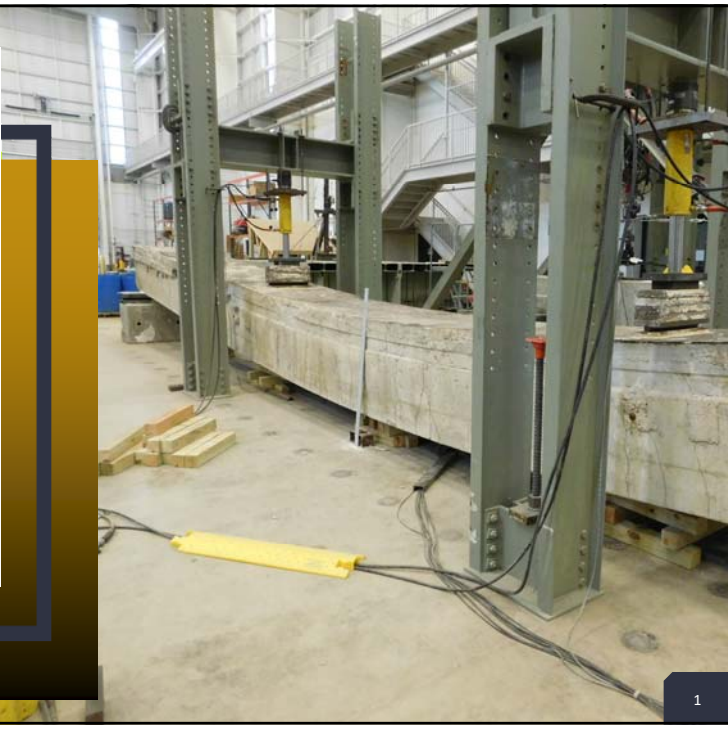


ADJACENT PRESTRESSED, PRECAST BOX BEAM BRIDGES

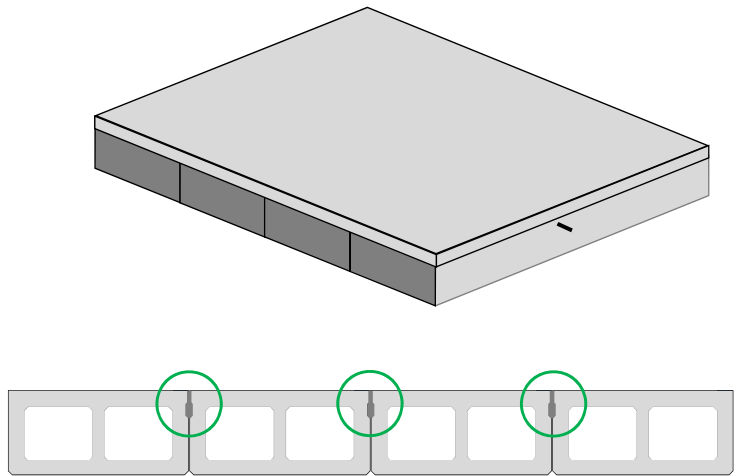
RYAN WHELCHER, Purdue University
 RYAN MOLLEY, KPFF
 LUIS FELIPE URREGO, Universidad de los Andes
 ROBERT FROSCH, Purdue University
 CHRISTOPHER WILLIAMS, Purdue University



1

AN ADJACENT BOX BEAM BRIDGE

- Box Girders
- Shear Keys
- Tie Rods
- Wearing Surface



2



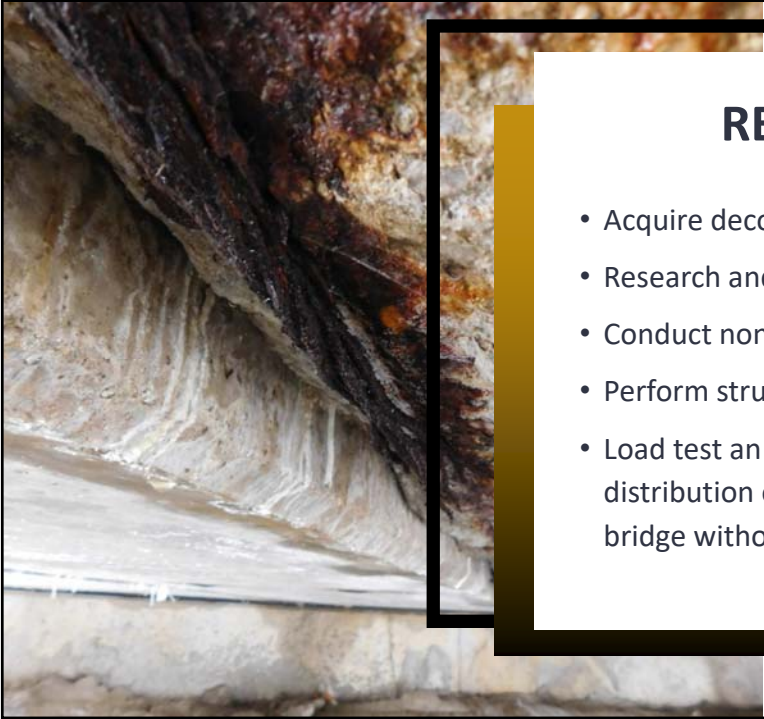
PROJECT MOTIVATION

- History of poor durability and performance
- Economical and simple to build
- Over 43,000 in US and 4,000 in Indiana




3

3



RESEARCH PLAN

- Acquire decommissioned bridge girders
- Research and acquire NDT equipment
- Conduct non-destructive evaluation
- Perform structural tests
- Load test an existing bridge to determine load distribution of a non-composite deck on a bridge without shear keys

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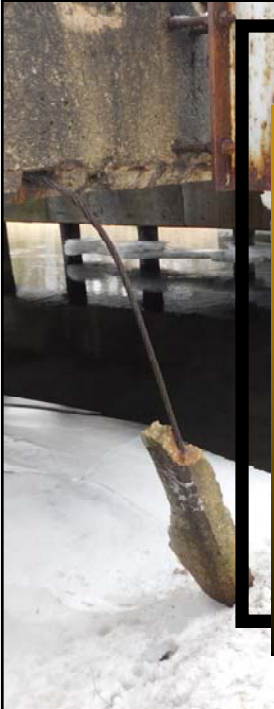


