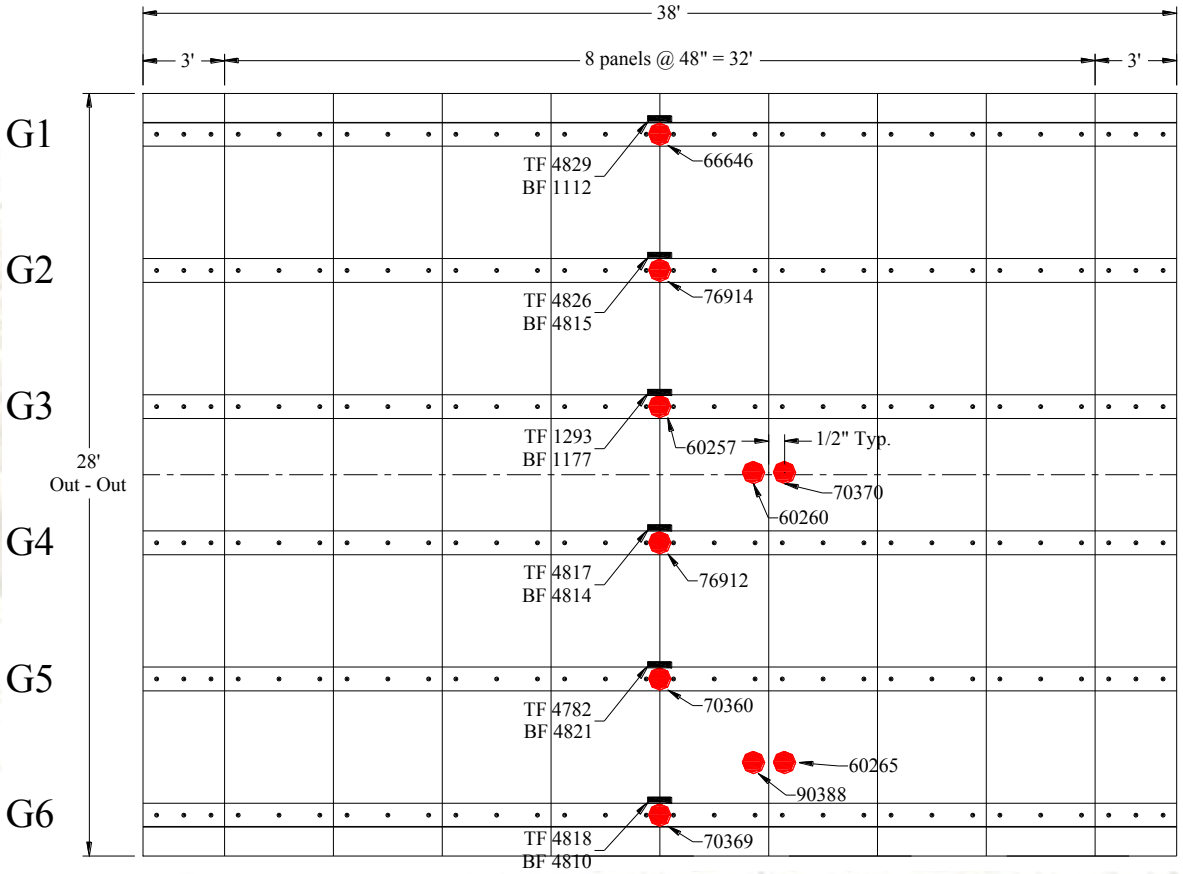
Demonstration Bridge Construction

Demo Bridge – Inspection Resutls

- **Span w/o Plywood**

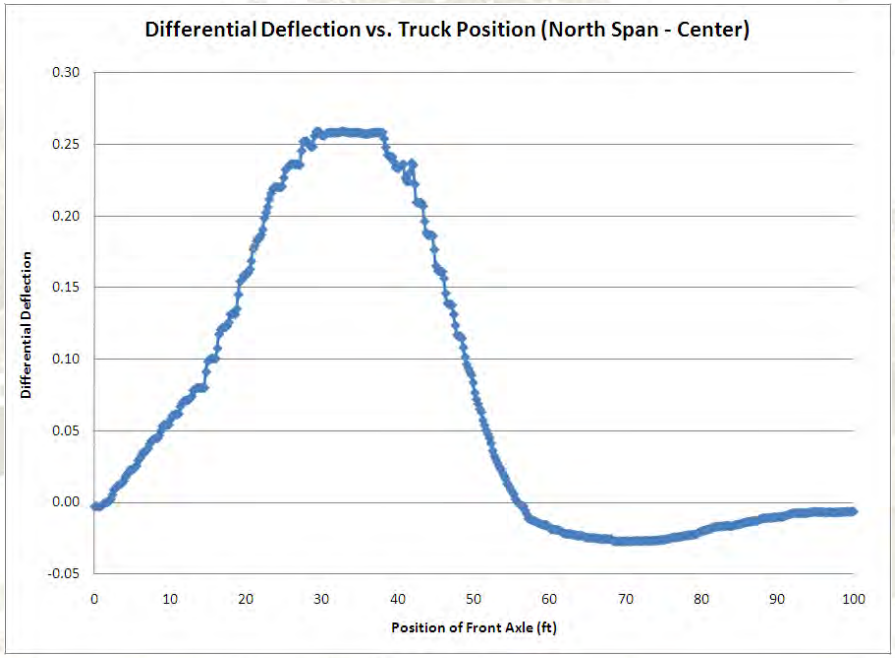
- **Span w/ Plywood**

Demo Bridge – Test Results

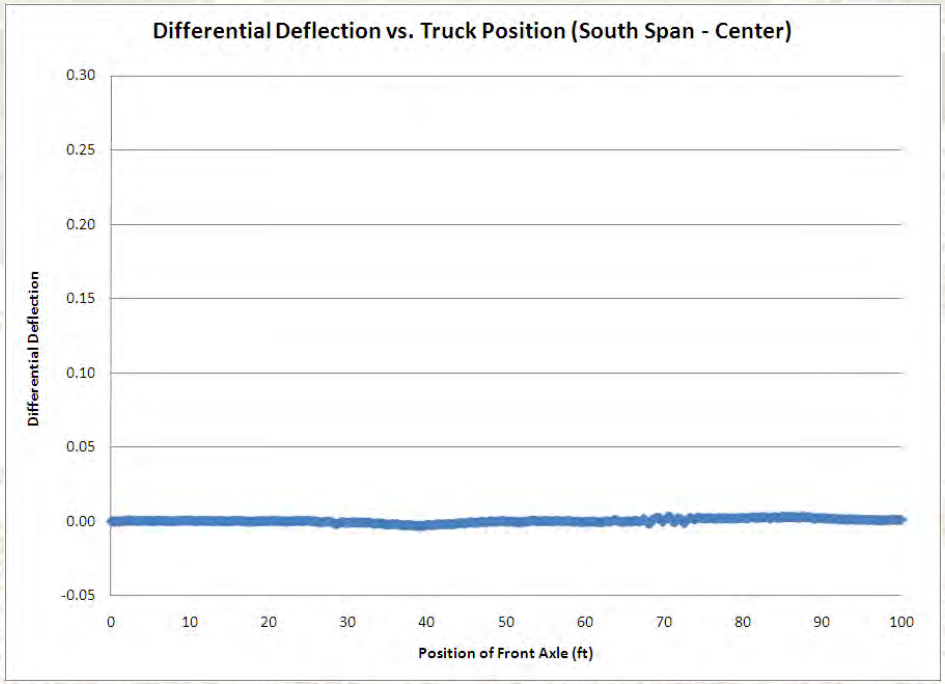


Test Results Cont.- Differential Deflections

- **Span w/o Plywood**



- **Span w/o Plywood**



Demo Bridge – Conclusions/Recommendations

- Plywood
  - reduces differential panel deflections
  - easy install
  - Alters asphalt cracking pattern
- Future investigations:
  - Plywood pattern
  - Tongue/Groove plywood
  - Asphalt Mix Design


Thank You!