

WA DOT, Oregon DOT, TSP2, USDA, USFS,
FHWA, Various ND Counties, MNDOT,
NDDOT, & KLI

Timber Bridge Repair & Rehab

2024 Local Roads Conference
Sioux Falls, SD

Bryon Fuchs
NDLTAP
bryon.fuchs@ndsu.edu
701-371-3483

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1

Bridge Repair/Rehab

- What is your intent with the repair or rehab?
 - Temporary or permanent?
 - Last another 2-yrs, 5-yrs, 20-yrs?
 - Improve overall condition?
 - Improve load carrying capacity?
 - Limp it along until replaced or as long as possible?
 - ??

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Bridge Repair/Rehab

- Things to consider
 - Cost
 - Time
 - Route
 - Traffic
 - Detour length
 - Equipment needed
 - CAPABILITIES & KNOWLEDGE OF THE FIX IT TEAM
 - DOES THIS OR WILL IT AFFECT THE LOAD RATING?

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Timber Bridge Repairs

- Need for Repair/Rehab
 - ROT
 - Overloads
 - Storm Damage
 - Normal wear/tear
- What does ROT Require?
 - Oxygen
 - Moisture
 - Favorable temperatures
 - Food Supply (wood)

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Timber Bridge Repairs

- Rot
 - Look near the ground line
 - Near the water line
 - Timber below the water should be protected as well



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Timber Bridge Repairs

- Rot
 - Overhangs and leaking Joints



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Timber Bridge Repairs

- When to perform repairs?
 - Rot
 - Depends on Member
 - Piles may be OK with 2-3" shell
 - Compressive load only
 - Flexural – not OK (ice or debris impacts)
 - Caps and/or beams may be more critical sooner
 - Check with load raters
 - Crack/Split/Crushing
 - Mostly caused by loading, but rot affects crushing from the load
 - Should trigger repair, shoring, or restricting the bridge


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Timber Bridge Repairs

- To Rot or not to Rot
 - Bridges members are usually treated with pressure treating preservatives
 - Treatments penetrate the outer shell through incising
 - Preservatives protect against rot and insect damage
- How to find Rot
 - Hammer Sounding
 - Strike members with a 3-lb hammer, listen for a dull or hollow sound – indicates a void behind wood



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Timber Bridge Repairs

- How to find Rot
 - Drilling
 - 3/8" x 18" ship augers
 - Watch material coming out of the hole
 - Rotted or wet material won't advance the auger
 - May look like mud at times
 - Plug the holes
 - Sterilize the bit before the next hole

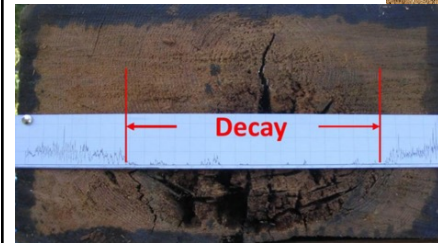


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Timber Bridge Repairs

- How to find Rot
 - Resistograph
 - Look for flat lining



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Timber Bridge Repairs

- You found Rot or perhaps you think you have some issues?
- Preservative(s)
 - Fumigation
 - Produces a gas – can move vertically and horizontally
 - Helpful for treating Fir and Cedar
 - Protects the heartwood
 - Requires certification for use



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Timber Bridge Repairs

- Preservative(s)
 - Borate
 - Solid form (Rods)
 - Paste
 - Powder
 - Used in log homes, RR's, and Utility Companies
 - Activates at 25% moisture (fungus starts at this)
 - Effective against insects and fungus
 - Follow recommendations on spacing and sizing
 - Check regulatory requirements



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Timber Bridge Repairs

- Protecting Wood from Moisture
 - Install flashing to keep the moisture off end grain
 - Maintain bridge joints and keep water of caps
 - Install water proofing on deck to prevent leakage



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Timber Bridge Repairs

- Other Common Problems
 - Cracks/Splits
 - Crushing



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Timber Cap Repairs



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Timber Cap Repairs

- Encapsulate with Steel
- Remove and replace



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Cap Replacement

- Replace Cap in kind
 - Lower cost
 - Difficult to obtain permit for creosote
 - New timber not as good as old growth
 - Requires traffic control and temporary road closures
 - May or will require a crane or a piece of equipment to lift cap in place
- Replace with a steel beam
 - Longer lasting
 - More difficult to match existing size
 - Costs more than in kind
 - Requires traffic control and temporary road closures

Replace with treated timber. Note 14 inch wide roof flashing to keep water out




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Timber Cap Repairs

- Lift Superstructure off cap
 - Methods
 - Build temporary bents under bridge to jack up bridge
 - Doesn't work well over water
 - Difficult on slopes
 - Difficult on high bridges
 - Time consuming
 - Minimum traffic impact
 - Jacking blocks chained to Piles
 - Jacking blocks clamped to Piles




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Timber Cap Repairs

- Encapsulate with Steel
 - Replacement of cap is difficult
 - Utilities
 - Other items?