SPECIMEN ACQUISITION

- Determine those bridges that will be replaced
- Inspect bridges to determine specimen quality
- Contact County, Engineer, or Contractor to coordinate girder salvage

5

5



COMMON DETERIORATION

- Longitudinal Cracking
- Exposed or Broken Strand



6

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BOX BEAM SPECIMENS
Wells Co. Bridge 79

7

BOX BEAM SPECIMENS
Newton Co. Bridge K5

8

BOX BEAM SPECIMENS

Elkhart Co. Bridge 102



9

9

NONDESTRUCTIVE TESTING



10

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NON-DESTRUCTIVE EVALUATION (NDE)



Ground Penetrating Radar (GPR)



Connectionless Electrical Pulse Response Analysis (CEPRA)



Half-cell potential measurement

11

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PRELIMINARY NDE RESULTS

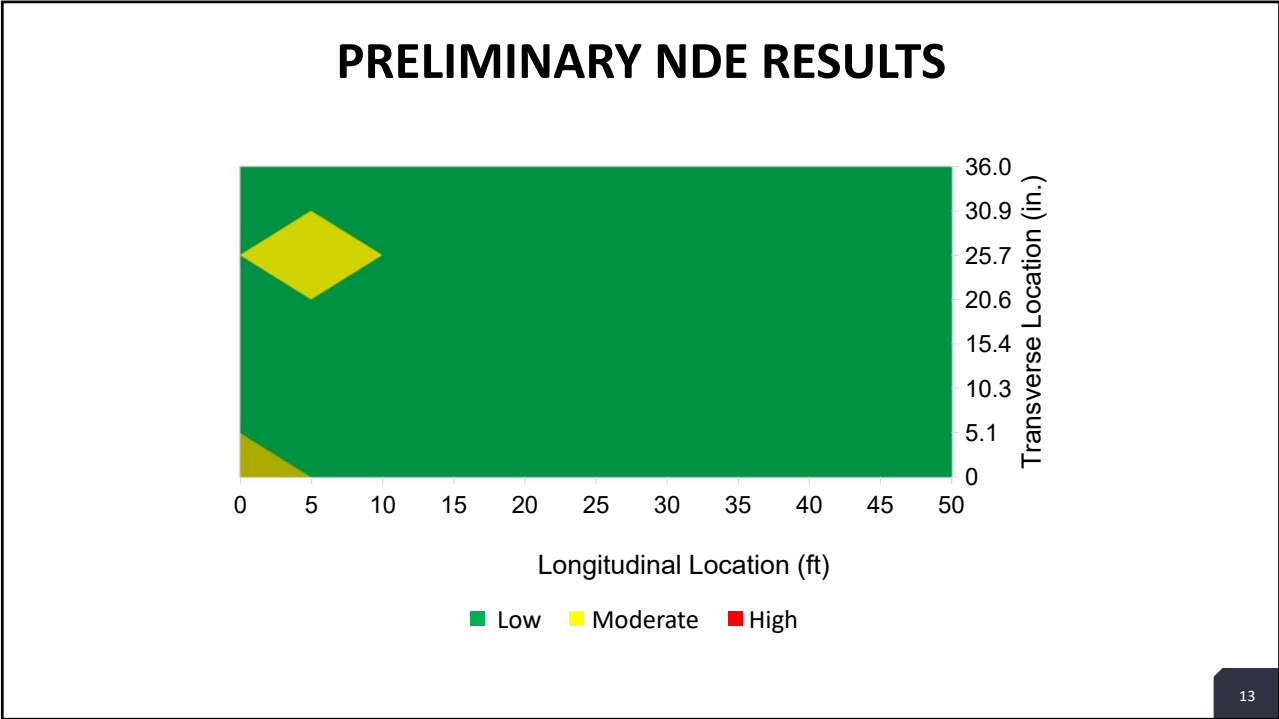


Specimen 409-1-ES

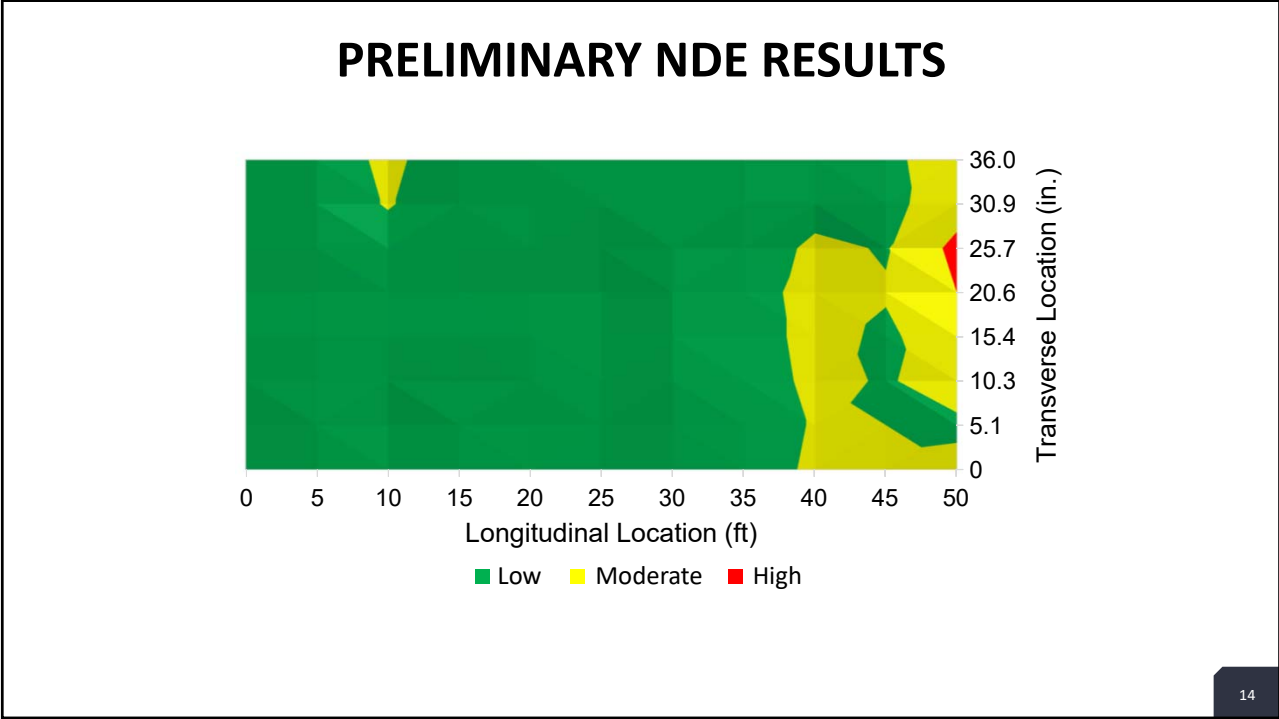
Span: 50'
Depth: 29"
Width: 36"

