

INTRODUCTION TO

# S-BRITE

Steel

Bridge

Research

Inspection

Training

Engineering





 <p>High Strength Structural Bolting</p>	 <p>Inspecting Steel Bridges for Fatigue</p>	 <p>Design of Steel Bridges for Fatigue &amp; Fracture</p>	 <p>Implementing Effective Retrofits in Selected Steel Bridge Details</p>	 <p>Welding in an Infrastructure System</p>
<p><b>TRAINING COURSES</b></p>				



# INSPECTION STEEL BRIDGES FOR FATIGUE

- Now required by INDOT for team leaders / FC inspection
- Next offering April 19-20, 2018
  - **REGISTRATION IS FILLING UP!!!**



# NEWEST COURSE

## STEEL BRIDGE RETROFITTING

- Development and implementation of effective retrofits in steel bridges is essential in extending the life of our aging infrastructure
  - INDOT has had mixed experience with such retrofit projects



# NEED FOR THE COURSE

- Few engineers have direct experience with proper retrofit selection
  - Younger/new engineers even less
- New research has resulted in improved guidance in retrofit selection and implementation



**S-BRITE Center**  
PURDUE UNIVERSITY



NCHRP 721 – Bowman, et.al.

# COURSE OBJECTIVE

- Develop classroom and hands-on training to educate bridge engineers and other stakeholders so that the most effective, efficient, and safe retrofit strategies are employed on INDOT's aging steel bridge inventory

# GENERAL COURSE LAYOUT

- Begin with introduction to fatigue and fracture
  - Brief and will consider target audience
  - Give background to retrofit concepts
- The majority of the course covers the following retrofits
  - Stop hole drilling
  - Surface treatments grinding and weld-toe improvement
  - Out of plane distortion
  - Constraint induced fracture

# GENERAL COURSE LAYOUT

- Each retrofit strategy is taught with
  - PowerPoint slides
  - Physical examples
  - Demonstration videos
  - Practice session
- The practice sessions take place on the specific area of each students' section of the beam
  - Course alternates between practice and class sessions



# GENERAL COURSE LAYOUT

- After the retrofits have been explained and practiced, a tour of actual bridge retrofits at the S-BRITE center is held
  - Shows large scale bridge girder failures and the repair methods used
- Second half of day two is heavily devoted to “testing”
  - Comprise of written, inspection, and hands-on portions

# SPECIMEN DESIGN

- A W36X135 is used as the main specimen
- It is cut into 10ft segments that can accommodate 5-6 students each
- Each student has a piece that will contain practice and testing sections of
  - A Hoan detail (CIF)
  - Out-of-plane distortion detail
  - Weld toe repair details
  - Nicks/gouges

## AGENDA—Day 1

- 8:00 – Welcome and Introduction  
Safety briefing
- 8:20 – Session 1: Intro to Fatigue
- 9:00 – Session 2: Intro to Fracture
- 9:30 - Break
- 9:45 – Session 3: Effects of Geometry & Residual Stresses
- 10:15 – Session 4: Stop-hole Drilling
- 11:00 – Stop-hole drilling practicum
- 12:00 – Lunch Break (provided)
- 12:45 – Session 5: Surface Treatments
- 1:25 – Surface treatment practicum
- 2:45 - Break
- 3:00 – Session 6: Out-of-plane Distortion
- 3:30 – Out-of-plane distortion practicum
- 5:00 – Adjourn, end of Day 1

## AGENDA—Day 2

- 8:00 – Session 7: Constraint-Induced Fracture
- 8:45 – CIF practicum
- 9:45 – S-BRITE Center field trip
- 11:15 - Lunch Break (provided)
- 12:00 – Discussion on Urgency  
And review of concepts
- 12:30 – Divisions 1 and 2 begin written test  
– Divisions 3 and 4 begin practicum test
- 1:30 – Divisions 1 and 2 complete written test  
– Divisions 1 and 2 begin practicum test  
– Divisions 3 and 4 continue practicum test
- 3:10 – Divisions 1 and 2 continue practicum test  
– Divisions 3 and 4 begin written test
- 4:10 – Testing completed
- 4:10 – Break
- 4:20 – Exam review and discussion
- 5:00 – Course completed

# HANDS-ON TRAINING



**NOT JUST DEATH BY POWERPOINT**

**YOU GET DIRTY!!!!**



# YOU GET DIRTY!!!!



**YOU GET DIRTY!!!!**



# FEEDBACK ON THE COURSE?

- *“Easily one of the best training courses I have ever had!”*
- *“The mix between classroom and hands-on exercises was great”*
- *“Hard work, but the hands-on training the drills and other tools was very helpful”*
- *“The instructors were brilliant, they are all great speakers, and are all good looking enough to be movie stars...”*



