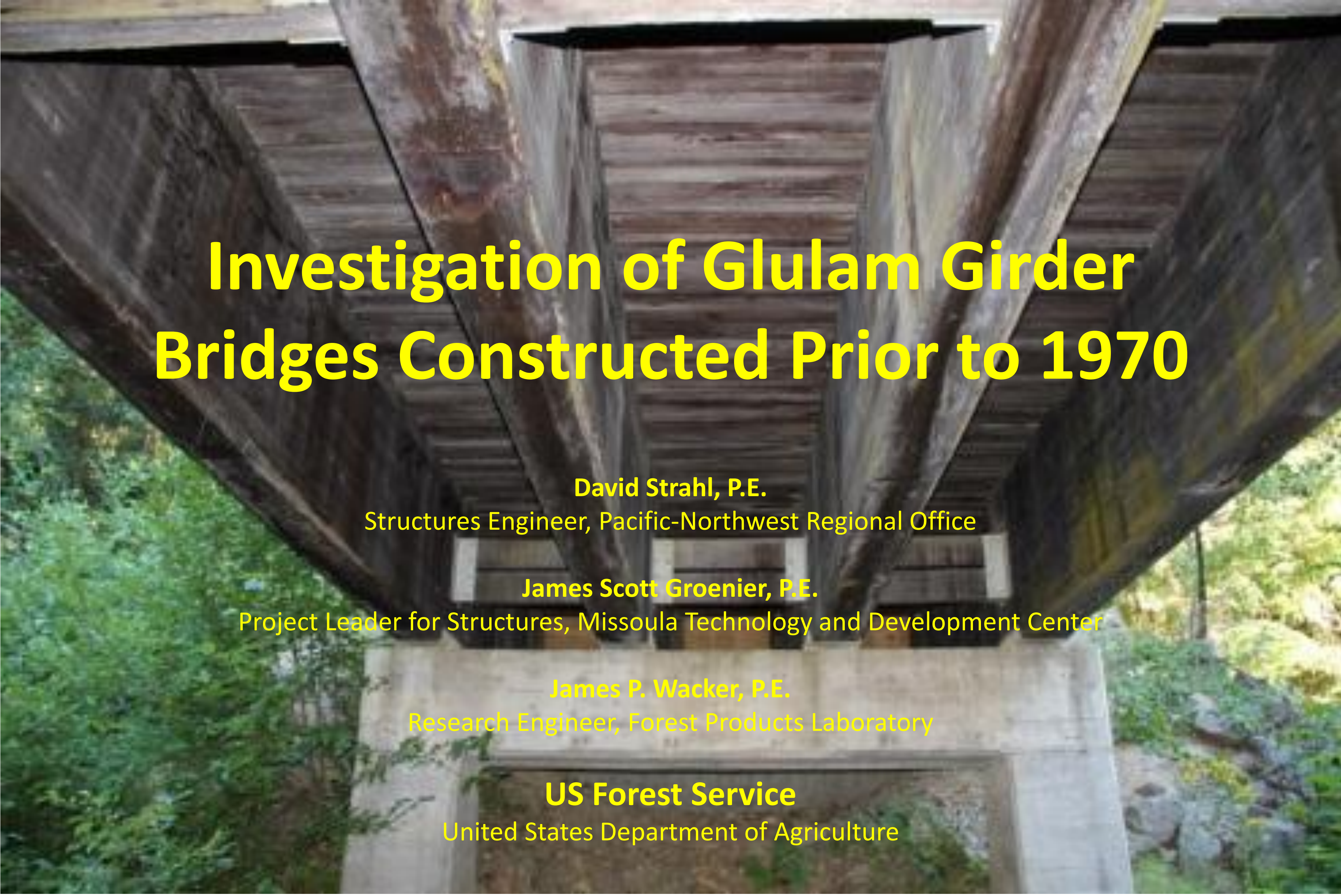

Investigation of Glulam Girder Bridges Constructed Prior to 1970

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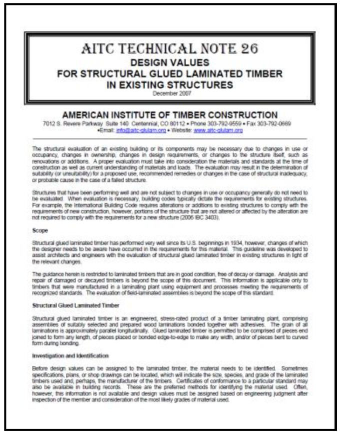
United States Department of Agriculture