12

12



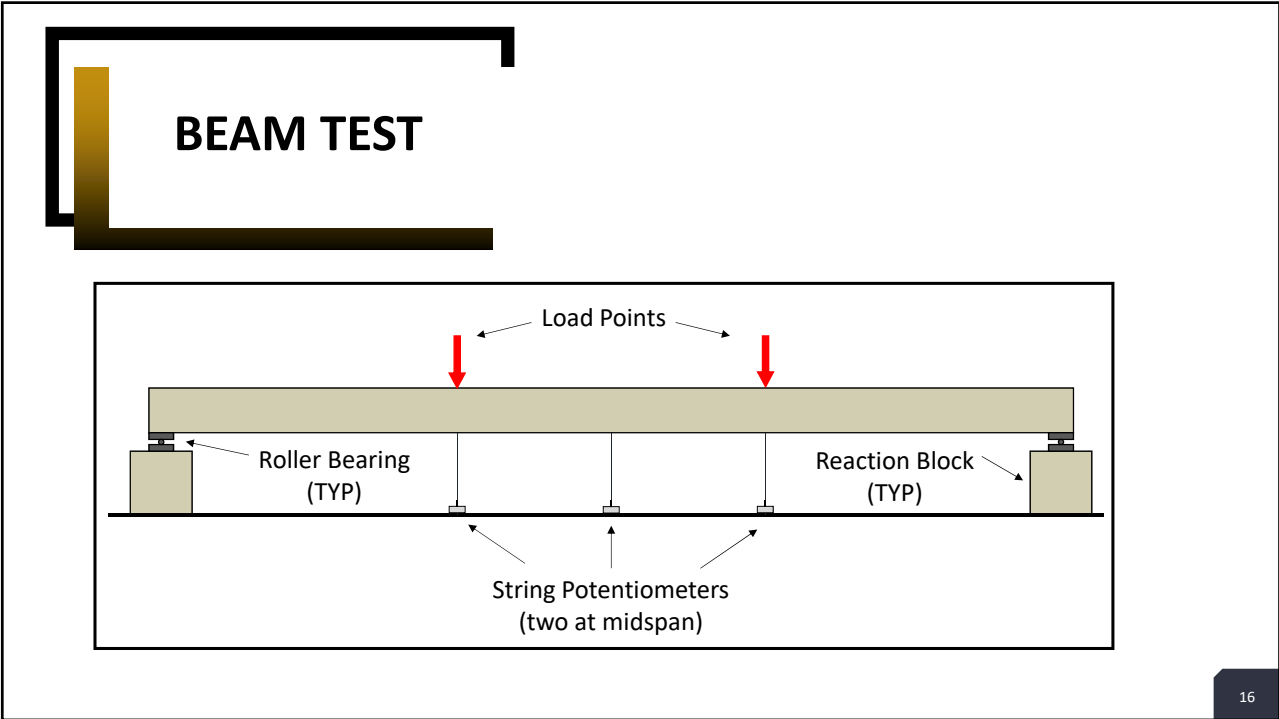
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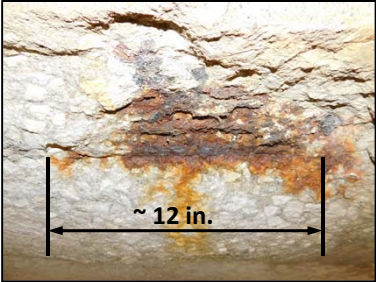

