SMOLEN ENGINEERING

21st Century Covered Bridge Design

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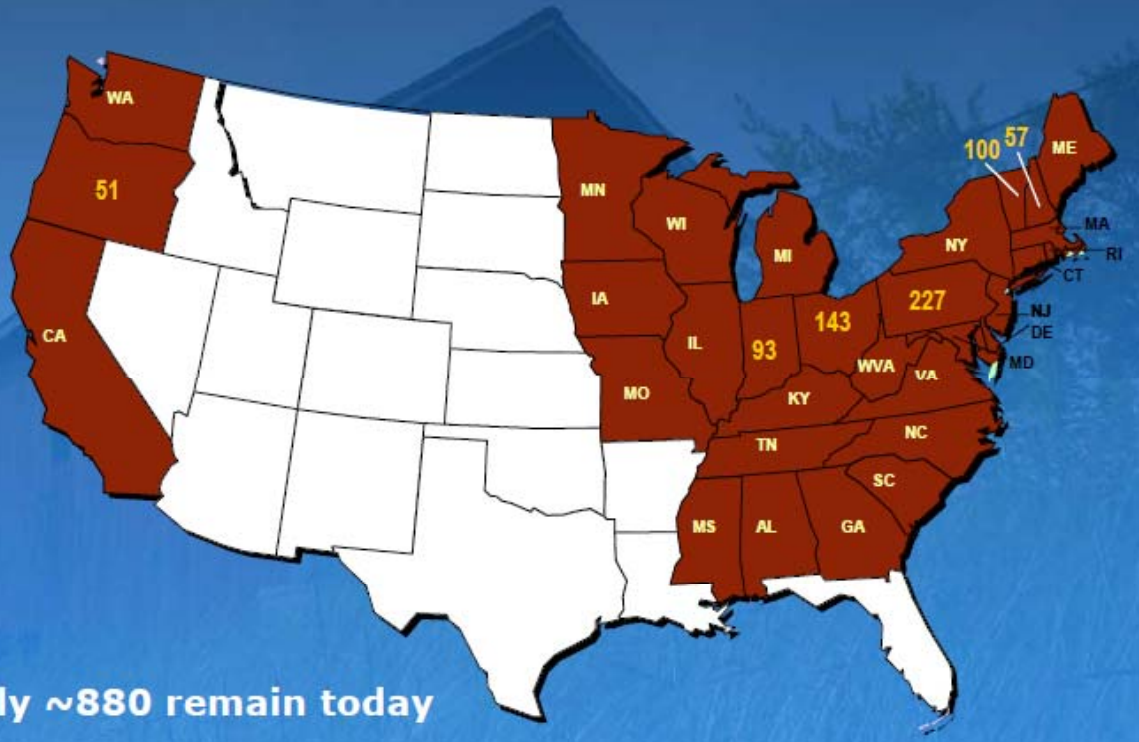
Presentation Overview

- Background on Covered Bridges
    - •Current Covered Bridge Numbers
    - •Truss Types
- Advantages of Covered Timber Bridges
- New Construction- Old verses Modern
    - •Truss Loadings & Stresses
    - •Timber Treatments
    - •Glue Lamination
    - •Galvanization
    - •Smolen Gulf Covered Bridge Construction
    - •Liberty Street Covered Bridge
    - •Miscellaneous Covered Bridge Examples

