

Oregon Highway Bridge Maintenance A Pilot Training Course /Workshop

Timber Preventative Maintenance

Jeff Swanstrom, P.E.

1



Timber Bridge Members

- The age of wood spans human history.
- Wood was probably the first material used by humans to construct a bridge
- Timber's strength, light weight properties desirable for bridge construction
- Timber is capable of supporting short-term overloads without adverse effects
- Timber bridges can be constructed in virtually any weather conditions
- Wood is not damaged by freezing & thawing and harmful effects of de-icing agents.
- Timber bridges are easily constructed and they look good in natural surroundings

Timber Bridge Members

With all of the positives and good properties of wood:

- Timber structures can not be installed and then simply walk away, hoping that all will be well
- Poor design, poor construction and poor management practices can be major factors in the degradation of a timber structure
- life of a timber bridge, deterioration can be minimized:
 - By proper inspection
 - Timely maintenance

BURNT RIVER (LIME)
BR# 01788 HWY 449 MP 0.46
BENT 4 7/27/11
IM01788_A5.jpg

What Defects to Look For in Timber

- Decay (interior and surface)
- Bug infestation
- Crushing of wood
- Cracks, splits, checks, and shakes
- Loose connections
- Loose wood members
- Cupping, curling of planks
- Fire damage



What Causes Decay?



Causes of Decay in Timber Bridge Members

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**The Following Four Conditions Are
Necessary For Decay Spores
To Germinate:**

- A Sufficient Supply of Oxygen
- A Favorable Temperature Range
- An Adequate Food Supply
- Available Water

TIMBER BRIDGE INSPECTION TECHNIQUES

By: Daniel G. Stromberg and William W. Salsig

Causes of Decay in Timber Bridge Members

Fungi



Causes of Decay in Timber Bridge Members

Insect Activity



Causes of Decay in Timber Bridge Members

Soil Conditions

Perched Water Table



Causes of Decay in Timber Bridge Members

Soil Conditions

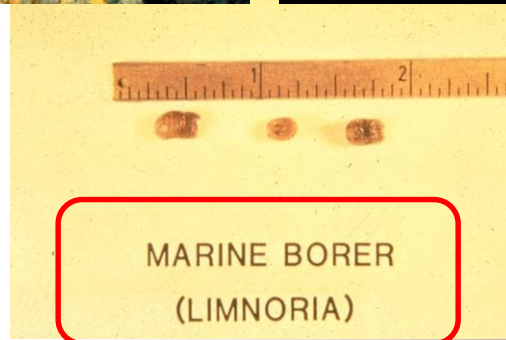
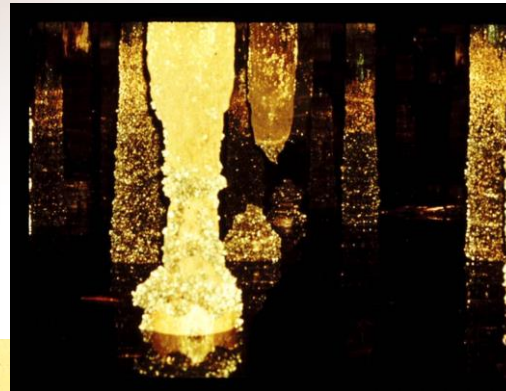
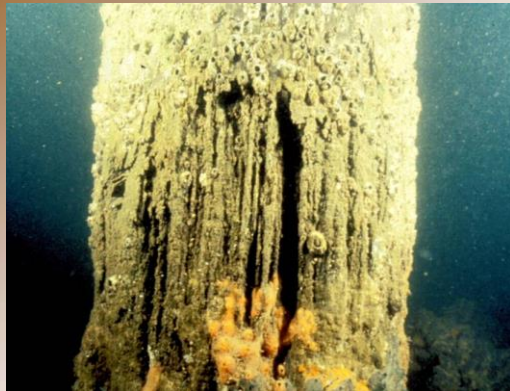
Granular or Impermeable Soil



Causes of Decay in Timber Bridge Members

Marine Borers (gribble or ship worm)

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Where to Find Decay in Timber Bridge Members

Wearing Surface

Check for “alligator” cracking, potholes, or panholes



Where to Find Decay in Timber Bridge Members

Drain holes



Where to Find Decay in Timber Bridge Members

Substructure

Check under Leaking Joints



Where to Find Decay in Timber Bridge Members

Substructure

Check areas in Inter-Tidal Zone



Where to Find Decay in Timber Bridge Members

Substructure

Check bracing areas and drift pin area



Where to Find Decay in Timber Bridge Members

Substructure

Check Timber Piling at/Below Ground Line



Where to Find Decay in Timber Bridge Members

SUBSTRUCTURE

Check for bulging in members



Where to Find Decay in Timber Bridge Members

Substructure

Check bearing areas



Where to Find Decay in Timber Bridge Members

- ❑ Contrary to popular belief, large wood Members provide good Fire resistance
- ❑ Fire damage generally only burns the surface of the timber
- ❑ If Fire burns through the treatment, this can set up conditions for decay



Where to Find Decay in Timber Bridge Members

Substructure

Check members with checks, splits, and cracks



Where to Find Decay in Timber Bridge Members

Definition: Checks, Splits, and Cracks

Commentary & Definitions

Check - Lengthwise separation of the wood fibers that generally follows the grain of wood (occurs only on one side of the member). Checks are generally caused by differential shrinkage within the member.



Split - Lengthwise separation of the wood fibers from one surface to the opposite or adjacent surface. Can be called a "through" check.



Crack - a crack is generally load related. It propagates from the tension face, can cross the wood grain, and occurs full width of the member, reducing capacity.