BEAM TEST

Specimen 409-1-ES

- Three exposed strands at L/8 from support

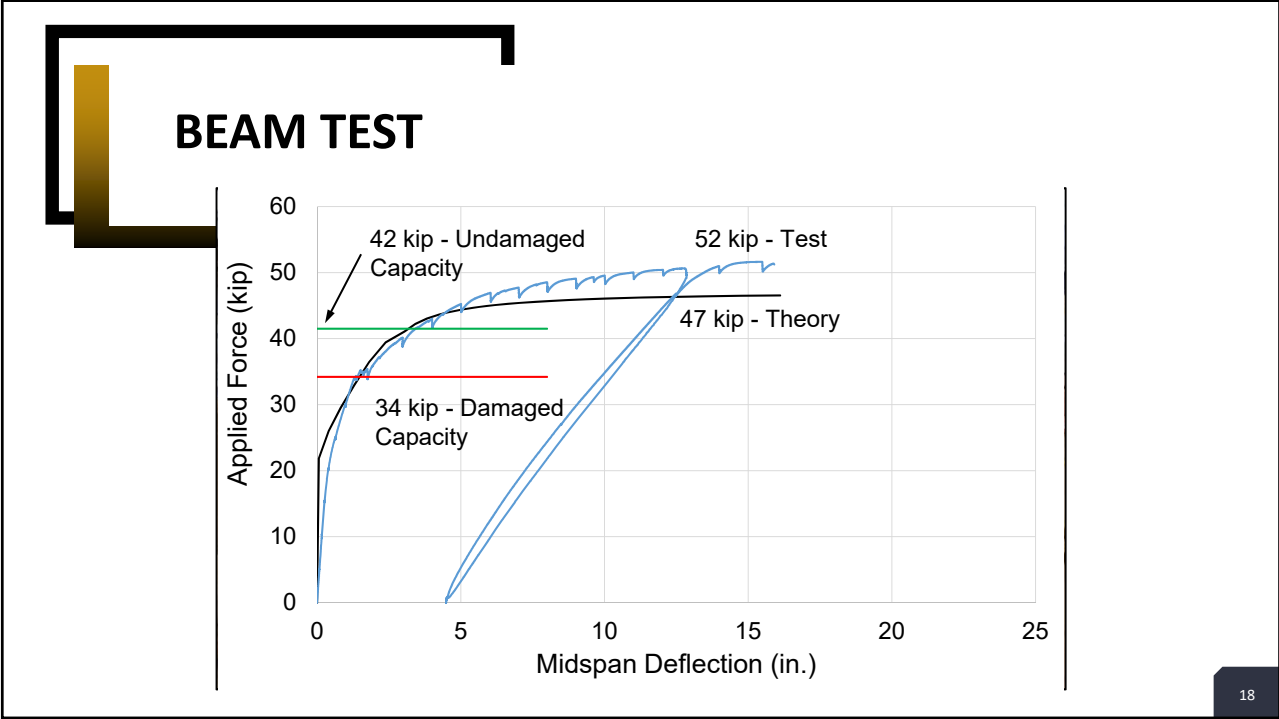
Specimen 409-2-UD

- No damage

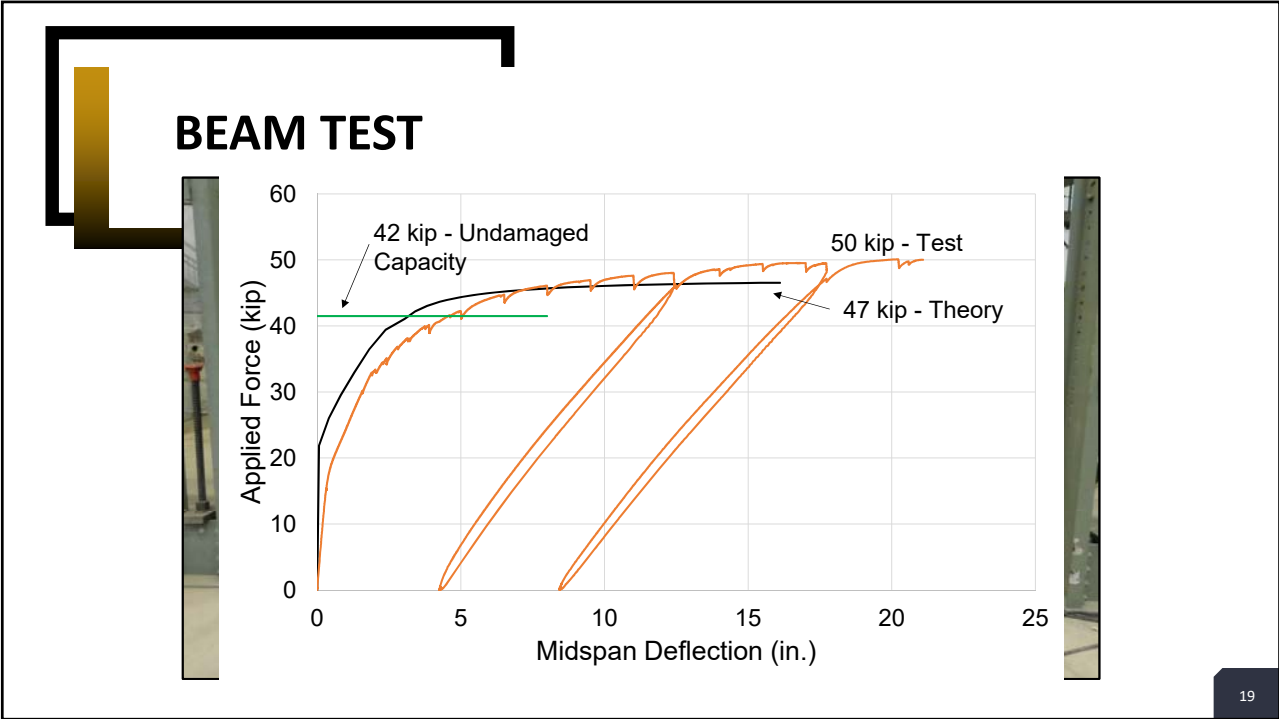



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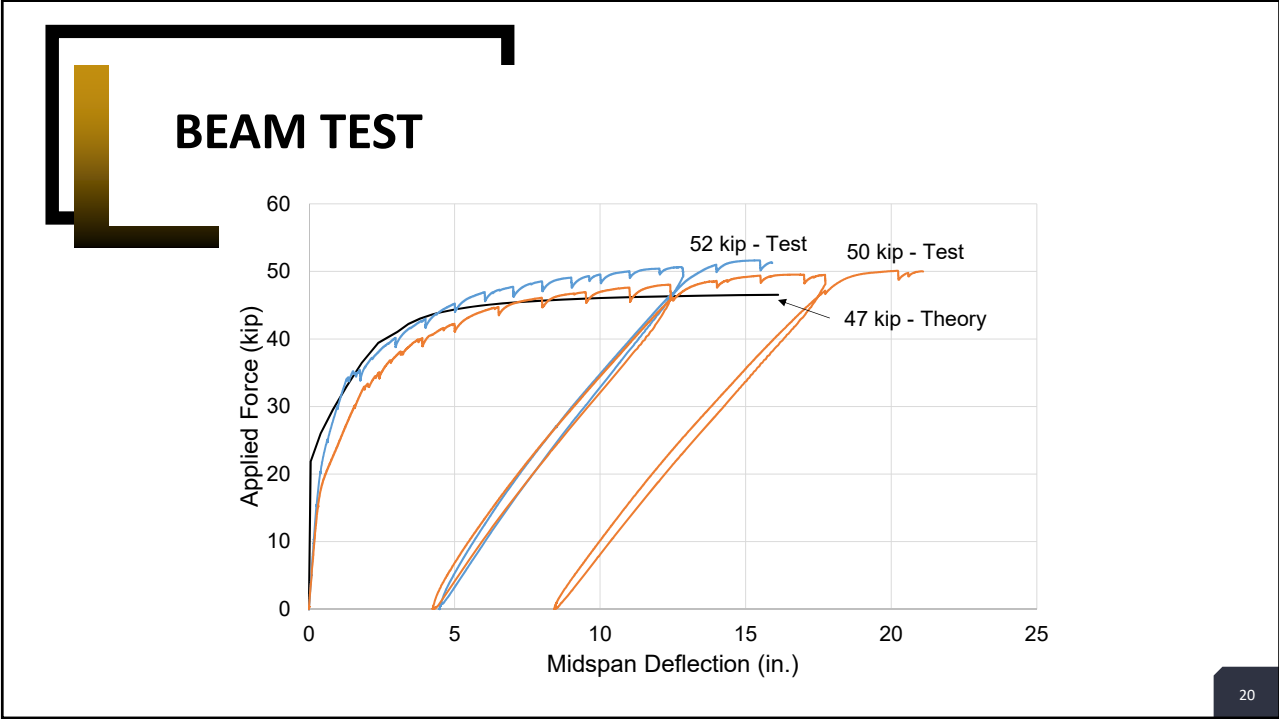
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TIPPECANOE COUNTY BRIDGE 115

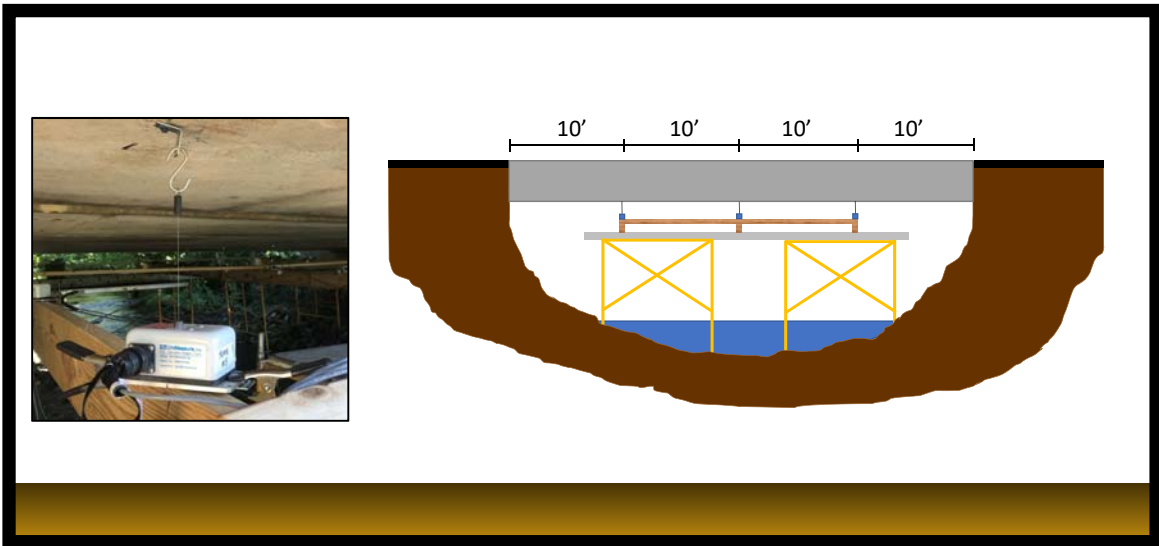