National Historic Covered Bridge Program

U.S. Department of Transportation
Federal Highway Administration

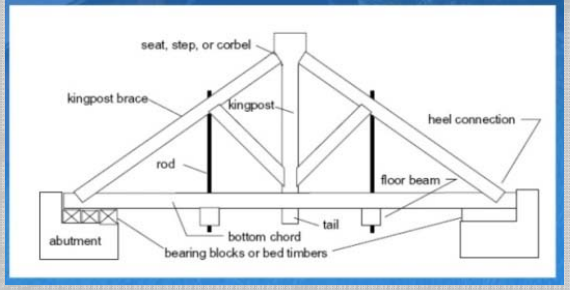
Covered Bridge Numbers



- Only ~880 remain today
- Majority are in 6 states
- Pennsylvania has 227

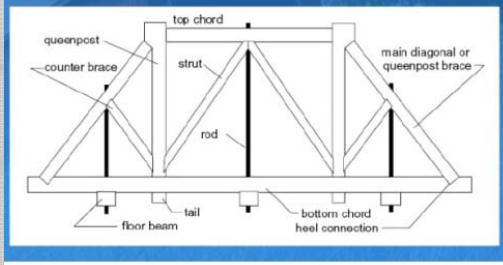
Kingpost Truss

- Clear span: 7 – 21 meters
- 30 surviving structures



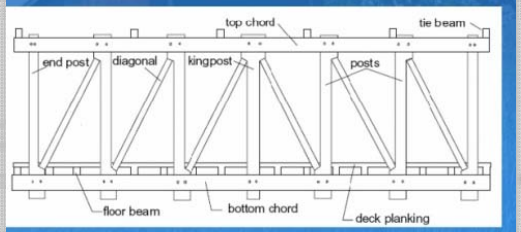
Queenpost Truss

- Clear span: 8 – 40 meters
- 101 surviving structures



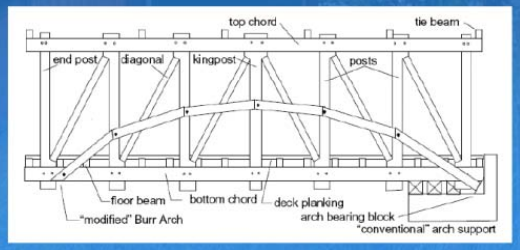
Multiple Kingpost Truss

- Clear span: 11 – 38 meters
- 95 surviving structures



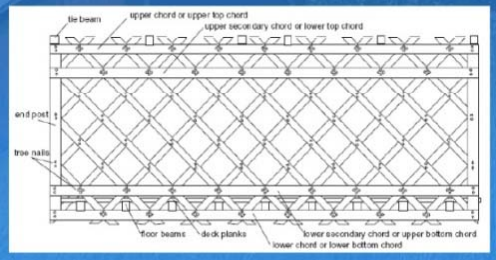
Burr Arch Truss

- Patented 1804
- Clear span: 10 – 68m
- 224 surviving bridges
- Longest single spans
- Increased stability



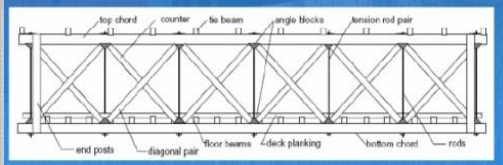
Town Lattice Truss

- Patented 1820
- Clear span: 8 – 50 meters
- 135 surviving structures
- sawn timbers (vs. hand hewn)



Howe Truss

- Patented 1840
- Clear Span: 6 – 60 meters
- 143 surviving structures



Timber Covered Bridges - Advantages:

Designed to Carry Modern Truck Traffic

Aesthetically Pleasing

Long Useful Life

Low Dead Weight

Resistant to Deicing Salt

Timber is a Renewable Resource

Absorbs Impact Loading

Year Round Construction

Negligible Thermal Expansion

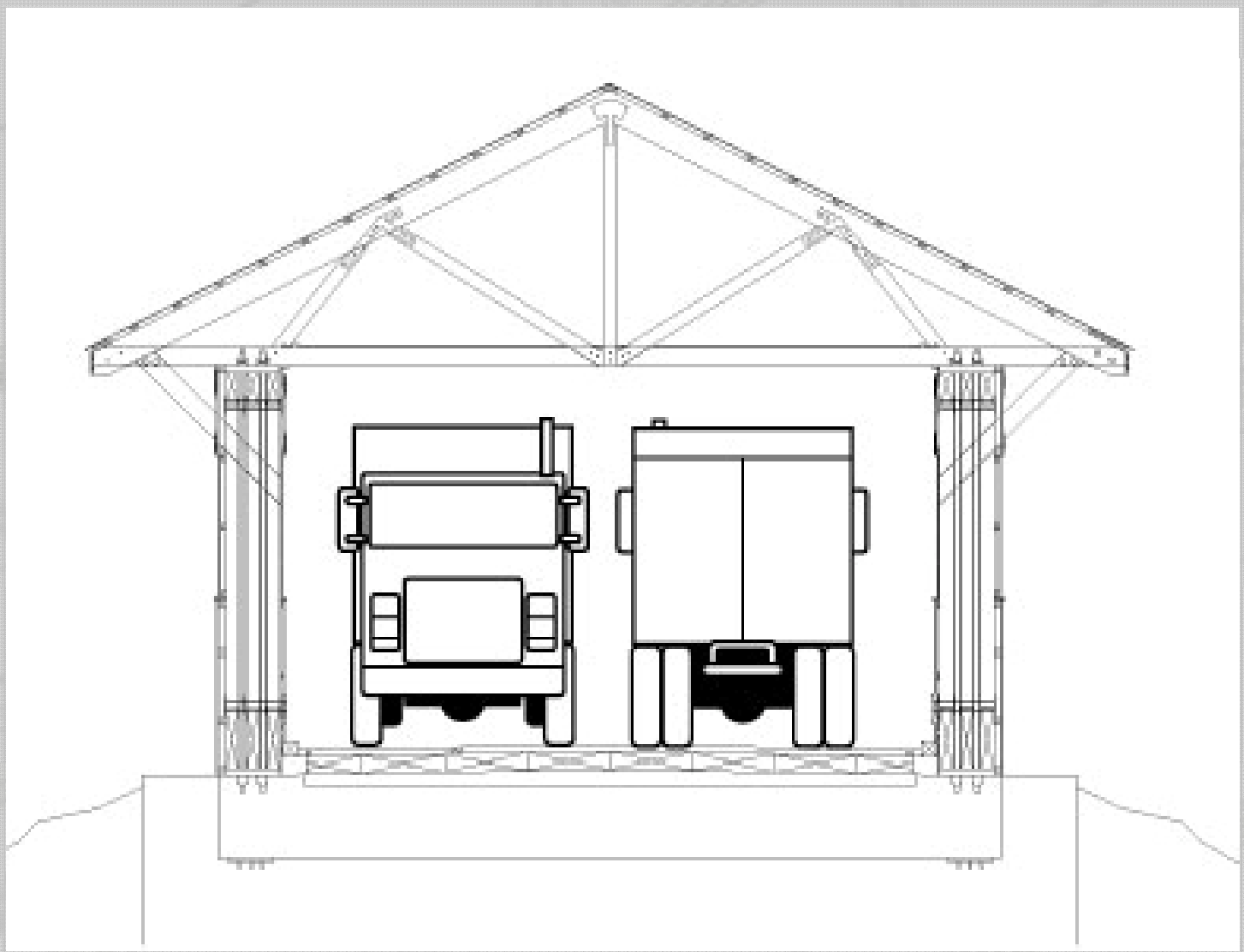
Low Total Cost of Ownership

A Destination that Provides Shelter

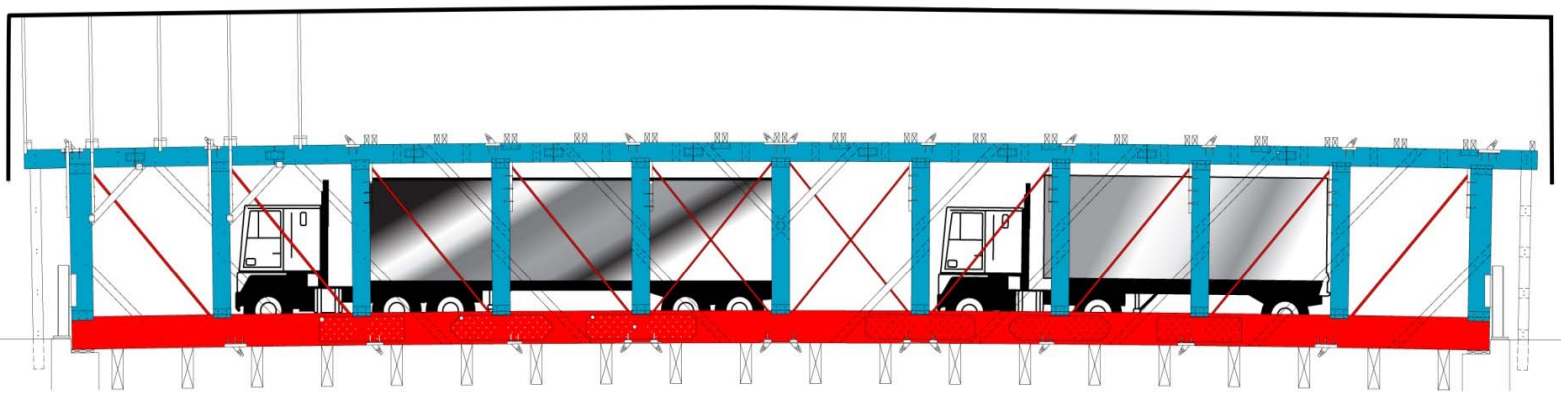
Tourism Development

Oldest Known Covered Bridge

Asia, Circa 975 AD



MODERN COVERED BRIDGE CONSTRUCTION



Truss Member Stresses

Tension

Compression

Common Pressure Preservatives for Wood Treatment-1

Water Borne

Common Name	Primary Constituents	Applications	Approvals	Attributes	Limitations
CCA	Chromated Copper Arsenate	2, 3B, 4A, 4B, 4C, 5A, 5B, 5C	AWPA, AASHTO	Proven durability	Only allowed for industrial applications. No longer acceptable for consumer applications and intimate skin contact. Should not be used for Douglas Fir (See ACZA).
ACZA	Amonical Copper Zinc Arsenate	2, 3A, 3B, 4A, 4B, 4C, 5A, 5B, 5C	AWPA, AASHTO	Bonds w/ Douglas Fir	Primarily used w/ Douglas Fir. Corrosivity similar to ACQ. Wood can be very dark brown in color w/ green streaks.
ACQ	Alkaline Copper Quat	2, 3A, 3B, 4A, 4B, 4C	AWPA, AASHTO	Alternative to CCA. Bonds w/ Douglas Fir	Elevated copper content can be corrosive to plated steel and aluminum. Do use in contact with aluminum. Requires hot-dipped or stainless hardware. Harder to find in SYP, being replaced by MCQ/MCA.