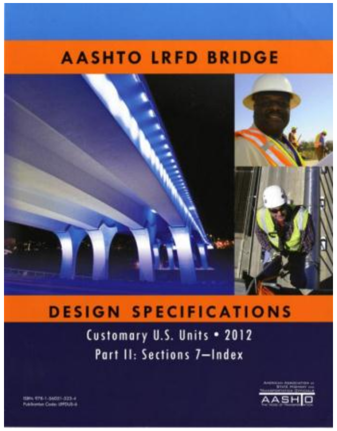
2nd International Conference on Timber Bridges (ICTB2013-Las Vegas)

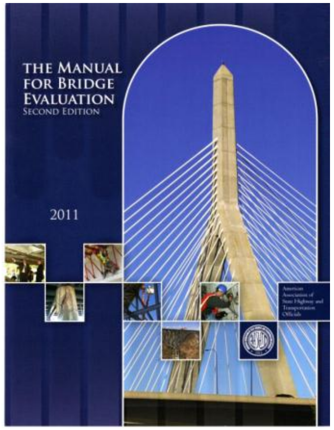
Problem

- **AITC Technical Note 26**
  - The laminating industry adopted the use of AITC special tension lamination grades in 1970. Without the use of these specially graded tension laminations, bending design values for modern structural glued laminated timber beams are required to be reduced by 15% for beams up to 15 inches deep and by 25% for beams deeper than 15 inches (ASTM D3737-05).
- **AASHTO LRFD Specifications** - <u>Reference Design Values</u>
  - In Table 8.4.1.2.3-1, the tabulated design values, Fbx, for bending about the x-x axis (Fbx), require the use of special tension laminations. If these special tension laminations are omitted, values shall be multiplied by 0.75 for members greater than or equal to 38 cm (15 in.) in depth or by 0.85 for members less than 38 cm in depth.
- **AASHTO Manual for Bridge Evaluation**
  - References National Design Specification for Wood Construction
- **Major Impacts**
  - Load restricted bridges, potential replacements, detours that delay critical fire suppression efforts


AITC TECHNICAL NOTE 26
DESIGN VALUES
FOR STRUCTURAL GLUED LAMINATED TIMBER
IN EXISTING STRUCTURES
December 2007

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION



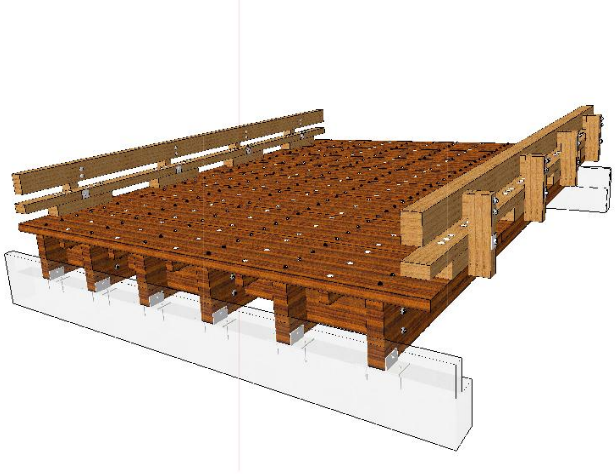


Older FS Glulam Girder Bridges

- Approximately 190 bridges located primarily in the Pacific-Northwestern states
- Scarf and butt joints used instead of finger-joints
- Many have balanced cantilevered end spans of 3m (10 ft.), 3-16-3
- Different decks (nailed, concrete, and glulam)
- Record of satisfactory bridge performance under heavy logging traffic for bridges built prior to 1970

Primary Objectives

- The overall goal is to help preserve these early glulam bridge structures:
  - Evaluate performance of several glulam bridges in the field
  - Evaluate strength of salvaged girders in the laboratory
  - Model the structural behavior of the girders
  - Develop a modified load rating rationale