- Built: 1957
- Rehabilitated: 1993
- Span: 40 ft
- Beam Depth: 21 in.
- Beam Width: 45 in.
- 7 Beams

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INSTRUMENTATION



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LOADING



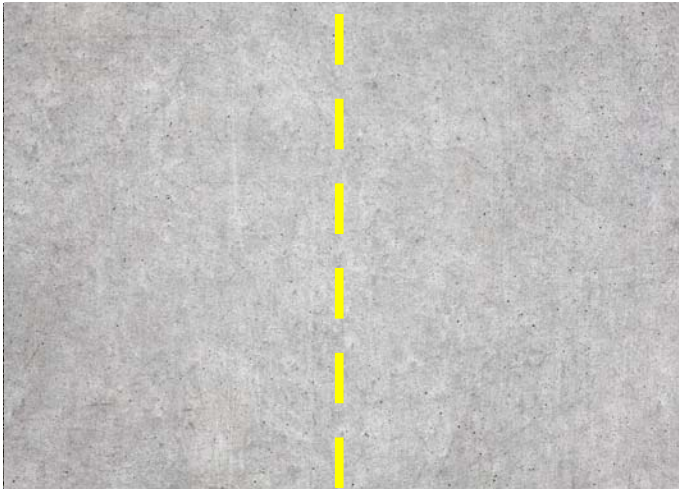
Dump Truck

- Weight: ~ 58,000 lb
- 30% to front axle
- 70% to tandem axle
- Wheelbase: 16' – 4"