CA	Copper Azole	2, 3A, 3B, 4A, 4B, 4C	AWPA, AASHTO	Alternative to CCA.	Elevated copper content can be corrosive to plated steel and aluminum. Do use in contact with aluminum. Requires hot-dipped or stainless hardware.
MCQ/MCA	Micronized Copper Quat/Azole	2, 3A, 3B, 4A, 4B, 4C	ICC, AASHTO	Less corrosive than ACQ. Natural wood color.	Can not be used with Douglas Fir. Natural wood color can make it hard to identify compared to untreated wood (look for end tag). Quat vs Azole depends on source of chemical.
µCA-C	Dispersed Copper Azole	2, 3A, 3B, 4A, 4B, 4C	ICC	Less corrosive than CA. Natural wood color.	Can not be used with Douglas Fir. Equivalent to MCQ. Some suppliers refer to "Micronized" others "Dispersed".
PTI	Propaconazole Tebuconazole Imidacloprid	2, 3A, 3B	AWPA	Metal free. Natural wood color.	Approved for above ground contact only.
Ecolife	DCOIT Imidacloprid	2, 3A, 3B	ICC	Metal free. Natural wood color.	Approved for above ground contact only.
Borate	Disodium Octaborate Tetrahydrate	UC2, UC3A	AWPA (not for exterior)	Completely penetrates wood.	Does not bond with wood. Must be protected from weather or borates will leach out. Should not be used for exterior applications.