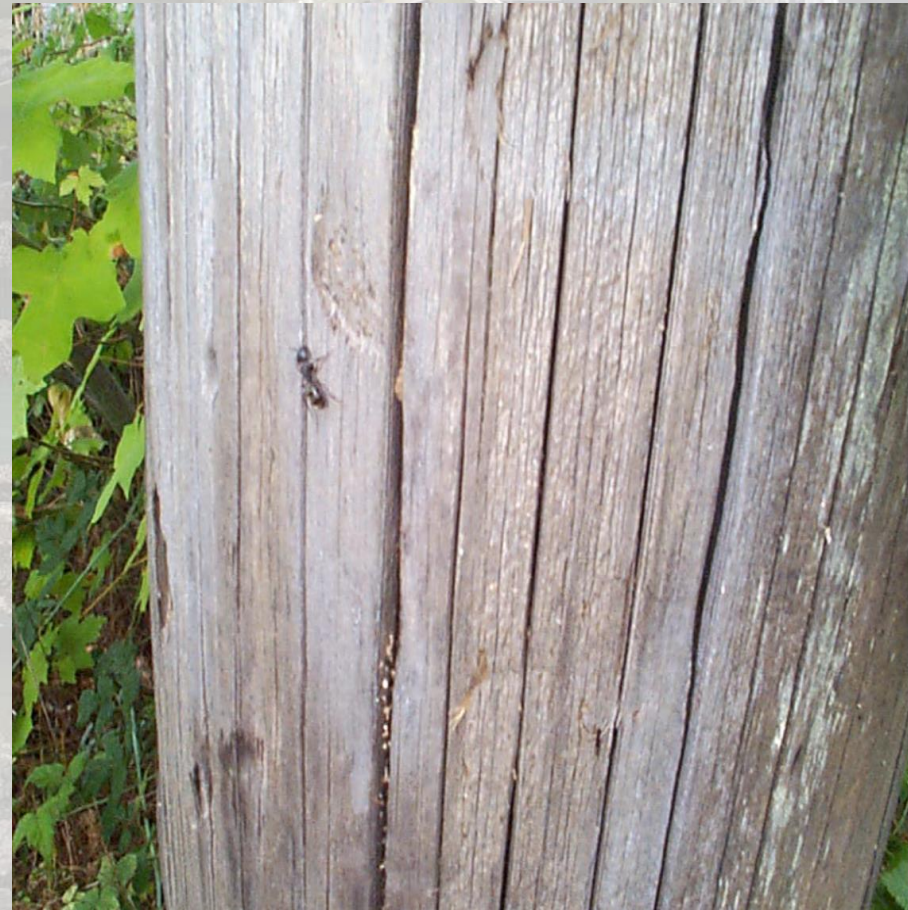
Where to Find Decay in Timber Bridge Members

Checks



Where to Find Decay in Timber Bridge Members

Splits



Where to Find Decay in Timber Bridge Members

Cracks



How to Detect Decay in Timber Bridge Members

- Timber inspection is a learned process that requires some knowledge of wood properties and technology.

Methods for Detecting Exterior Deterioration

- 1.) Visual Inspection:
 - Fruiting bodies
 - Sunken faces
 - Bulging faces
 - Staining or discoloration
 - Insect activity
 - Plant or moss growth



How to Detect Decay in Timber Bridge Members

Methods for Detecting Exterior Deterioration cont.

2) Probing

3) Pick Test

Methods for Detecting Interior Deterioration

1) Sounding



sounding the wood surface by striking it with a 3lb hammer or other object and based on the tonal quality of the sounds, a trained inspector can interpret dull or hollow sounds that may indicate the presence of large interior voids or decay.

How to Detect Decay in Timber Bridge Members

Methods for Detecting Interior Deterioration cont.

2) Drilling and Coring

To ensure that bridge inspectors are not spreading decay fungi, throughout a structure, while boring, drill bits should be sterilized after every hole is drilled.

How to Detect Decay in Timber Bridge Members

Timber Boring



How to Detect Decay in Timber Bridge Members

Suggested Equipment:

- 1/2" Electric Drill (w/reverse)
- Gas Powered Drill (optional)
- Increment Borer (optional)
- 3/8" x 12" ship augers and 3/8" x 18" ship augers (1/2" bits optional)
- 25% Chlorine-Water or Boric Acid Solution in Squirt Bottle
- Cleaning Rags
- Treated or hardwood plugs (1/8" larger than bit size)
- Generator, Hammers, Keel
- Extension Ladder, Measuring Tapes, Ropes
- 3-wire Extension Cords, Bit File, Shovel
- Paper and Pencils, Clipboard, Straight Edge
- Harness, Lanyard, Goggles

How to Detect Decay in Timber Bridge Members

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How to Detect Decay in Timber Bridge Members

- Boring Procedure:
- Sterilize drill bit with disinfectant before drilling each hole (25% chlorine or boric acid solution)
- Get base reading: measure the exposed bit in the drill chuck
- Drill and record findings on face of timber in consecutive order
- In some instances, another boring may be useful to get both a horizontal And vertical dimension of a rotten member
- Plug the drill hole with a treated wooden plug.
- Reasons why a bit will not feed:
 - Decay
 - Drilling with grain of wood
 - Season checks and splits

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How to Detect Decay in Timber Bridge Members

Other devices for detecting decay (Resistograph F400-S)

