Bridge Durability and Preservative Issues

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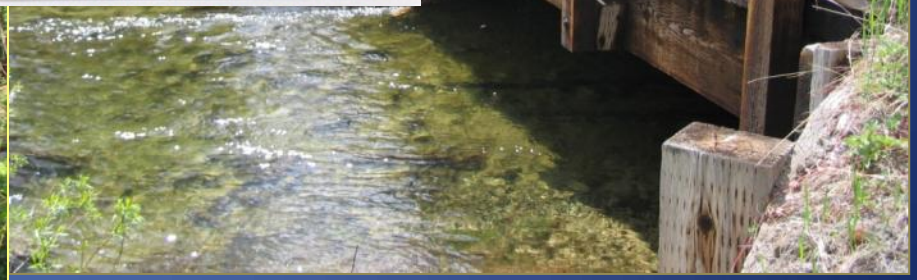
SmallWood 2010

April 20-22

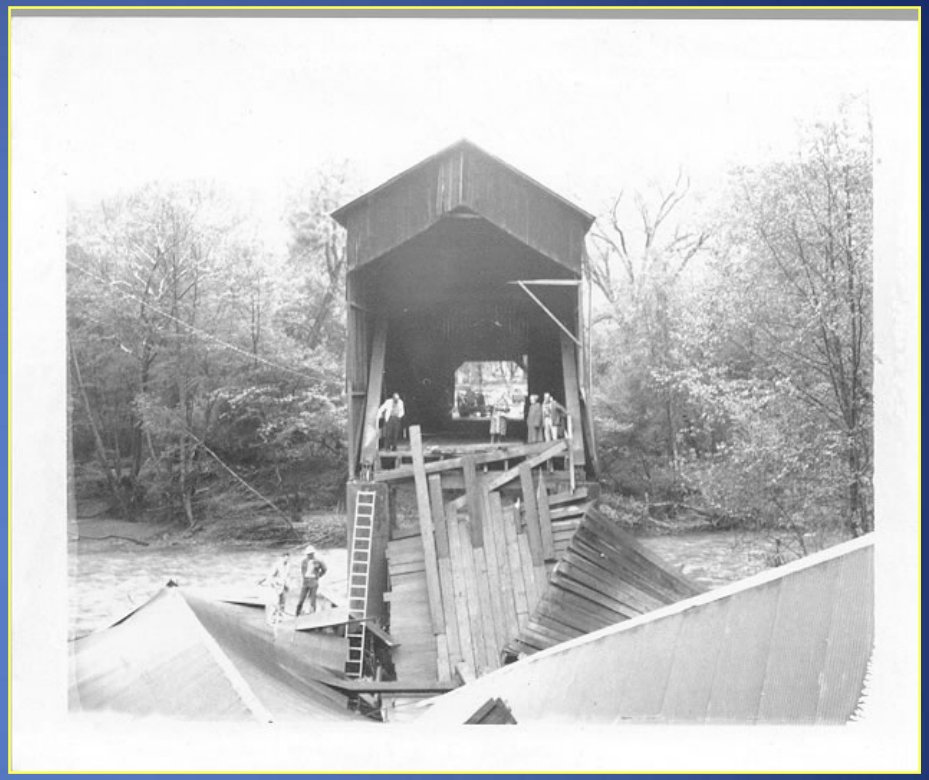
Hot Springs, AR

Timber bridges can provide superior performance for many years with proper maintenance



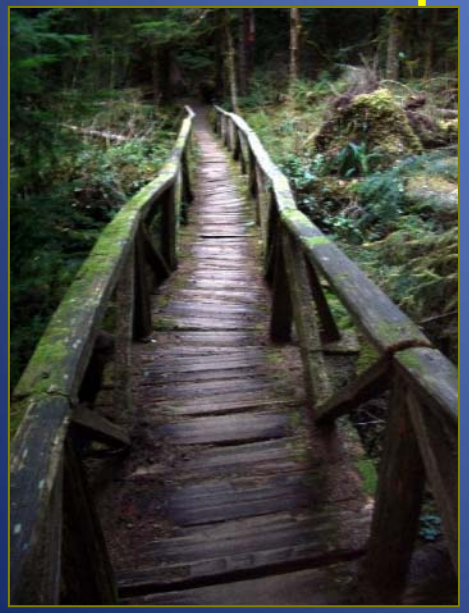
Modern engineered timber bridges

Periodic inspections assure long service life



Problems:

- Improper installation
- Lack of inspection



- Lack of maintenance
- Lack of in-place treatment
- Improper retrofit techniques

Causes of deterioration

- Chemical
- Physical
- Biological

Chemical Deterioration

- Acidic wood
- Salt water
- Non-galvanized fasteners
- Salt water + certain water based preservatives

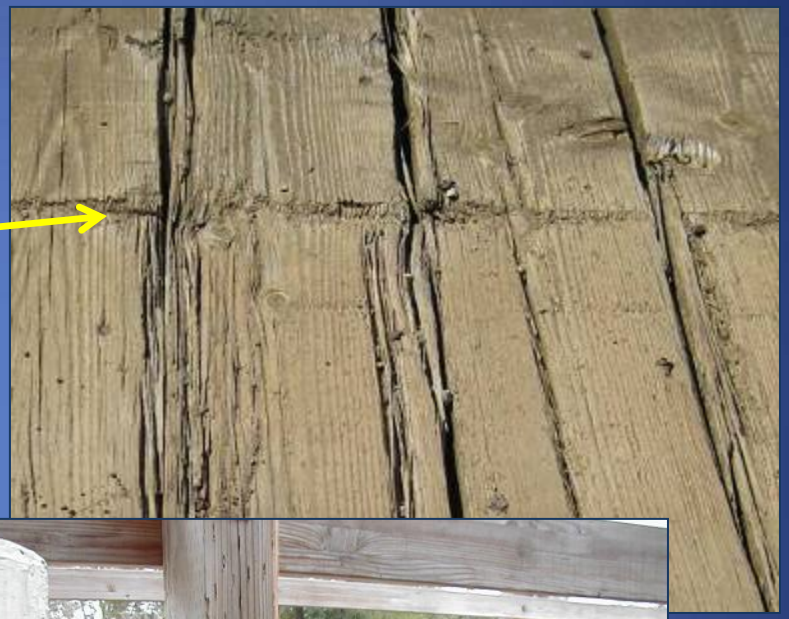
Salt damage causes a “fuzzy” appearance

Bridge fastener damage following exposure to water-based preservative

Physical deterioration

- Salt
- Vehicular damage
- Spillage of fertilizer

  Causes degradation to wood and corrosion to fasteners
- Fire
- Overload
- Animal damage