Common Pressure Preservatives for Wood Treatment-2

Oil-Borne

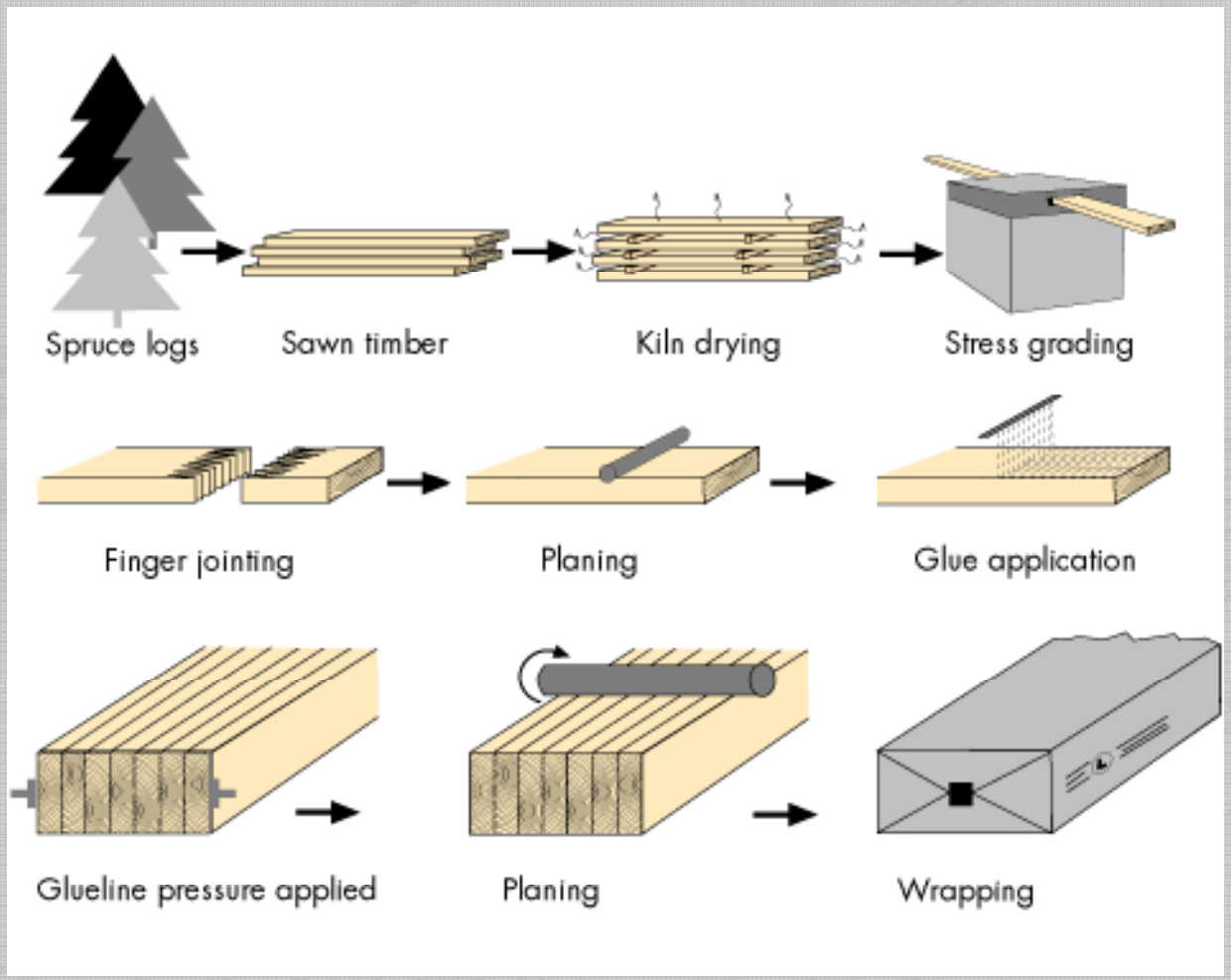
Common Name	Constituents	Applications	Approvals		Limitations
Penta Type A	Penta-chlorophenol	3B, 4A, 4B, 4C, 5A, 5B, 5C	AWPA, AASHTO	Waterproof. Durability similar to creosote	Restricted use pesticide. Oil residue may be present, limit intimate skin contact. Can migrate in wood.
Penta Type C	Penta-chlorophenol	3A, 3B, 4A, 4B, 4C	AWPA, AASHTO	Dry to the touch	Limited waterproofing. Color will fade.
CuNap	Copper Naphthenate	3B, 4A, 4B, 4C, 5A, 5B, 5C	AWPA, AASHTO	Waterproof. Durability similar to creosote. Not a dermal toxin - skin contact okay.	Some aroma.
Creosote	Creosote	4A, 4B, 4C, 5A, 5B, 5C	AWPA, AASHTO	Waterproof. Benchmark for durability	Limited supply. Restricted use pesticide. Dermal toxin, workers should wear skin protection, avoid intimate skin contact.