# WHEN WILL IT BE OFFERED AGAIN?

- *Obligated to provide 5 courses for INDOT personnel*
- *Fifth class is scheduled for April 4-5, 2018*
  - *By invitation only since focus is for INDOT*
- *Future classes not scheduled.....WHY?*
  - *Need early commitment from attendees due to considerable effort to coordinate the class*
    - *Specimens, equipment, etc.*
  - *Estimated cost is \$1,800/person*
    - *Includes specimens, training materials, meals and breaks*

## OTHER S-BRITE NEWS

- More specimens and components continue to arrive

# DRESBACH BRIDGE GIRDERS (MINNESOTA)



# "NEW" 40 FT RIVETED DPG BRIDGE

- Build date is unknown
  - Rehab in 1968
- Formerly on Norfolk & Western RY. Co



# "NEW" 40 FT RIVETED DPG



# “NEW” GRANT COUNTY BRIDGE 10

- Carried County Road 500N over Mississinewa River northwest of Marion, Indiana
- Build 1972



# "NEW" GRANT COUNTY BRIDGE 10



# COMPONENTS FROM PORTAGE BRIDGE

- Should arrive March 2018
- Built?



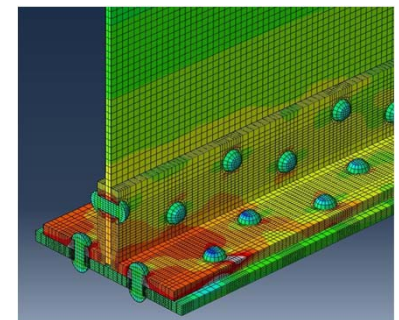
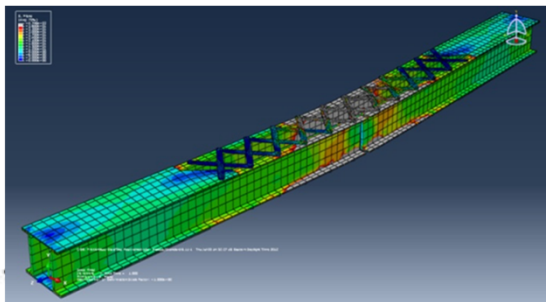


# OTHER S-BRITE NEWS

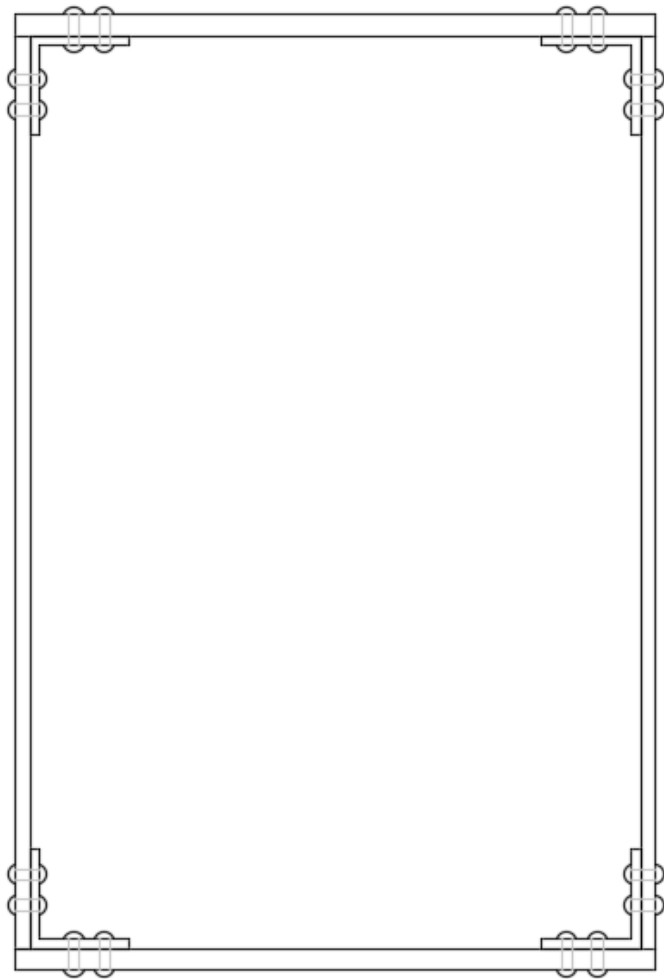
- More specimens and components continue to arrive
- **RRFC Bridge Rating Specs.**
  - Code/commentary completed
  - AASHTO MBE will ballot to add reference to these specifications for rating guidance
  - Includes provisions to perform simple system analysis to show bridge is not FC