Biological degradation

Fungal

- -Brown rot (#1)
- -White rot
- -Soft rot
- -Mold and sapstain

Insects

- -Termites (#2)
- -Carpenter ants
- -Powder post beetles

Marine borers

- -Mollusks
- -Crustaceans

Types of fungal decay

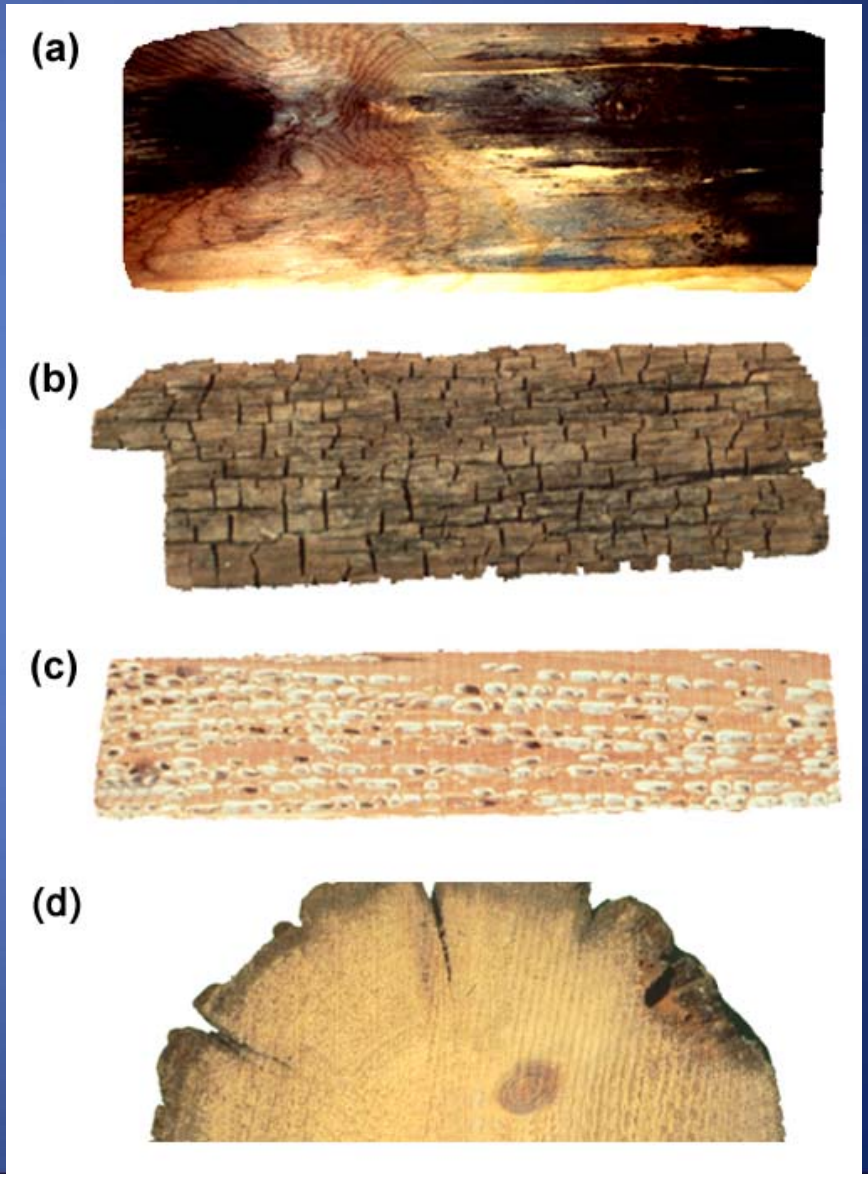
- Mold and sapstain

  -no strength loss
- Brown rot decay

  -rapid strength loss
- White-rot decay

  -gradual strength loss
- Soft rot decay

  -slow progression inward



Two main types of decay

White-rot

- Prefers hardwoods
- Gradual strength loss
- Wood becomes bleached and spongy
- Normally retain shape and size

Brown-rot

- Prefers softwoods, but not fussy eaters
- Rapid strength loss
- Wood becomes dark brown and crumbles
- Wood eventually collapses
- Can survive for years in dry wood and then reactivate when wet

Brown rot Decay fungi

- Decrease strength
- Darkens wood
- Requires
  -food, water, temp.
- Starts where end grain (cross-section) is exposed to weather (pile tops cut on-site)

Termites

- Most common insect problem
- Can severely damage support or structural members
- Especially problematic
  - In soil contact
  - Near bridge abutments

Corrective actions

Marine borers

Mollusks

- Small entrance holes below water surface
- Remain unnoticed until piling failure
- Create shell-lined galleries
- Bore into wood for protection not food
- Intolerant of creosote
- May cause significant strength loss

Crustaceans

- Attack wood surface near waterline
- Result in decrease
  in pile diameter
- Move from pile to pile
- Creosote tolerant

Control options for marine borers

General protection

- Plastic barriers around piles
- Steel/metal sleeves around piles
- Concrete barriers

Specific protection

- Creosote treatment for mollusk control
- Dual treatment for crustacean control
  (ACZA or CCA plus creosote)

Problems occur when

- Pile tops are cut on site
- Components are notched
- Components are drilled for fasteners

Inspect on regular intervals

- Inspect: 5 -10 yr rotation
- Piles
- Joints
- Ground contact areas (retaining walls, posts, piles)
- Deck
- Fasteners

Critical areas for inspection and remedial treatment

- Joints
- Fasteners
- Checks
- Splits
- Pile tops
- Pile groundline
- Pile waterline

Inspection methods

- Visual assessment
- Probing/pick test
- Moisture measurement
- Sounding
- Drill resistance
- Core boring