This list has been compiled as a quick reference for the growing number of pressure preservatives available for wood treatment.
Applications are based on American Wood Protection Association Use Categories.
This summary should not be used exclusively when determining the appropriate preservative(s) for a specific project.
AASHTO M168 recognizes preservatives with an appropriate ICC-ESR (International Code Council Evaluation Service Report.
Additional information can be found at the following websites:

Western Wood Preservers Institute www.wwpinstitute.org
American Wood Protection Association www.awpa.com

Modern Glue Laminated Timber Structural Members

The Glue Lamination Manufacturing Process

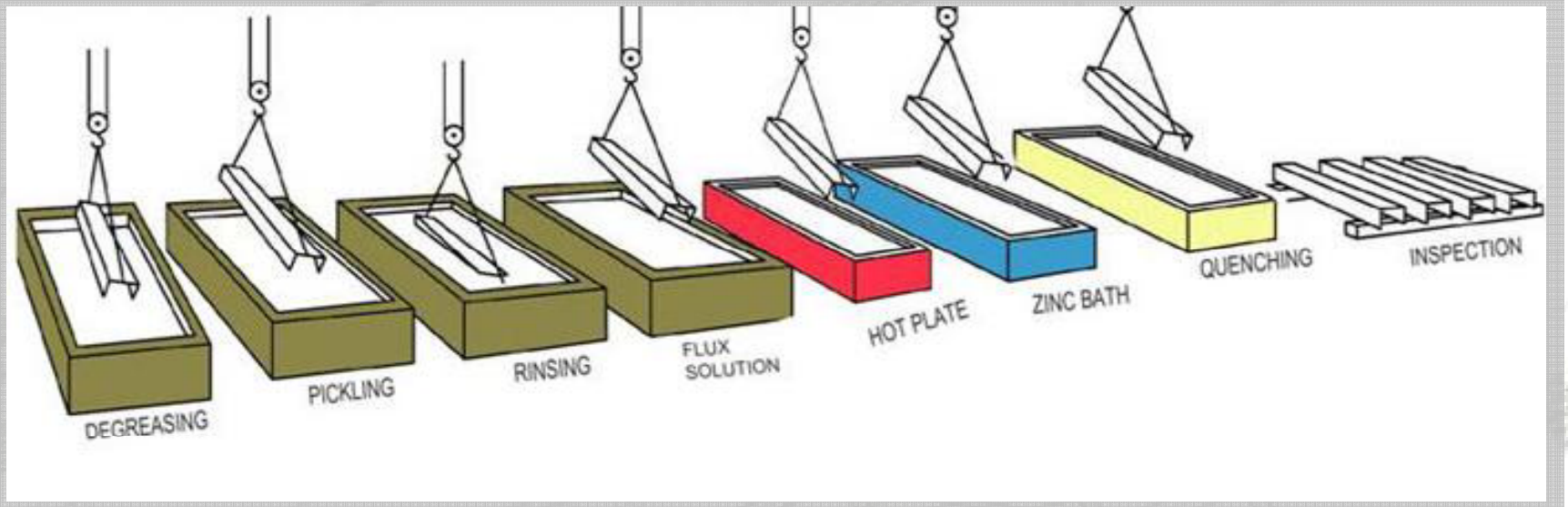


The Manufacturing Plant Should Be An American Institute of Timber Construction Plant