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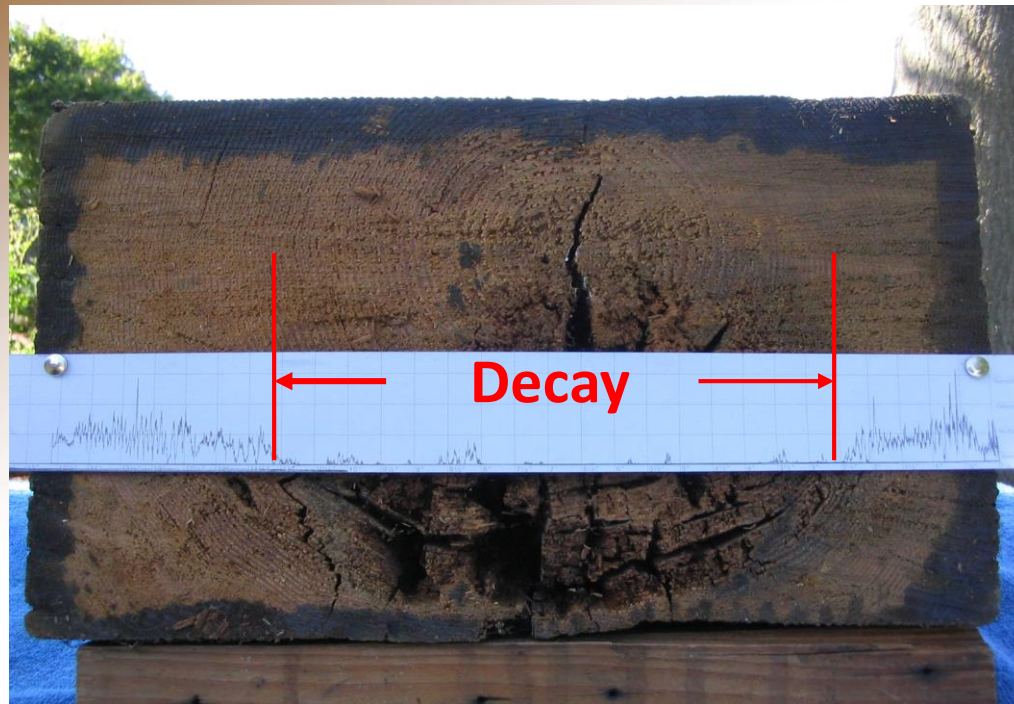


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Other devices for detecting decay

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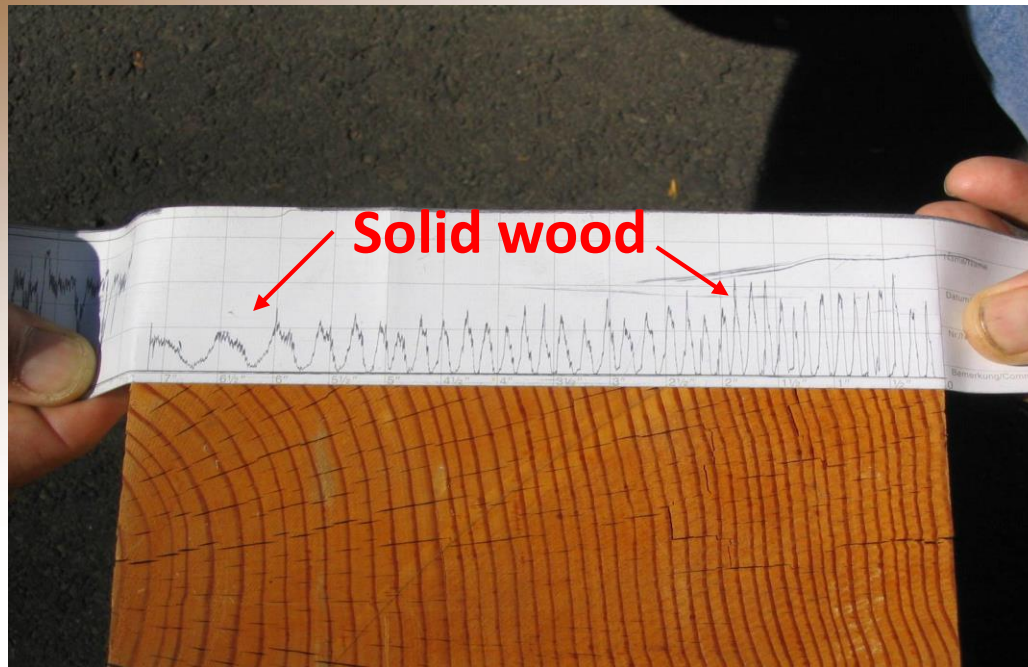
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How to Detect Decay in Timber Bridge Members

Resistograph in Action



How to Detect Decay in Timber Bridge Members

Other devices for detecting decay (Resistograph MD 300)



How to Detect Decay in Timber Bridge Members

- Important for Owner/Agency personnel to understand timber inspection procedures
 - Check inspectors work to verify results or in case member is missed
 - Ability to perform cursory inspections for monitoring timber members
 - Help understand condition of timber bridge inventory

Pre-Construction Protection Methods of Timber

- Pre-treated with preservatives to protect against:
 - Moisture penetration
 - Fungus development
 - Pest infestation



Post-Construction Timber Deck Protection Methods

- Overlays
- Water repellents
- Paints

Timber Deck Protection

Methods: Overlays

- Overlays:
 - Asphalt
 - Protect against moisture penetration and abrasion
- “Runners” applied along wheel lines:
 - Protect the wood from abrasion and decay
 - Distribute wheel loads



Timber Deck Protection

Methods: Water Repellents

- Economical and simple method
- Used to lower the absorbed water content of timber deck members
 - Requires frequent application
- Inhibits fungal and insect growth

Timber Deck Protection Methods: Paints

- Complete cover and regular reapplication
- Paint systems will generally begin to crack and allow moisture into the wood
- Paint on roadway surface quickly worn away by traffic
- In areas where snow and ice collect paint deterioration can also occur quickly



Preventive Maintenance

- Washing and cleaning
- Moisture control
- In-place preservation treatment
- Sealing