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TEST 1

Q ← → V




25

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FIELD TESTING

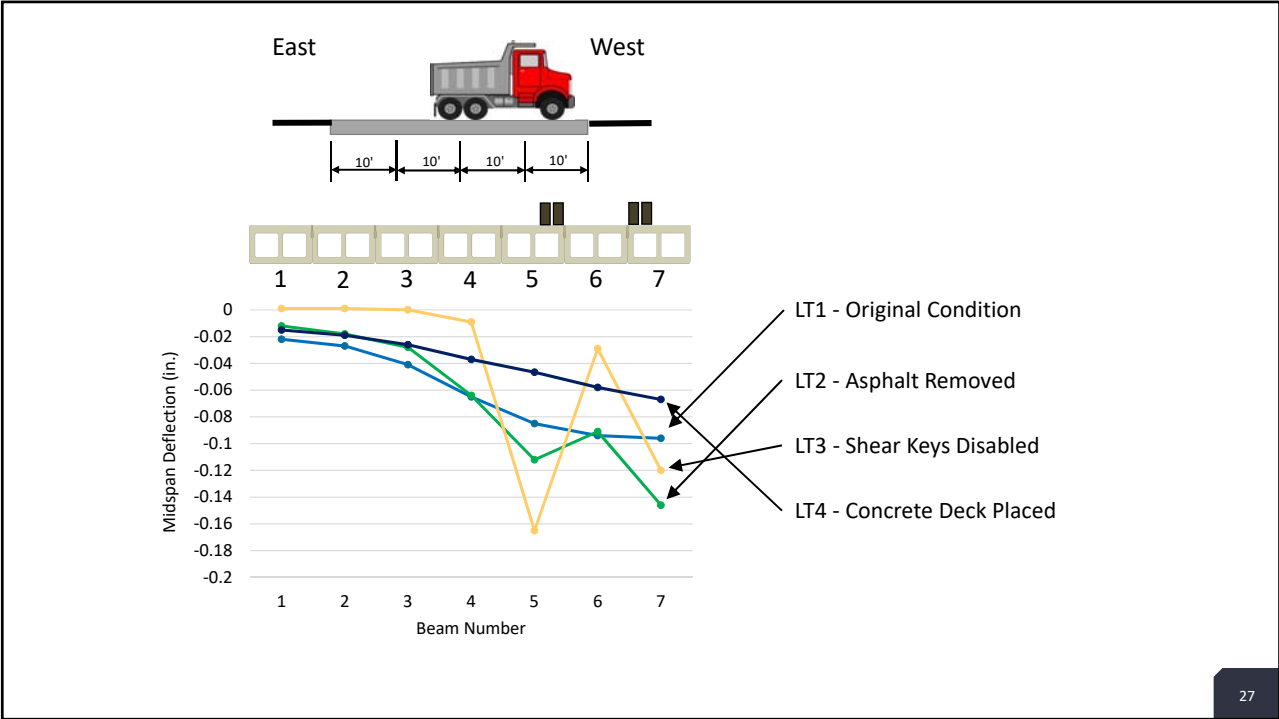
Bridge Deck Modifications

- Milling
- Shear Key Cutting
- Surface Preparation
- Bridge Deck Cast

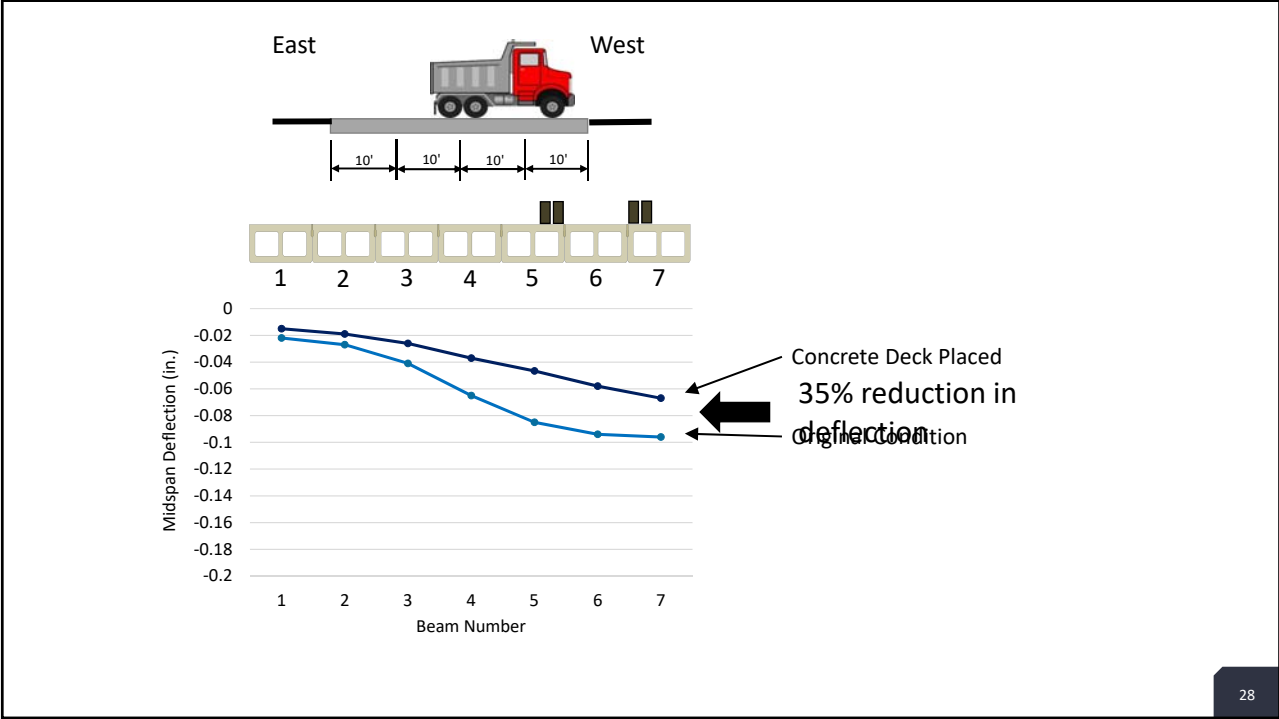


