TIMBER BRIDGE REPAIR DETAILS AND BEST PRACTICES

By

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OUTLINE

1. Bridge Statistics
2. Wood in bridge applications
3. Performance issues
4. Decay and Damage Observations
5. Repair Details and Best Practices
6. Recommendations
7. Q&A
Wood is a **NATURALLY Renewable Resource** and the strongest natural bio-polymer suitable for structural applications.
Wood Decay Hazard Map

American Wood Protection Association

- Developed for RR Ties
- Ground contact exposure
- In-ground stake studies
Timber Bridge National Statistics

- 473,580 total bridges listed in the Dec 2010 NBI database
  - 24,267 timber or concrete deck/timber stringer (LA count – 2068; second highest in the nation. 1,313 of these bridges are structurally deficient or functionally obsolete)
  - 24,492 timber deck/steel stringer (LA count – 62)
  - 450 timber deck/concrete or other stringer (LA count – 22)
  - 49,209 (~10.4%) utilize timber as a structural component in the superstructure. (LA count – 2,152)
- Substructure. material data not included in NBI currently.
Materials for Timber Bridges

- Logs
- Sawn lumber
- Glulam
- Structural composite lumber
- Round timber poles
- FRP-reinforced glulam
Timber Bridge Superstructures

- Girder System
- Longitudinal Deck
- Arch
- Truss
- Suspension
- Others
Girder Systems
Sawn lumber girders
w/ lumber plank deck
Longitudinal Decks
Glulam Arches

Longest clear span in the US!
Suspension Bridge
Key Performance Issues

- **Focus Areas**
  - Girders
  - Decks
  - Drainage details
  - Abutments
  - Pier supports
  - Wearing surface
  - Guardrails
  - Connections
Bridge Superstructure Decay Observations
Stringer decay at guard rail post anchorage location
Bridge 62-2, Pile Damage
Bridge 62-1

Cross section of original 12"x12" cap between pile D & E
xx-decayed area of cap
Location of a bridge cluster

All Louisiana bridges are in Zone 5

Bridge 08-4
Bridge 08-4
Stringer Decay at Support Location
Bridge 08-4
Potential Decay Locations in the Bridge Superstructure

Critical location for pile cap

Critical location for stringer
Crushing of girder at pile cap
Bridge Superstructure Repair Details
Jacking of deck to add or replace a stringer

Courtesy: Wheeler Lumber, LLC
Stringer wedge cut and beveled and slid into place

Courtesy: Wheeler Lumber, LLC
Cribbing to replace a decayed pile cap

Courtesy: Wheeler Lumber, LLC
Notching of stringers at Bent #2
CFRP Rod to Anchor Stringer to Pile Cap with Flashing
FRP Flashing on Stringers to Prevent Moisture Damage
FRP Flashing on Top of Girder Deflects Moisture away from Girder
FRP Flashing on Top of Piles, Pile Cap and Girders
Repaired Bridge Deck with FRP Wrapped Curb
Decking Boards & Railing Posts Sealed with Resin to Prevent End Grain Moisture Penetration
Bridge Substructure
Decay Observations
Bridge 62-2, Damaged Pile
Bridge 62-2, Pile Damage
Bridge 62-1, Decayed Pile
Bridge 62-1, Pile Damage
Bridge 62-2, Pile Damage
Bridge 08-4
Deterioration at bottom of pile
Bridge 08-4
Bridge 62-2, Pile Damage

Bent #4

Pile B 75% Loss and Crushing

12'

9'
Pile bent replacement
Part of pile alternating gets wet and dry

Dry part of pile

Decay comes from the bottom of the inside

At ground level: perfect conditions for bacteria which destroy the wood

At lower level: bad conditions for bacteria
DRILLING PILE USING THE MICRO-DRILL TO DETERMINE DECAY

1. Drill below 45° at ground level

2. Drill below 45° approx. 10 inches under the ground level
**Measurement result**
The graph profile recording.

The resistance against the drilling needle is measured and automatically recorded on the strip.

Due to the different mechanical resistance within a tree the graph profile represents the difference between early wood and late wood. The graph profiles shows finer and thicker lines.
Bridge Substructure Repair Details
Replacement of Deteriorated Pile Section
Reinforced Concrete Jacket
Bridge 62-2, Pile Damage

- Bent #4
- Pile C: 15% Loss
- Pile B: 75% Loss
Bridge 62-1, Pile Damage
FRP Wrapped Pile with FRP Flashing to Prevent Moisture Penetration through Top of Pileage
Carbon Rods used to attach Splice
Pile before and during FRP wrapping
OBSERVATIONS & RECOMMENDATIONS

• The absence of a durable vapour barrier between the wood deck and the asphalt overlay allows moisture to be trapped at the interface of the deck and the overlay and contribute to the decay and deterioration of the deck.

• Once the asphalt cracks -- which it does due to the flexibility of the timber deck -- moisture travels to the wood deck and gets trapped above the deck if there is no provision for the moisture to escape.

• It is critical that a flexible and reliable vapour barrier be placed between the timber deck and the asphalt or between two layers of asphalt to improve the service life of the deck.
• The use of a water shedding groove in the timber deck board is important to avoid trapping of moisture.

• Timber abutments/wing walls must be constructed with a durable vapour barrier between the boards and the soil material. Mechanisms – weep holes -- to drain moisture behind the wall must be in place.

• Inexpensive continuous flashing on timber stringers and pile caps will prevent moisture accumulation that can contribute to deterioration.

• End grain of pile caps, decking boards, guard rail posts must be sealed to inhibit decay.
• Timber pile deterioration in the wet-dry zone should be inhibited by one of the following methods:
  – External Treatment Paste applied at ground level
  – External Treatment Pre-made bandages with preservative
  – External Treatment Paper after treatment with external paste
  – Internal Fumigant Treatment
  – Boron rods
Questions?