# OTHER S-BRITE NEWS

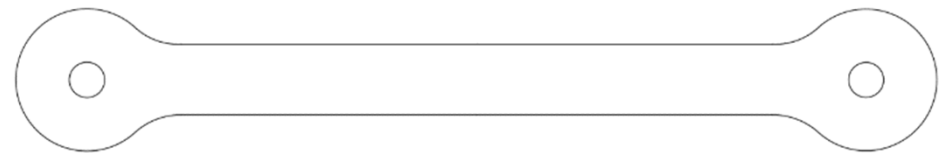
- More specimens and components continue to arrive
- RRFC Bridge Rating Specs.
- **Internal Redundancy**
  - INDOT was Lead State for TPF-5(253)
  - Proposed Guide Specifications completed
  - Include provisions for both flexural and members loading in axial tension
  - Moving to ballot in 2018
    - Game changer regarding FC inspection



# APPLICABLE X-SECTIONS FOR AXIAL MEMBERS:

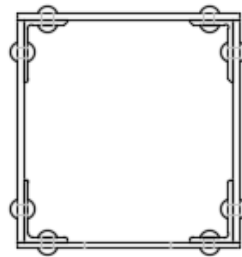


Tension tie

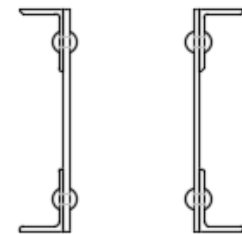


Multi-eyebared

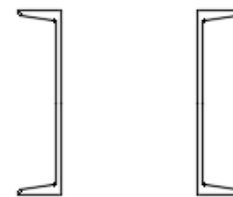
Multi-component truss



Multi-component truss



Two-component truss



# EXPERIMENTAL TESTING

- Fracture resilience

TPF 5(253)

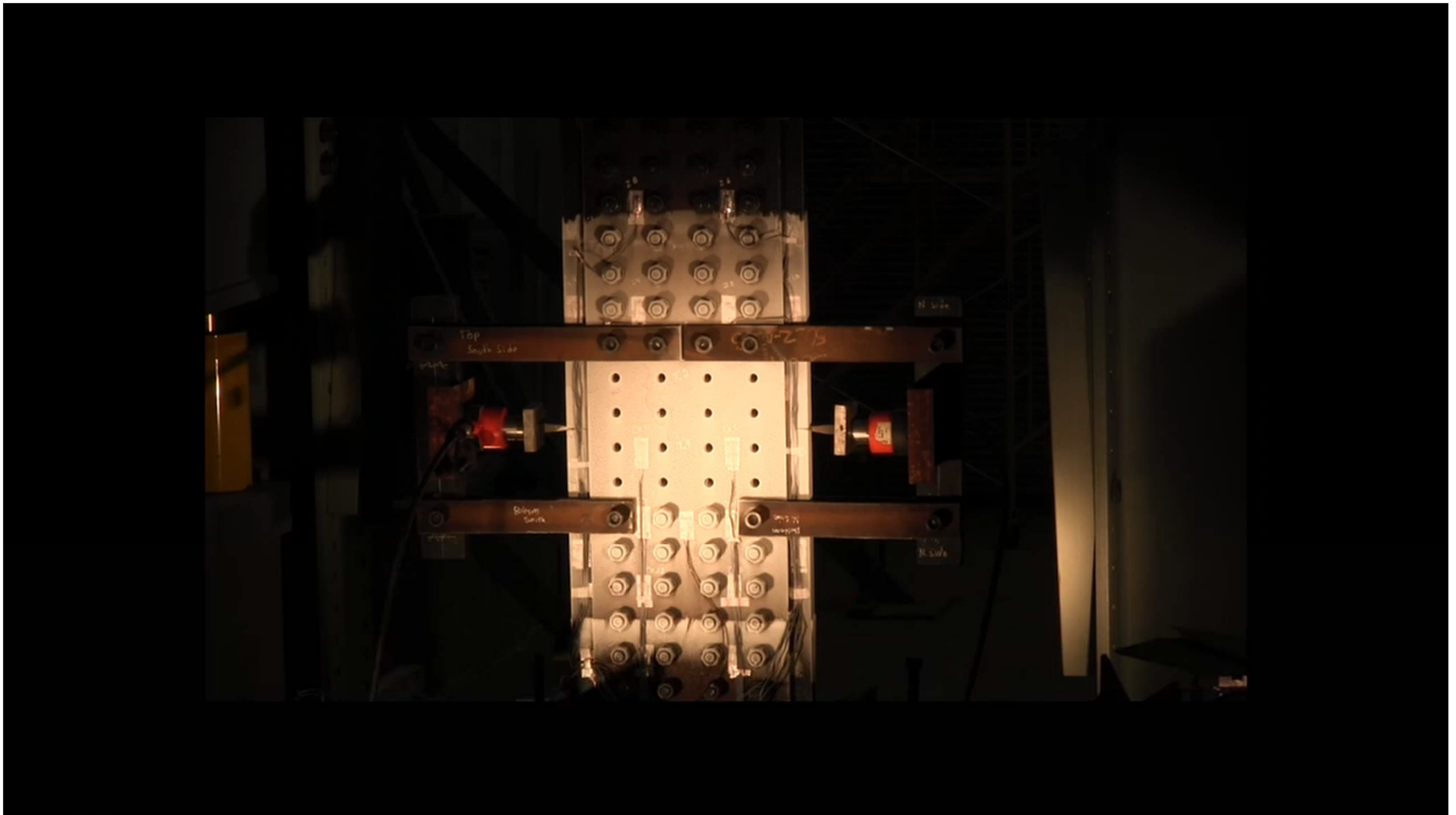
Member-level Redundancy of Built-up Steel Girders