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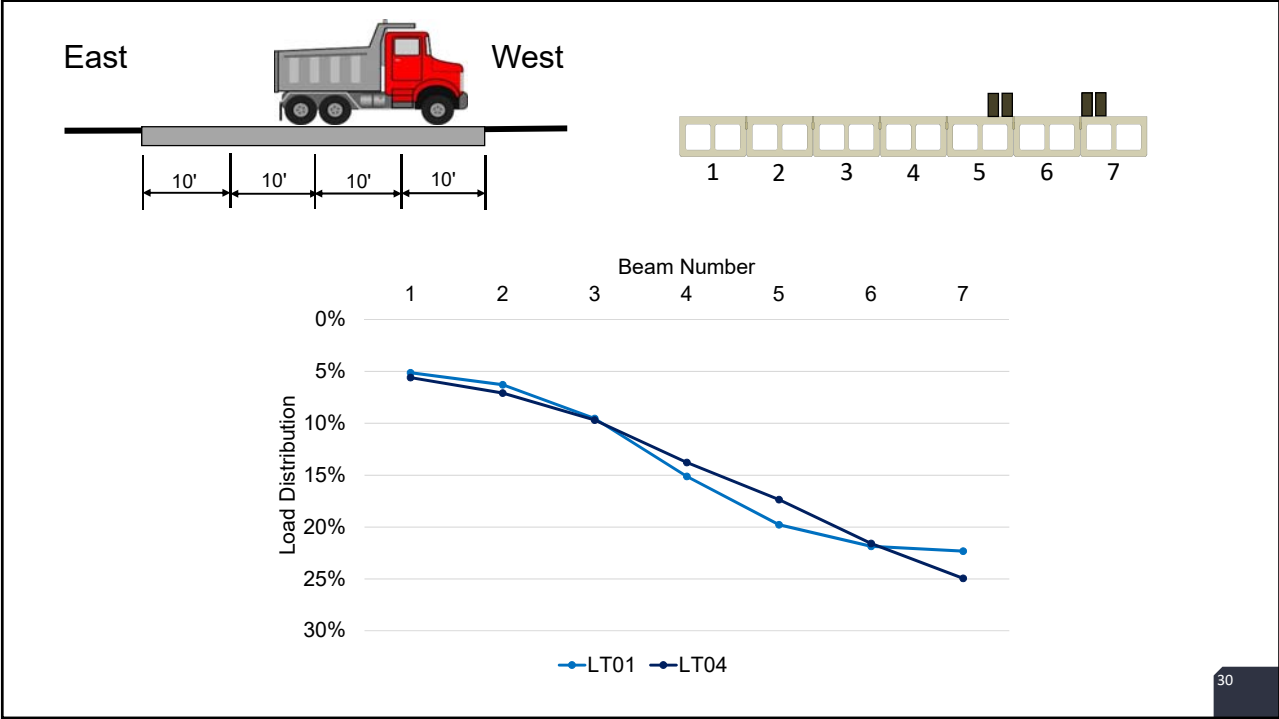
LOAD DISTRIBUTION

- The proportion of load carried by a given beam was calculated as follows

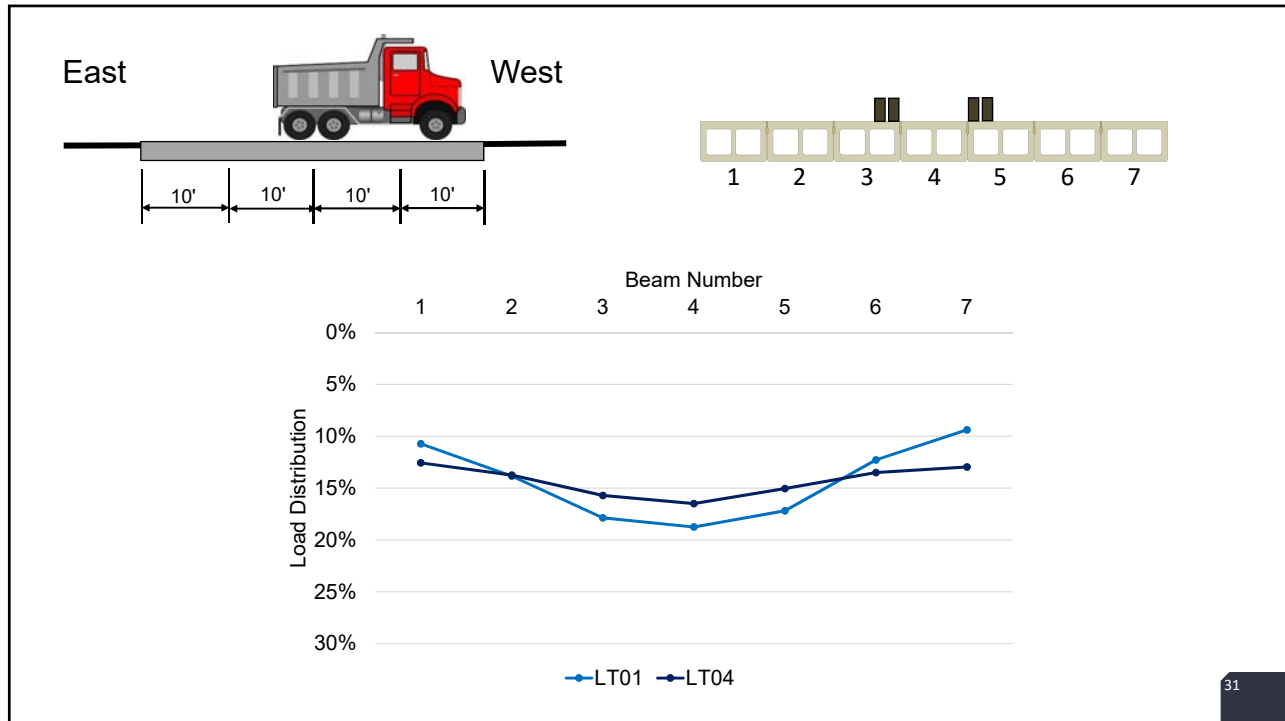
$$DF_i = \frac{\Delta_{midspan_i}}{\sum \Delta_{midspan_i}}$$

