Historic Construction Practices & Procedures

How They Built Our COVERED BRIDGES

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Dayton, Ohio
by
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# Credits and Thanks

Some who have helped with vintage photos, plans, records and ideas….always looking for more….

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Life Without Bridges

“Now what?”

“Now what?”
Planning & Designing for Covered Bridges
Engineering Calculations

Live Loads

20 Ton Truck

Live load 100 lb per square foot of roadway and 20 ton truck as per diagram.

LOADING DIAGRAM
...maximum 6 Tons...

“...no vehicles drawn by more than 5 horses...” (England, 1629)

Broad Wheels Act (England, 1753)

18” wide wheels for very heavy loads
Early Greek Cart

“...two horse team...”

“...road as wide as the height of the thumbs of a mounted man with his arms extended upward....” (Norse Law, AD 950)
Engineering Calculations

Wheel Gauge

Worn Ruts in Roman Road
How To Support the Loads: Covered Bridge Truss Types

Covered bridges are typically wooden truss structures. The enclosing roof protected the timbers from weathering and extended the life of the bridge.

One of the more common methods used for achieving longer spans was the multiple kingpost truss. A simple, wooden, kingpost truss forms the center and panels are added symmetrically. With the use of iron in bridge construction, the Howe truss -- in its simplest form -- appears to be a type of multiple kingpost truss.

**MULTIPLE KINGPOST TRUSS (covered)**

**HOWE TRUSS (covered)**

Stephen H. Long (1784-1864) of the U.S. Army Topographical Engineers may be best known for documents he made of his missions to explore and map the United States as it expanded westward. In 1818-20, when he viewed the treeless plains of the Great Plains, he called it the "American Desert" -- and the name stuck. While working for the Baltimore and Ohio Railroad, he developed the X truss in 1830 with further improvements patented in 1836 and 1837. The wooden truss was also known as the Long truss and he is cited as the first American to use mathematical calculations in his design.

**LONG "X" TRUSS (covered)**

Theodore Burr built a bridge spanning the Hudson River at Waterford, NY in 1824. By adding arch segments to a multiple kingpost truss, the Burr arch truss was able to attain longer spans. His truss design, patented in 1817, is not a true arch as it relies on the interaction of the arch segments with the truss members to carry the load. There were many of this type in the Pittsburgh area and they continue to be one of the most common types of covered bridges. Many later covered bridge truss types used an added arch based on the success of the Burr truss.

**BURR ARCH TRUSS (covered)**

**TOWN LATTICE TRUSS (covered)**

Herman Haupt designed and patented his truss configuration in 1839. He was in engineering management for several railroads including the Pennsylvania Railroad (1848) and drafted as Superintendent of military railroads for the Union Army during the Civil War. The Haupt truss concentrates much of its compressive forces through the end panels and onto the abutments.

**HAUPT TRUSS (covered)**

Other bridge designers were busy as well. An OhioCITY web page cites examples of designs used for some covered bridges in their state. Robert W. Smith of Top City, OH, patented the Smith truss in 1861 and used it for many years. Three variations of the Smith truss are still standing in Ohio covered bridges.

**SMITH TRUSS (covered)**

Robert C. Partridge received a patent for his truss design which is a modification of the Smith truss. Four of the five Partridge truss bridges near his home in Marysville, Union County, OH, are still in use.

**PARTRIDGE TRUSS (covered)**

Herbert Childs design of 1846 was a multiple king post with the addition of iron rods. The Childs truss was used exclusively by Ohio bridge builder Brigham Sherman after 1853.

**CHILD'S TRUSS (covered)**
Long Truss Components

Figure 35. Diagram of Long truss.
Truss Type Details

Figure 25. Diagram of kingpost truss.

Figure 26. Diagram of kingpost truss with subdiagonals.

Figure 27. Diagram of queenpost truss.
More Truss Types

Burr Truss
Preble County
Roberts Double Barreled
(2 Lanes, 3 Trusses)
The Childs Truss, a modified multiple kingpost truss, as built in Preble County, Ohio 1887 to 1895 by E.S. Sherman.

**Childs Truss**
**Preble County**
**(all except Roberts)**

Former Pence Schoolhouse Bridge, Monroe Central Road
The Winchester Covered Bridge
1888-1947
Childs Truss, Built by E. S. Sherman
Preble County’s Longest Covered Bridge
Two Spans of 152’-8”, Total 305’-4”
Enterprise Road,
East of Gratis, Ohio

Photos during Demolition, 1947
Even More Truss Types

Figure 34. Diagram of Town lattice truss.