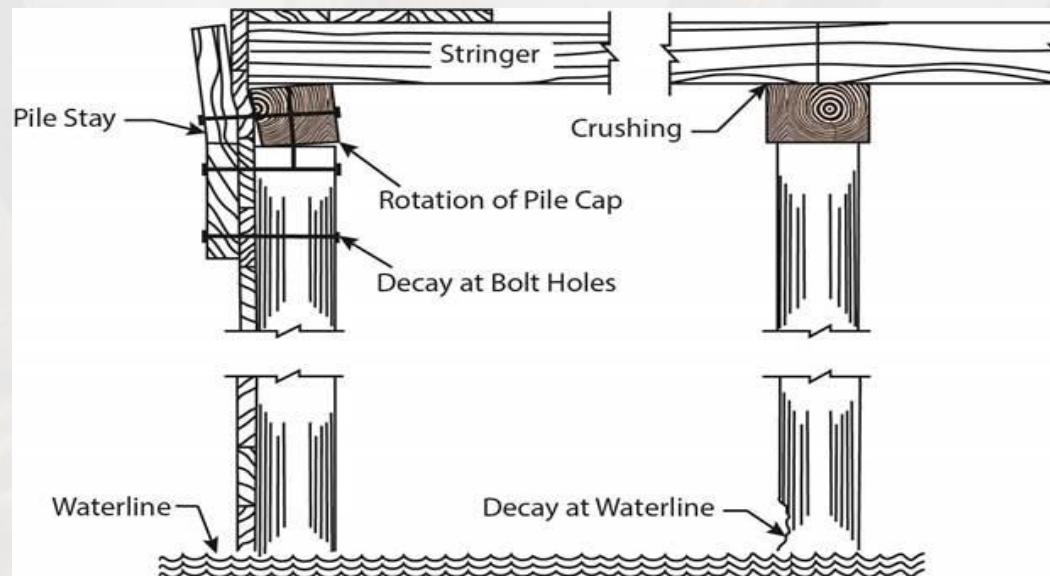
Preventive Maintenance

- Cleaning debris and vegetation growth and covering exposed wood



Preventive Maintenance Techniques

- Cleaning
- Moisture control
- Preservative treatments



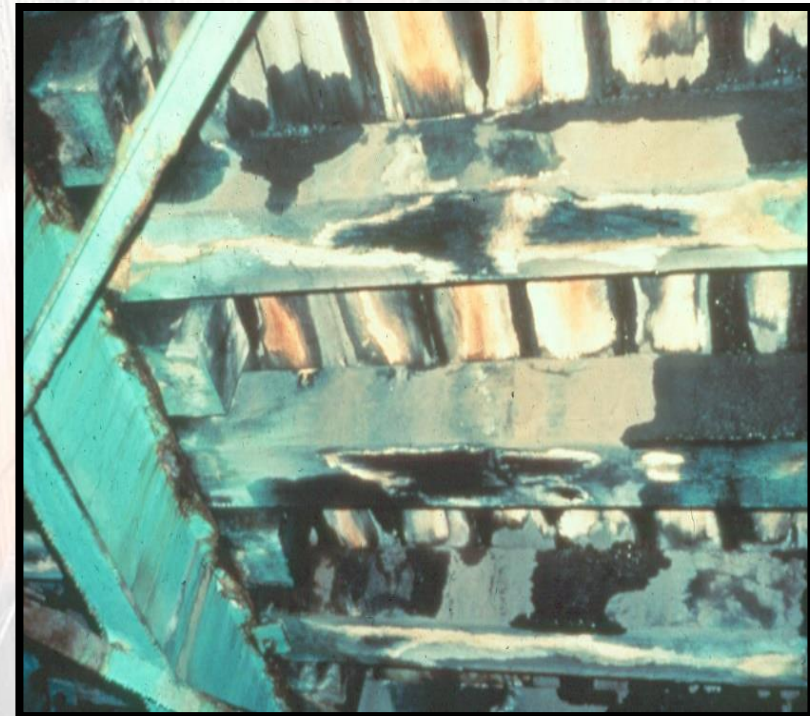
Preventive Maintenance Techniques (cont)

- Preservative treatments
 - Surface treatments
 - Pressure treatments
 - In-place treatments

In-place Preservative Treatment

Surface treatments

- Protect against fungi growth and decay
 - Brown rot fungi
 - White rot fungi
 - Soft rot fungi
- Reduce the effect of weathering,
- drying out, and surface rotting
- Applied by brushing or spraying
 - Preferable to apply to dry wood
 - Oil-based copper naphthenate
 - Boron



Preservative Treatments

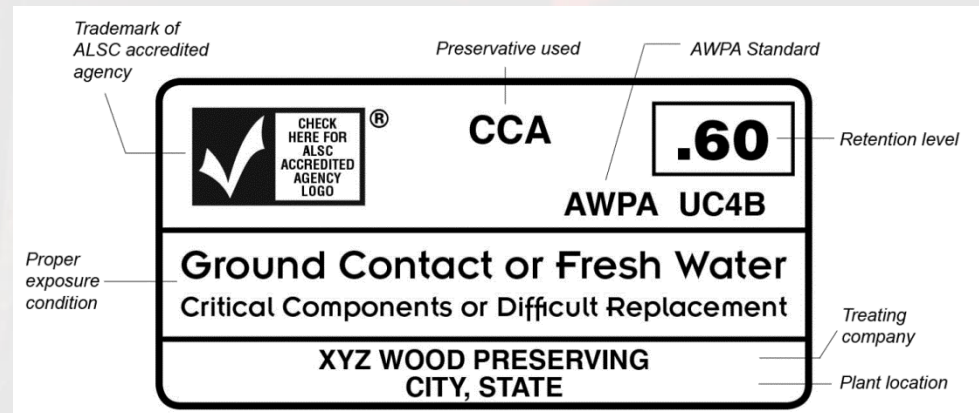
Surface treatments

- Non-pressure methods
- Applied to newly exposed, untreated wood
 - Liquid
 - Powder
 - Solid
- Applied before decay begins