29

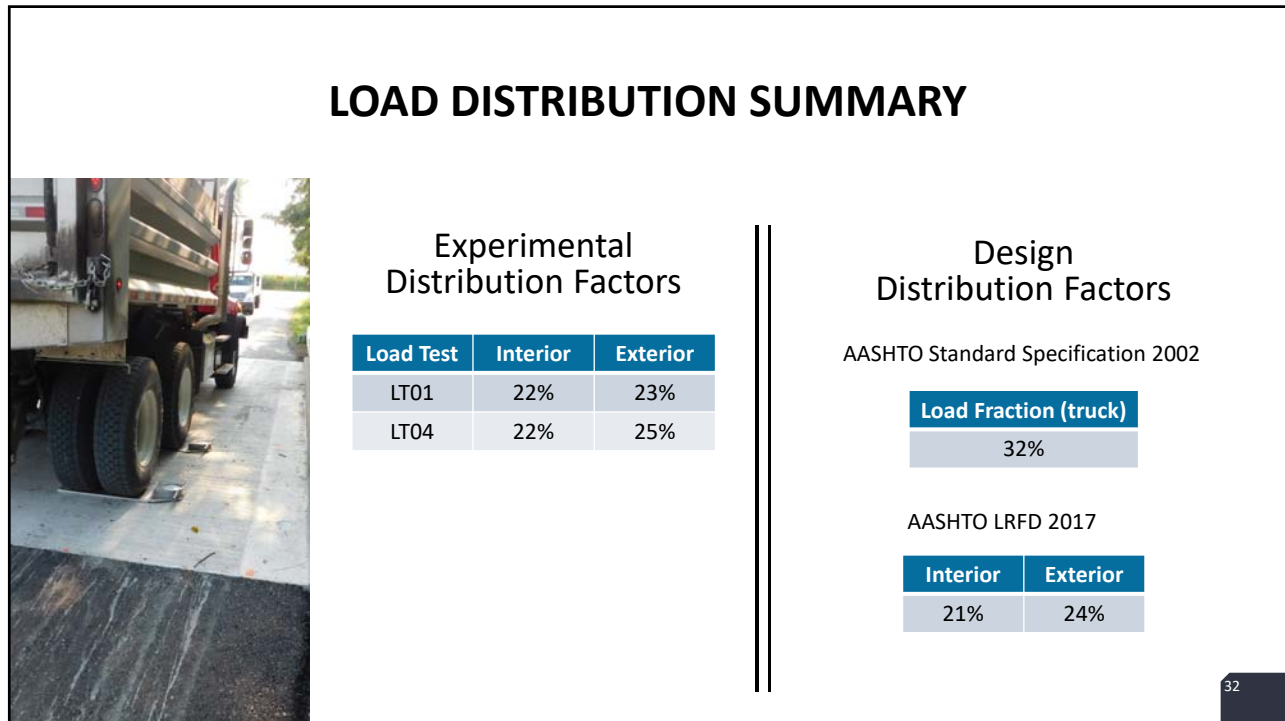
29



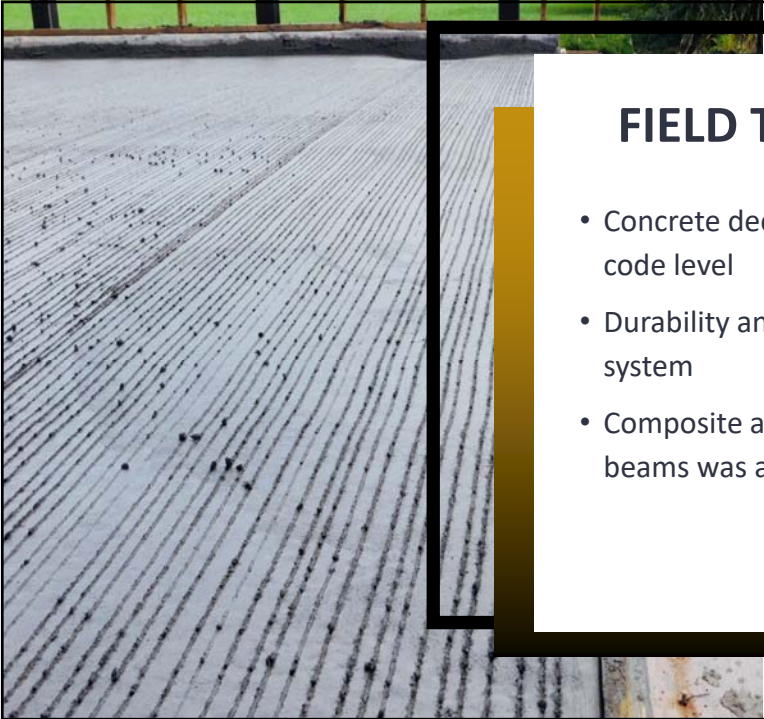
30



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32



FIELD TEST CONCLUSIONS

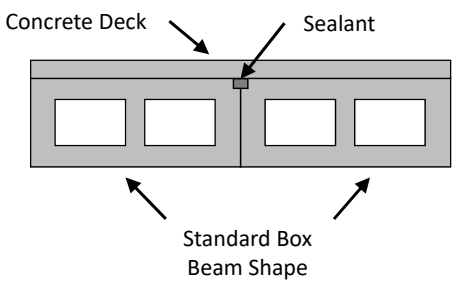
- Concrete deck restored load distribution to a code level
- Durability and stiffness were added to the system
- Composite action between the deck and the beams was achieved

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IMPLICATIONS TO BEST PRACTICE

- Recommend all new construction use concrete decks
- Potential new design of adjacent box beam bridges without shear keys



Concrete Deck

Sealant

Standard Box Beam Shape

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PROJECT BENEFITS

- Improved inspection capability for bridge inspectors
- Increase in bridge load rating accuracy
- Development of next generation box beams

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ACKNOWLEDGMENTS

PURDUE
UNIVERSITY






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