Field Investigations - 2009

- Evaluated 3 bridges in southern Oregon
- Overall bridge inspection
  - Live load testing
  - Investigate tension zone laminations using NDE tools

Upper Williamson bridge

Elder Creek bridge

Dairy Creek bridge

Bridge Case Study 1

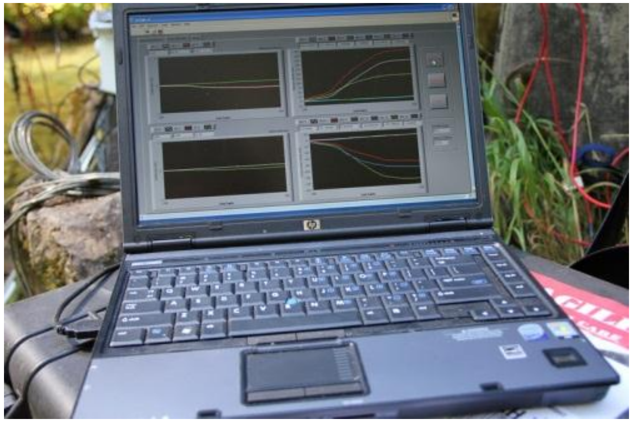
Elder Creek Bridge

- Bridge Inspection Process
  - Visual techniques, hammer sounding & moisture meter to identify areas to examine closely
  - Stress wave timing and resistance micro-drilling NDE tools to characterize internal condition of bridge members