Preservative Treatments

Pressure treatments

- Completed at the plant
- Three classes:
 - Waterborne
 - Oil-type
 - Creosote



Preservative Treatments

In-place treatments

- Surface treatments
- Internal treatments



Pile Preservation

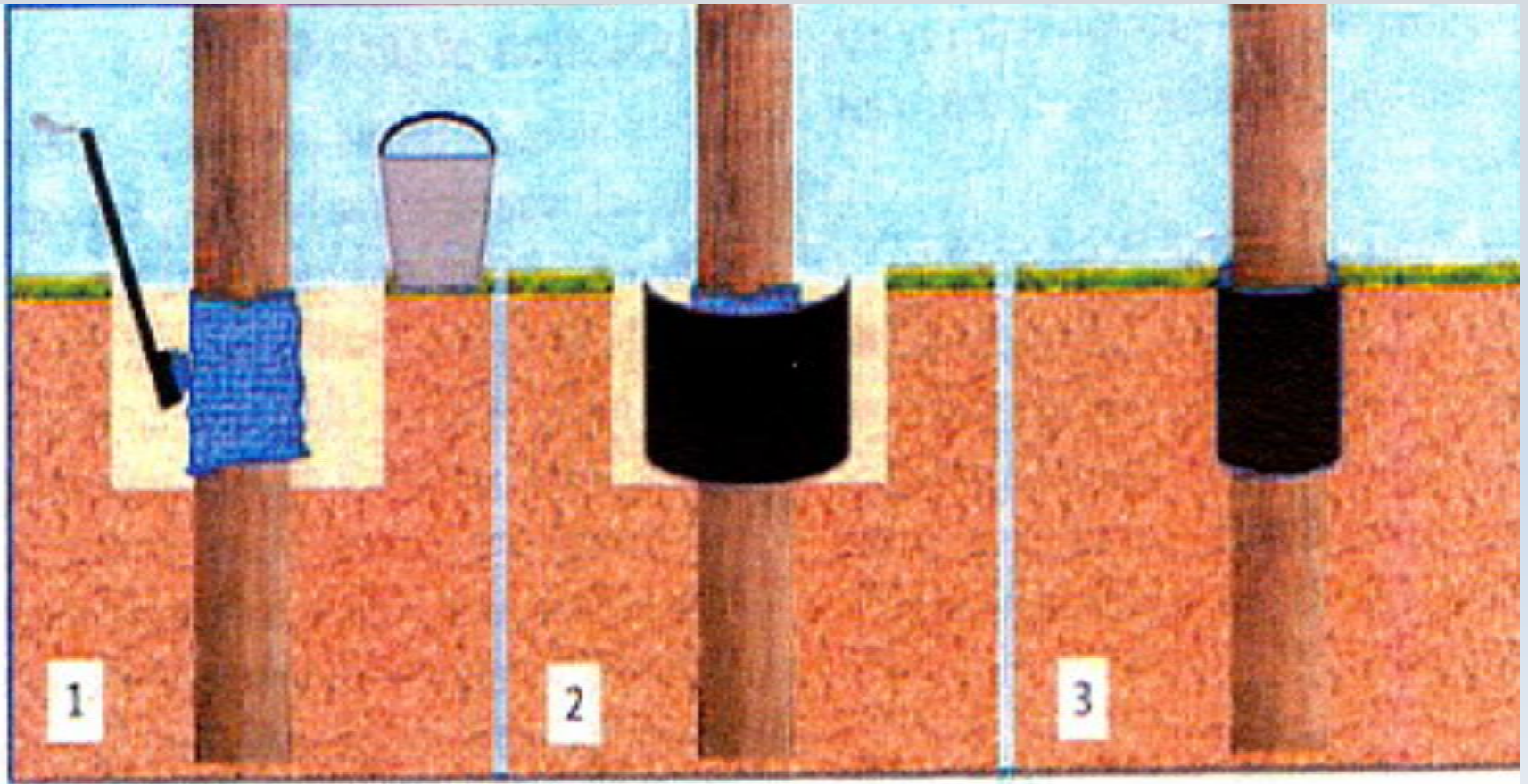


Figure 45. Steps in application of an external groundline wrap treatment.



United States
Department of
Agriculture
Forest Service

In cooperation
with the
United States
Department of
Transportation

Forest
Products
Laboratory

Federal
Highway
Administration

General
Technical
Report
FPL-GTR-205



Guide for In-Place Treatment of Wood in Historic Covered and Modern Bridges

Stan Lebow
Grant Kirker
Robert White
Terry Amburgey
H. Michael Barnes
Michael Sanders
Jeff Morrell

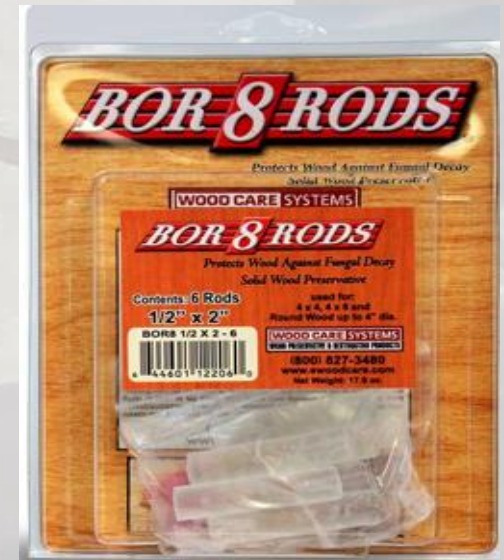


Prevention

- Borate Rods
- Fumigation

Use of borate rods

- Low cost means to prevent rot by killing the fungus that causes the rot.
- In use by the log home industry, railroads, utility companies
- Activated at 25% moisture content same as when fungus activates.
- Kills wood destroying insects
- Can act as a Fire retardant
- Protection lasts about ten years.
- Available at paint stores.