Figure 35. Diagram of Long truss.
Figure 28. Diagram of multiple kingpost trusses.
Engineering Plans - Trusses
Engineering Plans – Covering the Bridge
Specifications

Preble County, Ohio

1865
Specifications

Preble County, Ohio

1865
Specifications

Preble County, Ohio

1865
Covered Bridge Costs

Quaker Covered Bridge, Croton, New York
Built in 1830 for $1067.66
Dec. 2, 1889

Pd. $ 1071.87

Pine lumber - C. S. Farmbouse
Day & Galloway & Brubaker self
Hard lumber - John Winckelman

Hauling timber, tools & "false bridge" from No. 7 site

Hired leach

Board of hands at Deckport at No. 6.

Patent of bridge & Supt. construction
127½ ft. @ $ 2.33½ ft.
Construction of Covered Bridges
Building a CB in Oregon, 1902

Arthur C. Striker, who worked on a construction crew superintended by his father, Aaron Noble Striker, bridge contractor, has described the erection of a covered bridge at Horse Creek, about fifty-five miles up the McKenzie from Eugene.

When the contract was let in 1902, wagons with tools and equipment set out for the bridge site, where a camp was set up. A partial list of tools includes axes, adzes, shovels, picks, hand saws, splitting froes, sledges, splitting mauls, dollies, truss rods, augers, jacks, peavies, hammers, nails, ropes, hand winches, drift pins, rifles, shotguns, and fishing equipment. No lumber was taken, because all such material was available at the site, where even the shingles and clapboards were rived. About six to eight men were required for the job, their pay scale being $2.50 per day, and every man was expected to be able to perform any part of the work necessary.
Bents were put on each side of the river. Heavy cedar logs were placed on level bedrock if possible, and drifted. Several holes were bored through the logs, and steel drift pins were driven in and through to the rock. The main posts were dapped into the mud sills, and dapped into the cap. Instead of sway braces, we placed diagonal posts inside of end posts and main bents. The posts were leveled, and sawed off before being capped.

After the bent was put in, the lower falsework went up, and work on the truss was started. After we placed the lower chord, we set the upper chord on the falsework directly above the lower chord, about fourteen feet. Then we placed diagonals between the two chords. At each panel we put in cross-ties on the upper chords, then dropped in rods, and tightened. A hand winch was used for raising diagonals and upper chords.

The next step was to swing the truss, which meant to tighten the truss rods, first at one end, then at the other, working toward the center. Then the useable lumber was salvaged from the falsework, and the remainder broken up to float downriver.
Striker’s description of hand-hewing beams is easily understood. “First have a chalk line to hew to. Chop plumb notches, then slab off to the line. Score into the line, and hew to the face of the stick. When two faces are hewed, tip over, level, and draw line same as before.”

Life in this bridge builder’s camp was hearty. “There was plenty of fresh fish for the table, and game was plentiful. Fresh eggs and milk were often supplied by farmers. The food was plain, but it was wholesome and plentiful. A man from the crew would cook. He would prepare meals and all the men would help him wash the dishes. The cook would then join the crew and work on the bridge. The men fished some after supper, but usually went to bed early, having worked about a ten-hour day. No drinking was permitted in my father’s crew, nor any profanity.”

Taken from “Oregon Covered Bridges” by Lee H. Nelson
Proud Crew Shows the Ladies their Project

Lowell Bridge, Oregon, 1907
Ohio Bridge Crew  (location unknown)

Photo from David Simmons, Ohio Historical Society
And if you have a bunch of CCC guys, you can have a really big crew
Dalesburg, Kentucky 1908
Morgan, Kentucky  1905
Mayslick, Kentucky  1905
Arch Stressed, Kentucky
Building a Covered Bridge

Abutments are usually made from locally quarried stone, or concrete poured in hand-made wood forms

Dalesburg, Kentucky
1908
Massive Stone Piers and Abutments

Butler Bridge
Kentucky
Limestone Abutments and Pier

The Last Winchester Covered Bridge
Preble County Ohio
Demolished 1947
Timber Abutments used in the West
Bents were put on each side of the river. Heavy cedar logs were placed on level bedrock if possible, and drifted. Several holes were bored through the logs, and steel drift pins were driven in and through to the rock. The main posts were dapped into the mud sills, and braces, we placed diagonal to...
Bents were put on each side of the river. Heavy cedar logs were placed on level bedrock if possible, and drifted. Several holes were bored through the logs, and steel drift pins were driven in and through to the rock. The main posts were dapped into the mud sills, and dapped into the cap. Instead of sway braces, the lower falsework directly placed diagonal cross-ties on the main posts. A hand.
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Building a Covered Bridge

The main posts were dapped into the mud sills and dapped into the cap. Instead of sway braces, we placed diagonal posts inside of end posts and main bents. The posts were leveled and sawed off before being capped.