An AITC Inspected And Approved Manufacturing Plant Assures Tight Quality Control

Final Size Planing

Bridge Members are Glued With A Waterproof Glue Such As Resorcinol



Hot Dip Galvanizing of All Steel Bridge Parts for Corrosion Control

Smolen Gulf Covered Bridge

Ashtabula, Ohio

Contractor: Union Industrial Contractors
Owner: Ashtabula County Engineer

Sixty Year Old Stringer Bridge to Be Removed

The Substructure Included Three Piers and Two Stub Abutments. Note the Galvanized Rebar

Prefabricated Glued Laminated Treated Floor Beam Being Installed

Prefabricated Structure Being Assembled

Structure Will Be Launched Onto Substructure

Floor Beam Being Positioned. Note That Structural Timber Treated Glued Laminated Southern Pine.

Some Site Fabrication Was Necessary

The Two Midspans Were Assembled In the Valley and Tarped For the Winter. Note the 40,000 CuYd Approach Embankment.

The Forward Span In Position

Erection Sequence

Galvanized Roofing Being Assembled

Crew's Take Extra Pride in Constructing a Timber Covered Bridge Because They Are High Profile and Long-Lasting.

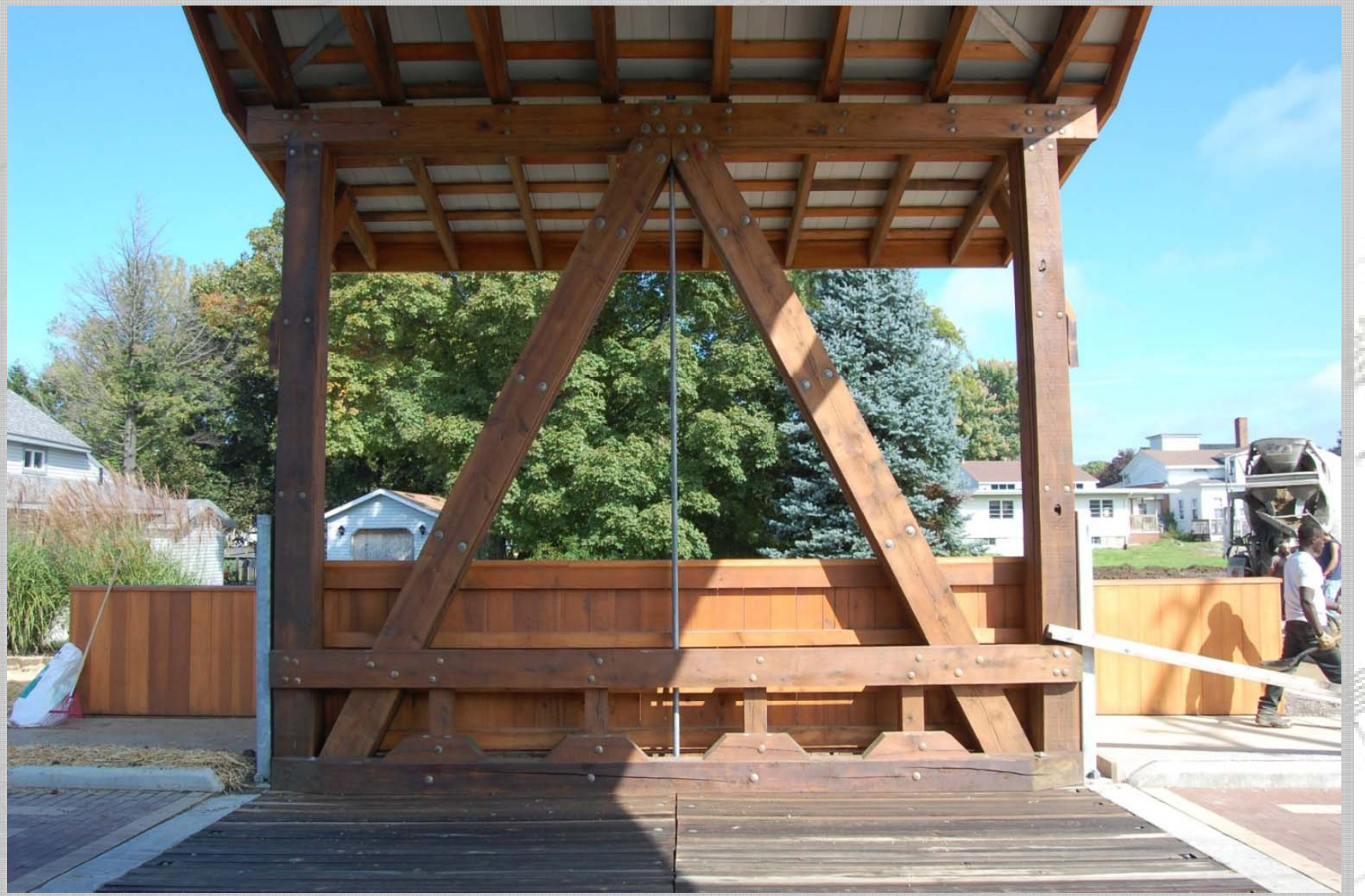
Longest Covered Bridge In The Nation

Liberty Street Covered Bridge

Geneva, Ohio

Substructure Contractor: Schwartz Construction
Superstructure: Ashtabula County JVS

Kingpost Main Truss Treated with Copper Napthenate



Timber Sawn From Donated Local Logs

CDBG paid for road paving

18’ – shortest authentic timber covered bridge in USA

Giddings Road Covered Bridge - Ashtabula County, Ohio

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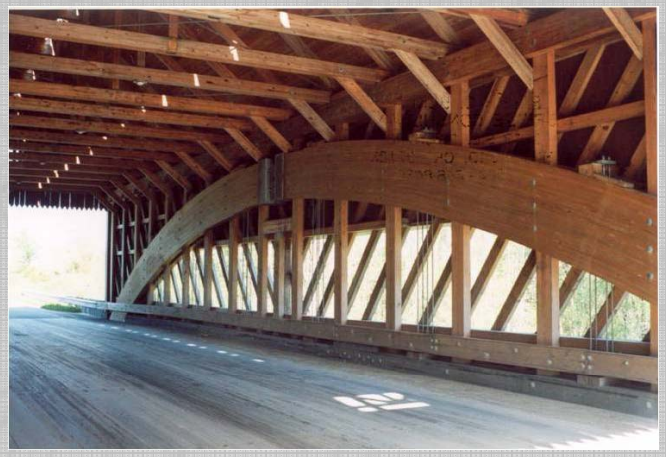

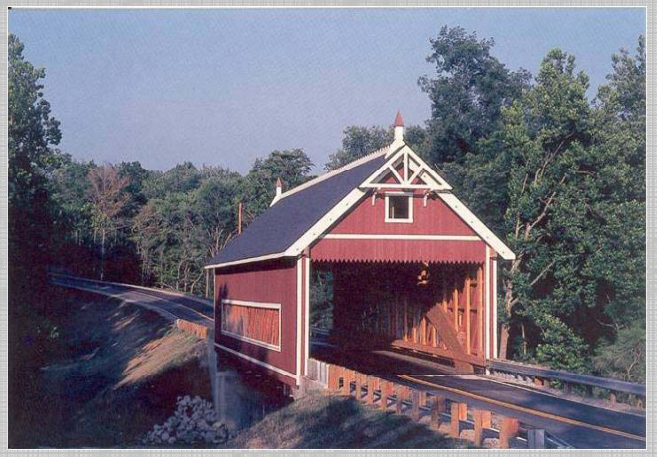

Netcher Road Covered Bridge – Ashtabula County, Ohio