The Rehabilitation of Quebec's Powerscourt Bridge

Michael Grayson, Engineer

Second National Covered Bridge Conference

Dayton, Ohio

June 7, 2013

Powerscourt Bridge ca. 1950, Richard Sanders Allen

POWERSCOURT COVERED BRIDGE

POWERSCOURT
QUEBEC

HERITAGE RECORDING REPORT
RECORDED IN JUNE 2003
HCS PROJECT NUMBER: 403098

PWGSC
CLIENT SERVICE TEAM FOR
CANADIAN HERITAGE AND
PARKS CANADA

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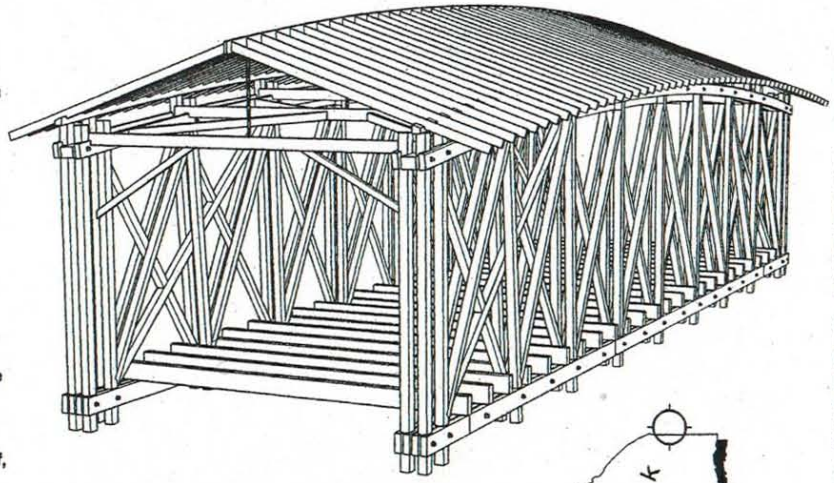
SERVICE DE CONSERVATION DU
PATRIMOINE

POWERSCOURT BRIDGE

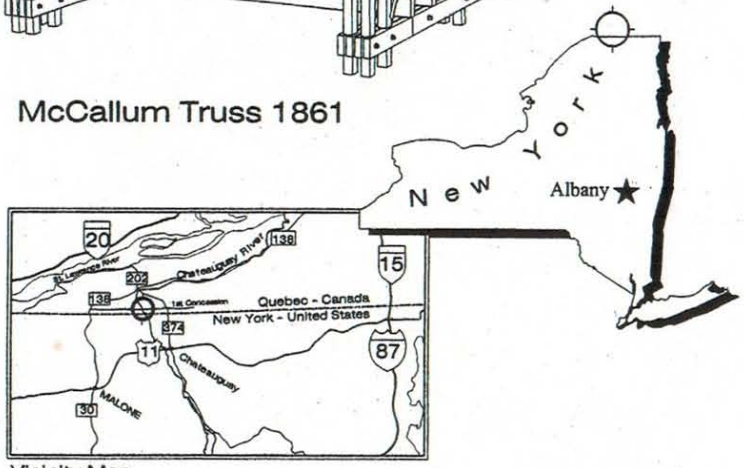
Spanning the Chateauguay River ~ Quebec, Canada

There was a bridge at this site prior to 1857 when an "extraordinary freshet" washed it away. A temporary bridge was subsequently destroyed by a flood in 1861. The Huntingdon County Council, in the Province of Quebec, immediately prepared plans and specifications for a new bridge and awarded the contract for its construction to Robert Graham, a local blacksmith, for $1,675. He completed the bridge by the end of the year, but declared bankruptcy in the process. It is probable, though not documented, that McCallum trusses existing on Canadian railroads at that date served as a model for this bridge. It may also explain why the Powerscourt Bridge has the basic member arrangement, but lacks several essential details, of a true McCallum truss-primarily, the poorly-framed counterbraces and the connections made without iron castings as specified in McCallum's patent. The bridge was repaired in 1881, 1894 and 1950, the roof, deck and siding have been replaced numerous times, but the trusses remain essentially intact.

In 1851, Daniel Craig McCallum (1815-1878) received a patent for a bridge truss that featured a curved upper chord that added arch action to the truss and long diagonal braces passing through multiple panels to carry the thrust of the arch down to the abutments. The exceptional stiffness of the McCallum truss made it an attractive option for railroad bridges and between 1851 and 1868 an estimated 150 McCallum trusses were built on railroad lines in North America. None of these structures survive and this is the only known example to have been built as a highway bridge. Because it was difficult to build and required pre-stressing, many bridge builders chose other more easily assembled designs. Within two decades, McCallum's design was obsolete.



McCallum Truss 1861



Vicinity Map
UTM: 18.566035.4983842

The Powerscourt Bridge is the oldest covered bridge in the Province of Quebec, the second oldest covered bridge in Canada, and the only surviving example of a McCallum type truss in the world.

Phase II of the National Covered Bridges Recording Project was undertaken during the summer of 2003 by the Historic American Engineering Record (HAER), a long-range program to document historically significant engineering and industrial works in the United States. HAER (Eric DeLony, Chief) is part of the Historic American Buildings Survey/Historic American Engineering Record/Historic American Landscapes Survey/Cultural Resources Geographic Information Systems (E. Blaine Cliver, Chief), a division of the National Park Service, U.S. Department of the Interior. The Federal Highway Administration funded the project. Jean-Pierre Jérôme and Christian Ouimet from Heritage Conservation Services, Public Works and Government Services Canada provided assistance on site and donated photogrammetric data to assist HAER with the documentation of this bridge.