Purdue University

PI - Robert Connor

Graduate Research Assistant - Matt Hebdon

# FRACTURE TESTS



# INSPECTION IMPLICATIONS



# INSPECTION IMPLICATIONS

- Members meeting the provisions of the Guide Specifications **are no longer classified as FCMs**
  - New Classification – Internally Redundant Member (IRM)
  - Calculations are easy...spreadsheet ready
- But, we still need to identify if a component breaks during the service life
- Inspection strategy defined in the Guide Specifications for IRMs
  - Handled through specific and targeted inspections
- Is this acceptable per CFRs?
  - YES

# INSPECTION IMPLICATIONS

- Special Inspection for IRMs
  - Definition of a Special Inspection is included in the CFRs
  - Per 23 CFR 650.305 – Definitions:
    - An inspection scheduled at the discretion of the bridge owner, used to monitor a particular known or suspected deficiency.*
- The objective is defined in the Guide Specifications
  - Specifically NOT a hands-on inspection
  - Objective is different – Find a broken component, not a fatigue crack at a rivet head
- Interval for this inspection calculated in the Spec
  - **Max** interval is 10 years
  - Routine inspections continue unaffected



# INSPECTION IMPLICATIONS

- Special Inspection for IRMs per proposed Guide Specifications:

*“In the specific context of these Guide Specifications, an inspection of sufficient depth to reliably detect severed or fractured components and other conditions deemed important in a member identified as an IRM.*

*To meet the objectives of the Special Inspection for IRMs, it is understood that special access equipment may be required for some bridges, while for others, it may be possible to reliably detect broken components from the ground using normal visual inspection techniques.”*

# MOVING FORWARD

- Have support of AASHTO:
  - T-5 – Load model presented at T-5 Oct. meeting
  - T-18 – Presented at T-18 Sept. 2017 mid-year
  - T-14 – Presented at previous T-14 meetings
- Moving Guide Specifications for IRMs to ballot at 2018 SCOBs
- Remaining tasks?
  - FHWA needs to update 2012 Memo...
- Stay Tuned!

# EXAMPLE – SHERMAN MINTON BRIDGE

- Tie will now likely be able to be classified as an IRM
  - Inspection strategy focused on finding broken components, not small cracks



# SUMMARY

- S-BRITE courses continue to expand
  - All course geared toward practicing professionals at all levels
- Research results are moving into practice
  - Guide Specifications for Internal Redundancy of Mechanically-fastened Built-up Steel Members
    - Moving to ballot in 2018
- Please continue to keep S-BRITE in mind when bridge replacements are being planned

*DAD, IS IT REALLY TRUE  
THERE USED TO BE BRIDGES  
THAT WERE CALLED  
FRACTURE CRITICAL?*

*YES SON, BUT THAT WAS  
A LONG TIME AGO...  
YOU DON'T HAVE TO BE  
AFRAID OF THEM  
ANYMORE*



**PURDUE**  
UNIVERSITY

**S-BRITE Center**  
PURDUE UNIVERSITY