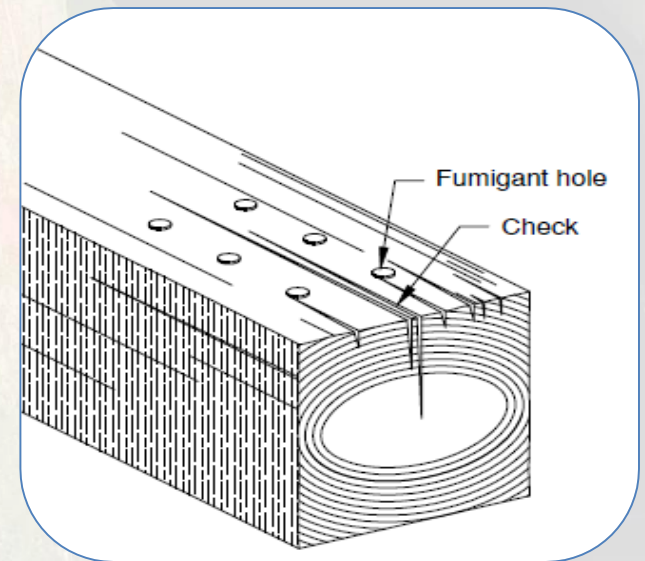
In-place Treatment: Borate

Internal treatments

- Products applied through drilled holes
- Liquid treatment
 - Liquids diffuse via wood moisture

Solid fumigants

- Holes on both sides of treatment area
- Borate rods
- 10-year treatment cycle



Use of borate rods

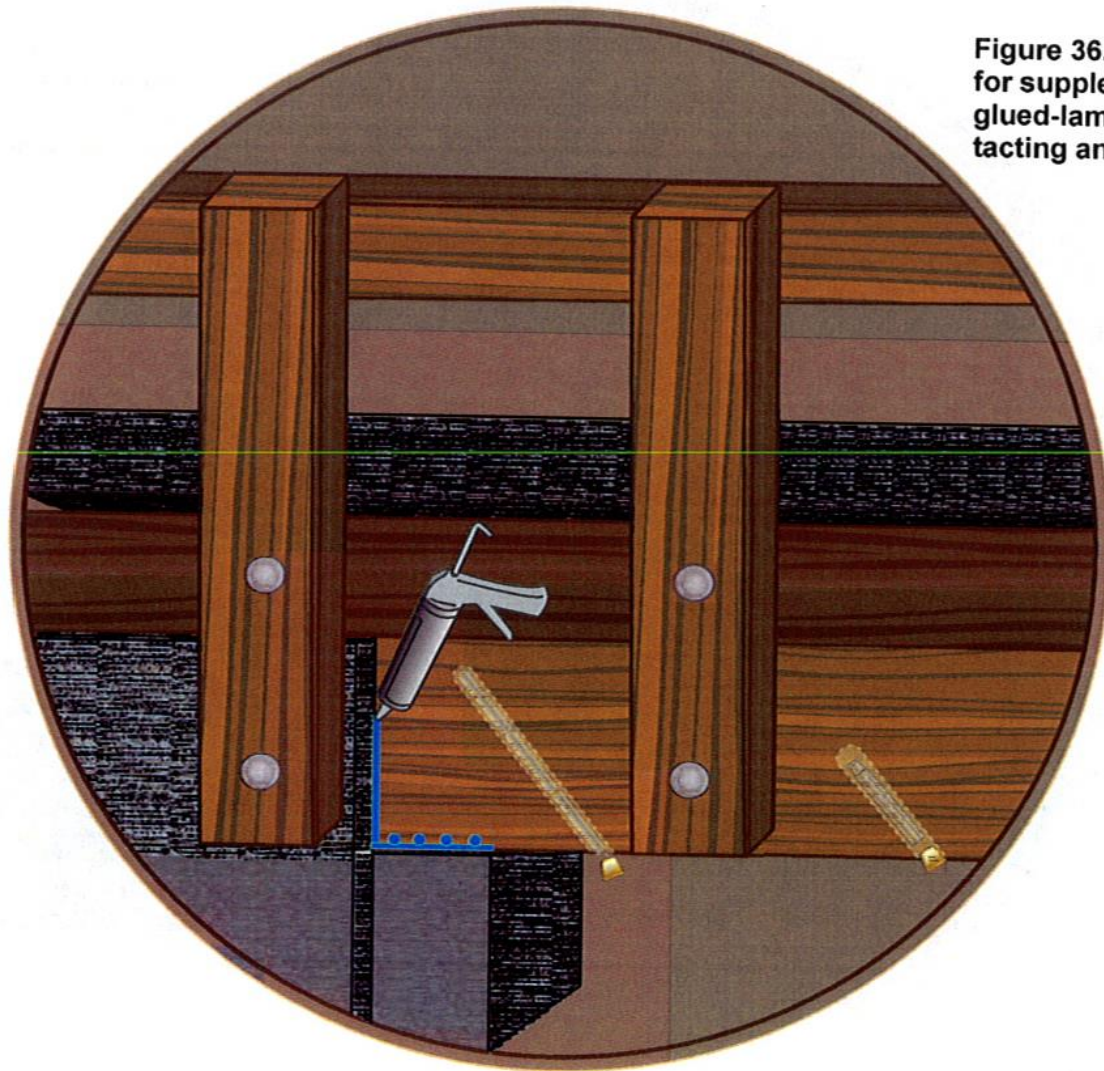


Figure 36. Example approach for supplemental treatment of glued-laminated beam contacting an abutment.