After the bent was put in, the lower part on the truss was started. After that, the other parts were added.
Falsework across a major river

Pike Street Bridge, Kentucky
Cables from the Ends

Oregon
Preparing the Lumber

• While some of us have been getting this temporary falsework built in the creek, the rest of our men have been selecting trees, cutting and hauling logs, and going ahead with hand hewing some of the larger pieces out there where they fell, in the woods. Everything is brought for final cutting to our “bridge yard”, in this case at one end of the bridge.

These “first person” accounts are written herein by Doug Kramer, taking “journalistic license” to more completely explain the construction process, and are based on personal construction experience and research of available covered bridge historical publications.
The "Yard"
A Bridge Site “Yard” from the 1940’s
Another “Yard” Scene
Assembling and Numbering the Chord Pieces for a Trial Fit
Oregon, long timbers!

Lane Co.-over Fall Creek, near Jasper, New 120’ span. Built 1904
Built 1938

Chord For Pengra Covered Bridge
Photo: Courtesy Arthur C. Striker
Dragging Timbers Out to the Bridge
So, we are **now** to the **first parts** of the bridge or falsework that are **too heavy** for a few of us to **lift up by hand** and set in place. Even some heavy timbers, like the parts of lower chords, were at least to be located down low and horizontal, so up to this point in the project we could **drag them across** and use **pry bars and rollers** to slide them into their **final position**.

We will need some **mechanical lifting assistance** for this next phase.
Gin Pole
(Cable-Supported)
with
Block and Tackle
Oregon 1920’s
After the bent was put in, the lower falsework went up, and work on the truss was started. After we placed the lower chord, we set the upper chord on the falsework directly above the lower chord, about fourteen feet. Then we placed diagonals between the two chords. At each panel we set in cross-ties, and fastened them down.
So we’re here now. We laid some planks across from bent to bent, and carried out each floor beam (cross beam) and set it crosswise on the lower falsework, in it’s final position. We laid some temporary walk boards across those, then carried out chord pieces and put together the lower chords in place on top of the floor beams.
Now we have built our upper falsework, bracing it in both directions to prepare to support the upper chords. We have assembled the upper chords and hoisted them up and over onto the tops of the cross pieces of the upper falsework.
So far, we have our Lower Chords set on our Temporary Falsework and the Upper Chords propped up in place.

We sure need the big rains to hold off for another two months or so.
Building a Covered Bridge

chord, about fourteen feet. Then we placed diagonals between the two chords. At each panel we put in cross-ties on the upper chords, then dropped in rods, and tightened. A hand winch was used for raising diagonals and upper chords.

Dalesburg, Kentucky 1908
Fitting the Diagonals
Building a Covered Bridge

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Building a Covered Bridge

The next step was to swing the truss, which meant to tighten the truss rods, first at one end, then at the other, working toward the center. Then the useable lumber was salvaged from the falsework, and the remainder broken up to float downriver.
Another Way To Build The Truss
Floor system cross-braces, stringers and planks were put in, so we could finally have a place to walk on. We added running boards on the floor to help keep wagons in their place.

Looking Glass Creek, Oregon

Winchester Bridge, Enterprise Road, East of Gratis, Preble County
Floor System
Making Shingles for the Roof

Working on the Switzer Bridge, Frankfort, Kentucky, early 1900’s
The Roof

Then the knee braces and the roof system were added. Rafters were set, much like on a building, then wood strapping and cedar wood shingles were nailed on.
Roof Framing
Siding and Rails

Nailers were placed along the sides, and siding attached. Hub rails were sometimes put on the inside to keep wagon axles from catching on the trusses.
Siding
Framing
Finishing the Pretty Parts, the Portals

The rest of the siding, around the end portals, was nailed on. Usually the siding was then whitewashed or painted red, but some bridges were just left unpainted.
Removing the Falsework

center. Then the useable lumber was salvaged from the falsework, and the remainder broken up to float downriver.

For the first time since we built the falsework to start the project, the creek is all clear, and our new covered bridge is standing on its own, spanning from one side of the creek to the other. Our crew has taken about four months to build the bridge, after the stone work.
Preparing the Road, Opening the Bridge

We have graded and finished the road approach, and we are done, the bridge is open!
Eldean Covered Bridge
Wedges in the Long Truss

Eldean Covered Bridge

Miami County, Ohio
That’s how they built our covered bridges.

Thank you for your interest.

Doug Kramer