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Timber Cap Repairs

- Encapsulate with Steel
 - Cutting off pile to install splice
 - Steel pile cap



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Timber Cap Repairs

- Encapsulate with Steel
 - Installing channel shims to connect steel cap to pile splice



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Timber Cap Repair

- Steel cladding
 - Longer last repair
 - More expansive than in kind
 - No crane needed
 - Can be made in different weight modulars



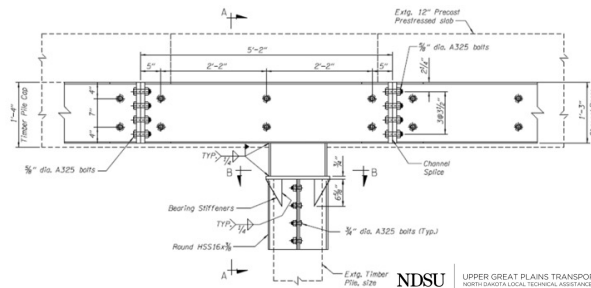
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Timber Cap Repair

- Steel Cladding – Fixed connection to piles



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Timber Cap Repairs

- Timber cap replacements – how to
 - Pile Clamps – used by Oregon and Washington DOT crews, and local agencies
 - Bridge is typically left open to traffic
 - Clamps can be round or square



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Timber Cap Repairs

- Replacing Cap with Pile Clamps



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Timber Cap Repairs

- [Replacing Cap with Pile Clamps](#)



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Timber Cap Repairs

- Jacking from the Ground



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Timber Cap Repairs

- Timber cap replacements
 - Steel H Beam of similar size
 - Requires shoring of the old structure while old is replaced with new



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Timber Beam Replacement

- Replacement in kind
 - Pros
 - Same material, thickness, etc. – load carrying capacity should be equal
 - With wooden deck – can be nailed
 - Usually can be managed with people or smaller equipment
 - Cons
 - Deck in-place
 - No room to work
 - Usually have to notch, etc. to get beam in-place
 - Can decrease load carrying capacity due to this
 - Basically beam is not full size

29

Timber Beam Replacement

- Replacement in kind
 - Cons
 - Remove Deck
 - A lot of extra work
 - Leave nail holes when replacing members for water to enter
 - Partial Deck removal
 - Extra work – but may allow you to use a full beam shape

30

Timber Beams

- Beams (Rot, crack, split): Jump Stringers
 - Install new beam next to cracked beam
 - Bigger isn't always better
 - Want capacity, but not too stiff to damage the deck



31

Timber Beams

- Beams - Jump Stringers
 - Shimming and diaphragm modifications may be required
 - Can be difficult to fit



32

Timber Beam Repair

- Splicing & Scabbing

Original member
Splice pieces
Top view
Defect in original member
Side view
A. Splicing
Existing member
Scab piece of timber or steel
Top view
Bolts or lag screws
Scab piece attached over the majority of the existing member to increase capacity.
Side view
B. Scabbing

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Timber Beams

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Timber Beam Repairs

- Beam Repair (crack) Stitching

Diagonal Beam Crack
Center Plate
Crack length
Min. Length of Fish Plate = 1/2 span length or 3 x length of crack, centered over bottom face of a diagonal crack.
Install 3/4" x 18" hex head galv. Lag screws
Minimum Stringer Width = 6"
all drill holes are 7/8" dia.
4 1/2" typical 1" w/4 w/4

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Timber Beam Repairs

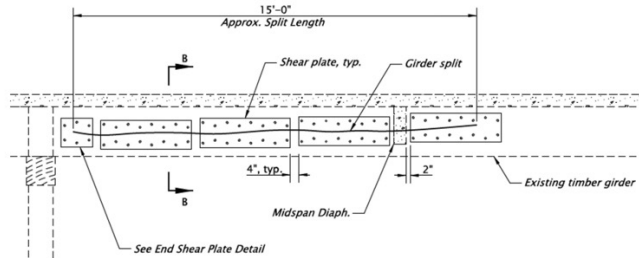
- Beam Repair (crack): Stitching

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Timber Beam Repairs

- Beam Repair (Split): Fish Plating



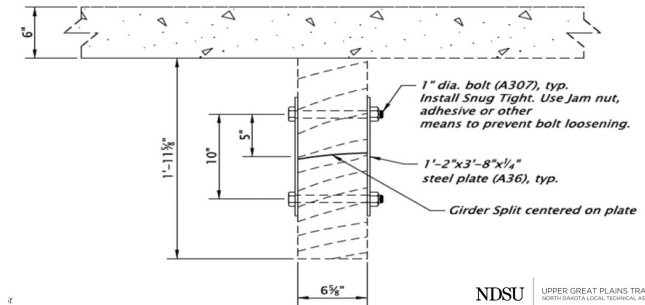
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Timber Beam Repairs