Use of borate rods

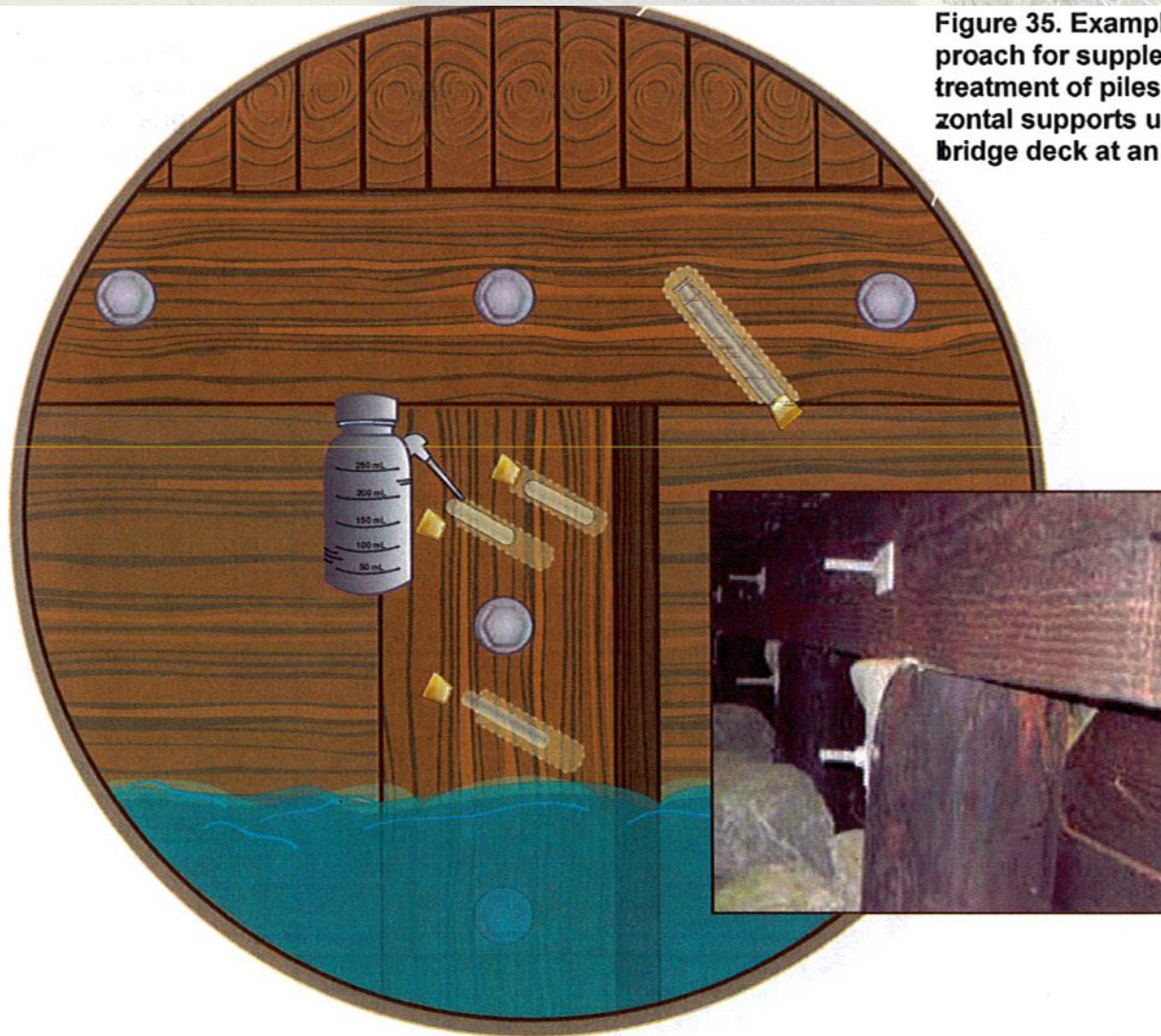


Figure 35. Example approach for supplemental treatment of piles and horizontal supports under the bridge deck at an abutment.

Drilling the holes



Inserting the rods



When to Use of borate rods



Tracking the Usage

Bridge number	Repair Date	Bridge Name	Repair Number	Borate installed
105/110	4/30/2013	1. O'Leary Creek	S13127	N Abutment Cap
101/140	5/28/2013	W Fork Hoquiam River	S13530	S Abutment cap
165/13	6/4/2013	Gulch # 1	S10002	Cap over pile 6D
101/254	6/6/2013	Little Quilcene	S12407	Pile 1F
108/106	5/23/2013	Skookum Creek	S12583	Cap pier 4
109/9	10/10/2013	Gillis Slough	S12798	Pile 1F
109/25	10/10/2013	Wreck Creek	S12426	Pile 1C

Fumigation



Fumigation



Fumigation



Fumigation



Fumigation



Fumigation



Fumigation



Fumigation



NATIONAL WOOD TREATING CO.