Supplemental (in-place) Treatments

Chemical barrier

- **Diffusible**
  - **Borates or fluorides (pastes, liquids, rods)**
  - **Can penetrate 100% of the wood member**
- **Non-diffusible**
  - **“Envelope” treatments**
  - **Topical protective barrier**
  - **Normally oil-based (creosote) = water repellent**
- **Fumigants**
  - **Liquid or gas → drilled holes**

Physical barrier

Properties and uses of in-place preservatives

In-place Preservative Type	Active Ingredient	Solvent Type	Internal vs. External	Leeching or Diffusing	Bridge Location	Handling & other
Surface treatment liquid	Copper naphthenate	Oil	External sprayed or brushed	Insoluble in water	Bolt holes, exposed end grain, checks & splits	Non-RUP
Surface treatment liquid or powder	Borate solutions	Water	External sprayed or brushed	Leech away by precipitation	Bolt holes, exposed end grain, checks & splits	Non-RUP
Surface treatment paste	CuNap, sodium fluoride, Cu-Hydrooxide, borates	Water	External & covered with wrap	Boron & fluoride move into wood, Copper stays at surface	Ground line area of terrestrial piles & under pile caps	Non-RUP
Diffusible Chemical Liquid	Boron, fluoride, copper	Water	Internal through drilled holes	Needs moisture to diffuse into wood	Pile & deep timbers w/ drill accessibility	Non-RUP, Low toxicity & ease of handling
Fumigant liquid	Chloropicrin	NA	Internal through drilled holes	Volatizes into gas & move into wood	Pile & deep timbers w/ drill accessibility	RUP
Fumigant Solid	Solid-melt MITC	NA	Internal through drilled holes	Volatizes into gas & move into wood	Pile & deep timbers w/ drill accessibility	RUP
Fumigant liquid	Methan Sodium (Vapam)	NA	Internal through drilled holes	Volatizes into gas & move into wood	Pile & deep timbers w/ drill accessibility	RUP
Fumigant Solid	Granular Dazomet	NA	Internal through drilled holes	Volatizes into gas & move into wood	Pile & deep timbers w/ drill accessibility	RUP

Methods of applying in-place treatments

- Brush
- Spray
- Pastes/Gels
- Rods
- Pads/Bandages
- Liquids

Where to apply in-place treatments

- Joints
- Fasteners
- Checks, voids, splits (normal weathering)
- Structural members at joints
- Exposed ends
- Areas in ground contact
- Decking
- Piling

Pressure treatment

- Penetrates
- Performed prior to delivery to the site
- All end grain surfaces are treated

AWPA Use Category System

- UC1-Interior, above ground dry
- UC2-Interior, above ground, damp
- **UC3-Exterior, above ground**
- **UC4-Ground contact or fresh water**
- **UC5-Salt water exposure**

AWPA Use Category and Commodity Specifications

Bridge Element	Commodity	Use	Exposure	Use Category	Commodity Specification (U1)	
					Section	Special Reqs
Piling	Piles, round	Highway construction	Ground contact or fresh water	4C	E	-
Backwall	Lumber & timbers	Highway construction	Ground contact or fresh water	4B	A	4.3
Cap beam	Lumber & timbers	Highway construction	Ground contact or fresh water	4B	A	4.3
Stringer	Lumber & timbers	Highway construction	Ground contact or fresh water	4B	A	4.3
Decking	Decking	Highway bridge structural	Above ground	4B	A	4.3
Glue-laminated beams and panels	Glue-laminated beams	Highway important structural	Ground contact or fresh water	4B	F	-
Glue-laminated beams and panels	Glue-laminated beams	Highway critical structural	Ground contact or fresh water	4C	F	-
Handrails & guardrails	Handrails & guardrails	Highway construction	Above ground, exterior	3B	A	4.3
Guide, Sign, & Site Post	Post round	Highway construction including guide, sign and sight	Ground contact or fresh water	4A	B	-
Guardrail post & spacer block	Post round	Highway construction including guardrail posts, spacer blocks	Ground contact or fresh water, moderate decay	4B	B	-
Guardrail post & sign post	Post (sawn 4 sides)	Highway construction, general	Ground contact or fresh water	4A	A	4.3

Thank you!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