- Beam Repair (Split): Fish Plating



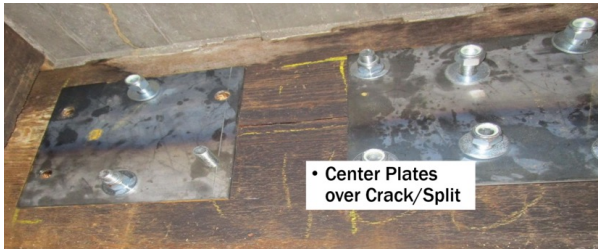
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Timber Beam Repairs

- Beam Repair (Split): Fish Plating



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Timber Pile Repairs

- How much rot is too much to repair?
 - Compression
 - Testing showed no issue with a concrete filled section with 2" shell remaining past the splice
 - Flexural
 - Testing showed an issue, only the 2" shell basically is there for strength




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Timber Pile Repairs

- Pile Repairs
 - Helper Piles
 - Useful in water or when shoring isn't feasible
 - May not get enough load capacity out of one helper, may require 2
 - Inspectors/rater may still rate the rotten pile if not removed



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Timber Pile Repairs

- Helper Piles
 - Custom Jacking sleeve



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Timber Pile Repairs

- Helper Piles



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Timber Pile Repairs

- Push, Block, & Repeat



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Timber Pile Repairs



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Timber Pile Repairs

- Pile Repair – Banding
 - Failing piles tend to mushroom out
 - Steel sleeves can be used sometimes



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Timber Pile Repairs

- Pile Repairs - Encapsulate



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Timber Pile Repairs



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48

Timber Pile Repairs



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50

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Timber Pile Repairs



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Timber Pile Repairs

- Pile Splicing

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Timber Pile Repairs

- Drawbacks
 - Difficult to install in tight spaces
 - Steel cage difficult to stage

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Timber Pile Repairs

- Newer Pile Repair method
 - Limits Excavation depths by reducing splice length & allowing splices at locations with 2" shells
 - Replaces concrete splice with steel casing
 - Preloading done by hydraulic jack for pile dead load control
 - Design was destructively tested by OSU

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Timber Pile Repairs

- Install shoring

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Timber Pile Repairs

- Excavate down a few feet below ground at least 2 feet



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Timber Pile Repairs

- Cut section of rotten pile
- Remove remaining rotten core
- Install some borate rods or other preservatives



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Timber Pile Repairs

- Fill cavity with high early strength concrete
- Also around and in between the remaining pile and steel casing
- Weld cover plate in place
- Use vent holes in plate to finish your pour after plate is welded in place



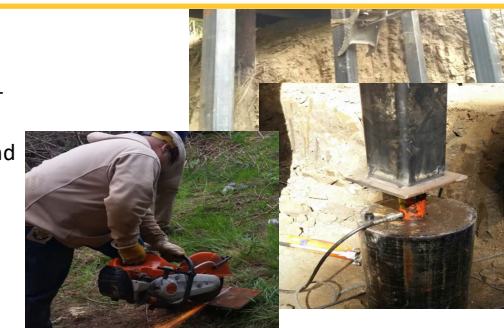
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Timber Pile Repairs

- Position steel pile
- Preload with a 20-ton hydraulic jack
- Cut shims to fit and weld in place



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Timber Pile Repairs

- Complete the splice



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Timber Pile Repairs

- Back fill to existing ground level
- Riprap for slope protection and scour

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Timber Pile Repairs

- Above ground splice
 - Same as below “Dumbbell repair”
 - Need to find all good wood when doing above ground splice
 - Slope the grout on the top part of the can so it drains water away



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Timber Pile Repair



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Pile repair (splice)

- Square pile on a scissor truss bridge



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Replace pile with Steel

- Round steel
- Dig into the ground, used a sonno-tube as a form for concrete
- Jacking box on top of steel pile to restore bearing once concrete has strength



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Timber Bridge Rehab



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67

Timber Bridge Rehab



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68

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Timber Bridge Rehab



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Timber Bridge Rehab

- Other Superstructure Options Besides Steel
 - Glulam Beams
 - Concrete beams
 - New Timber stringers, but maybe more of them
- Deck Options
 - New planks
 - Glulam Deck

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Resources

- [TSP2](#)
- [TSP2 Pocket Guides](#)
- [Concrete Bridge Deck Preservation Resource Guide](#)
- [USFS Timber Bridge Manual](#)
- [Guide for in-place Treatment of wood in historic covered and modern bridges. \(USDA\)](#)

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73