P.O. Box 1946 • Corvallis, Oregon 97339 • (503) 754-0552

PILING AND TIMBER INSPECTION AND ON-SITE TREATMENT SUMMARY

Page 1/1

Client: Marion County

Facility: Gallon House Covered Bridge

Inspectors: Zach Silbermeyer & Dylan Howard

Date: 8/20/15

Type of project: Inspection ☒ On-Site Treatment MTC
Capping _____ General Survey _____
Estimate _____ Other _____

Description of facility: _____

Number of piling: Bearing _____ Fender _____
Marina _____ Bulkhead _____
Other _____

Number and dimensions of timbers: _____

Contact person/address/phone no.: _____

Steve Chambers
Marion Co.
503-588-5036

Serviceable members with decay:

Piling	Timbers
	Cap #1

Rejected members:

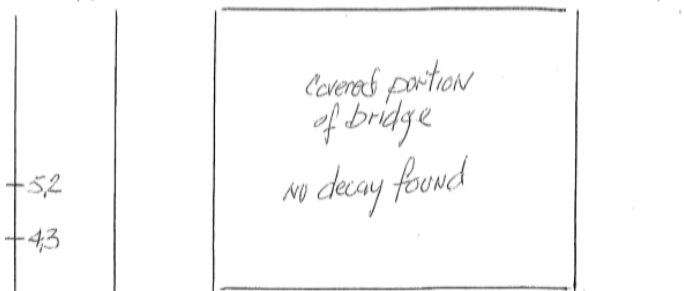
Reinforceable	Wrappable	Recommended Replacement		
		Normal	Accelerated	Emergency

Sketch and Numbering System of Facility:



North approach

South approach



Note: The location of decay in wooden caps (lines) and piling (circles) is represented above. The first of the pair of numbers is shell depth, the second is the width of the decay pocket.

Fumigation



Fumigation

Covered Bridges



Fumigation

Covered Bridges



Fumigation

Covered Bridges



Client: Linn County Road Department

Facility: Short Covered Bridge

Inspectors: Jon Crumpton and Alex Walker

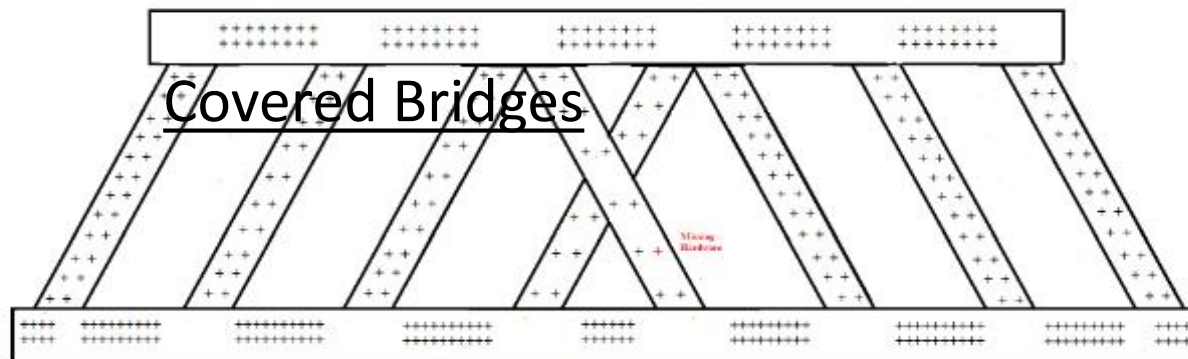
Date: 8/13/18 - 8/20/18

Sketch and Numbering System of Facility: No Internal Decay Found
Minor Buprestid Beetles Present Throughout Bridge
Loose Hardware Noted Throughout Bridge

No Scale
N ←

No Scale
↓
N

Covered Bridges



+ + +

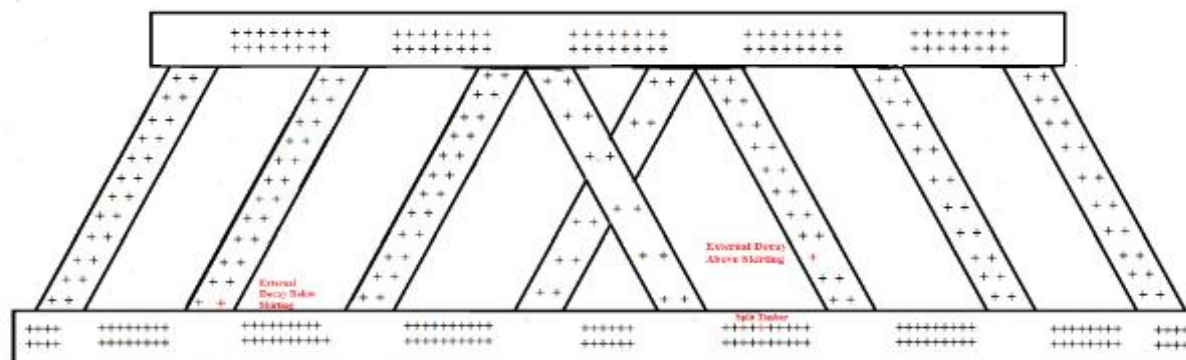
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Note: The location of decay in wooden caps (lines) and piling (circles) is represented above. The first of the pair of numbers is shell depth, the second is the width of the decay pocket.

Fumigation

Timber Bridge Fumigation Treatment Spec

- Treatment Materials
 - Wood Fumigant
 - Insecticide
 - Re-plugs
 - Re-plugs: Wood
- Re-Treating Previously Treated Structures
- Drilling Treatment Holes
 - New or Previously Untreated Piles
 - Pile with Decay Pockets
 - New or Previously Treated Pile Caps

Fumigation (cont)

- Fumigant Treatment
- Internal Insecticide Treatment
- Drilling Treatment Holes
- Plugging treatment and inspection holes
- Tagging and Marking in the Field
- Recording and Reporting Inspection and Treatment Results

A photograph of a wooden pier or walkway extending over a body of water. The pier has a metal railing and blue pipes running along its length. The structure is supported by wooden pilings. To the right, there is a rocky shoreline with some vegetation and a small building in the background. The sky is overcast.

QUESTIONS?