Bridge Case Study 1

Elder Creek Bridge

- Live Load Testing



Bridge Case Study 1

Elder Creek Bridge

- Investigate tension zone laminations

Field Investigations - 2010

- Evaluated 3 bridges in southern Washington

Panther Creek bridge

Lost Creek No.2 bridge

Little Creek bridge

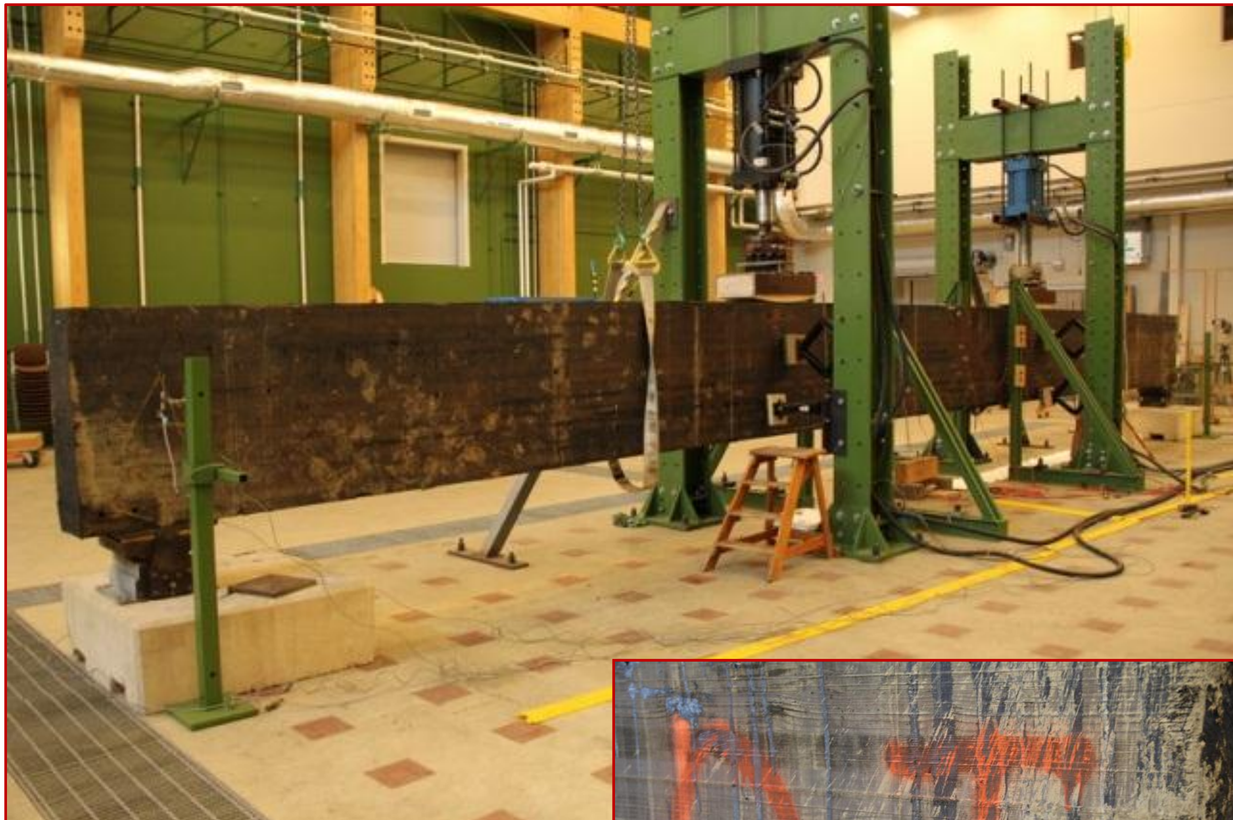
Field Investigations - 2010

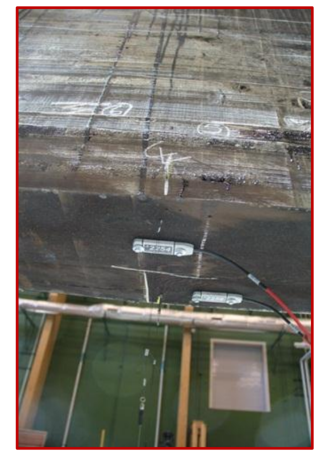
Jenny Creek Bridge - Alaska

- Built in 1965 in temperate rainforests of the Southeast Alaskan coast
- 4 interior beams were salvaged & transported to FPL
- Opportunity to generate data on residual strength pre-1970's glulam

Laboratory NDE Testing-2012

Laboratory Static Bending Tests





Laboratory Results

Date tested	Beam No.	Type	Modulus of Elasticity, **MPa** (10^6 lb/in^2)	Total Deflection, **cm** (in.)	Failure Load, **kN** (Kip)	Failure Stress, **MPa** (psi)
16 May	1	Post-1970	**12,342** (1.79)	**8.4** (3.30)	**632** (142)	23.6 (3430)
17 May	2	Pre-1970	**11,652** (1.69)	**10.0** (3.95)	**609** (137)	22.8 (3310)
17 May	3		**11,997** (1.74)	**9.4** (3.69)	**654** (147)	24.3 (3520)
18 May	4		**11,583** (1.68)	**9.1** (3.60)	**601** (135)	22.9 (3320)
20 June	5		**11,307** (1.64)	**11.6** (4.55)	**703** (158)	26.2 (3800)
22 June	6	Post-1970	**12,204** (1.77)	**9.3** (3.68)	**685** (154)	25.5 (3700)

Average MOE = 11,652 MPa (1.69 X 10^6 lb/in.^{2})

Average MOR = 645 kN (145 Kip)

Average Failure Stress = 24 MPa (3488 lb/in.^{2})

Failed Girder Specimens

General Load-Testing Procedures (MBE) A8.1-General

The steps required for load rating of bridges through load testing include the following:

Step 1. Inspection and theoretical load rating

Step 2. Development of load test program

Step 3. Planning and preparation for load test

Step 4. Execution of load test

Step 5. Evaluation of load test results

Step 6. Determination of final load rating

Step 7. Reporting

Summary

- *Field evaluations are completed* – many bridges remain in good condition and continue to safely carry design truck loads;
- *Laboratory testing completed* – ultimate strength of salvaged bridge girders significantly exceeded design levels;
- *Modeling structural behavior* – in progress, not finalized
- *Specialized load rating process for FS* – in progress

Acknowledgements

- **Partners:** Gifford Pinchot National Forest, Fremont-Winema National Forest.
- Galen Reed (Northwest University Student) and Dr. Hudong Xu (Northeast Forestry University-China), and Dr. Junguo Zhang (Beijing Forestry University-China).
- William Salsig (retired FS bridge engineer)
- Lola Hislop, Rogue River-Siskiyou NF

Questions?