The measured drawings, historical reports, engineering reports and photography were completed under the direction of Christopher Marston, Project Leader, Naomi Hernandez, Summer Team Supervisor and Richard O'Connor, Senior Historian. The field team consisted of Dana Lockett, HAER Architect, Thomas M. Behrens, HAER Architect, Lola Bennett, HAER Historian and Magdalena Karakova, US/ICOMOS, Slovakia. Large-format photography was produced by Jet Lowe, HAER Photographer.

DELINEATED BY: THOMAS M. BEHRENS, NAOMI HERNANDEZ, 2003

NATIONAL COVERED BRIDGES RECORDING PROJECT
HISTORIC AMERICAN ENGINEERING RECORD
UNITED STATES DEPARTMENT OF THE INTERIOR

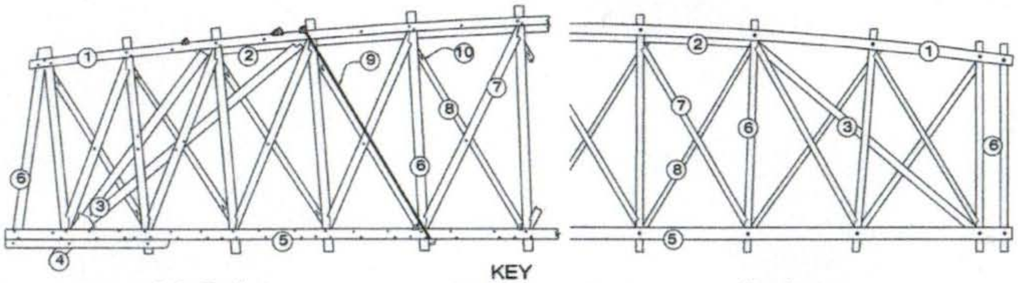
CHATEAUGUAY VICINITY

POWERSCOURT BRIDGE 1861
SPANNING CHATEAUGUAY RIVER, HUNTINGDON COUNTY, QUEBEC, CANADA
FRANKLIN COUNTY
NEW YORK

SHEET 1 OF 7

HISTORIC AMERICAN ENGINEERING RECORD
NY-332

McCallum Patent - Graham Construction Comparison

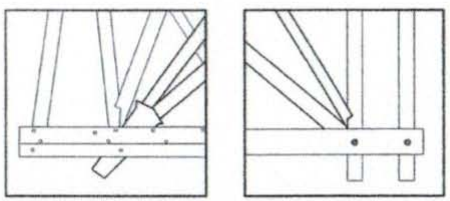


McCallum　　　　Graham

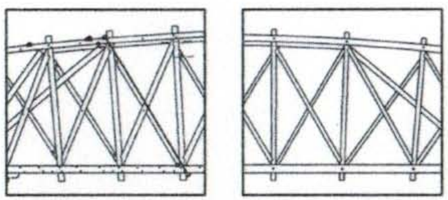
KEY

1. Upper Chord
2. Arched Chord
3. Arch Brace
4. Iron Shoe
5. Lower Chord
6. Post
7. Brace
8. Counter Brace
9. Tension Rod
10. Iron Pre-stressing Assembly

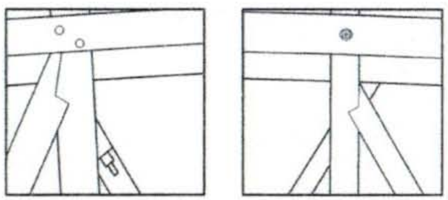
In comparing the truss-system patent granted to Daniel C. McCallum in 1857 with the extant structure in 2003, several deviations became apparent. Most notable of these was the omission and/or misplacement of key cast-iron components. It is suspected that these variations caused deficiencies in this bridge. It is difficult to prove these suspicions at the time of this documentation because there are no other surviving examples of a McCallum truss to compare to. However, the use of the McCallum truss design on numerous railroads would suggest a valid and reliable truss design with a structural performance superior to what currently exists at the Powerscourt Bridge. Some of observed differences are noted below.



Cast-iron shoes, an integral part of McCallum's design are not present in the extant structure. The resulting effect is, instead of the compressive force from the arch braces being transfered past the lower chord and into the abutment, the force is being transfrered through the lower chord. The lower chord may not be properly sized or the proper material to absorb the compression forces at this point. Aditionally, the diagonal braces designed to tranfer the loads from the arched chord to the abutment (via the iron shoe) had been reduced from two members down to one, increasing the burden on the remaining joints and member.



In his 1857 patent McCallum specified tension rods running diagonally (parallel to a counter brace) and external to the chords from the lower chord to an upper-chord panel point where an arch brace meets the arched chord. The intent of these tension rods were to counteract the deflection of the lower chord and transfer their resistance load to the diagonal brace and the arched chord. The rods as specified in the patent were not extant in the current structure and evidence suggests they were never present.



The diagonal counterbraces in McCallum's patent were to be connected near the upper panel points via a bearing plate with a threaded yolk and nut passing through a iron stirrup connected to and spanning the posts. With this configuration the bearing plate could be adjusted to impart a pre-stressing force on the cross braces, and re-adjusted if necessary. In its current condition the Powerscourt bridge counterbraces are connected to the arched chord through a mortise-and-tenon joint, with no capacity for pre stressing. Tension rods are currently placed along side the counter braces to correct this deficiency. Physical evidence suggests that this was a repair done subsequent to the original construction.

Delineated by: Thomas M. Behrens, Naomi Hernandez, 2003

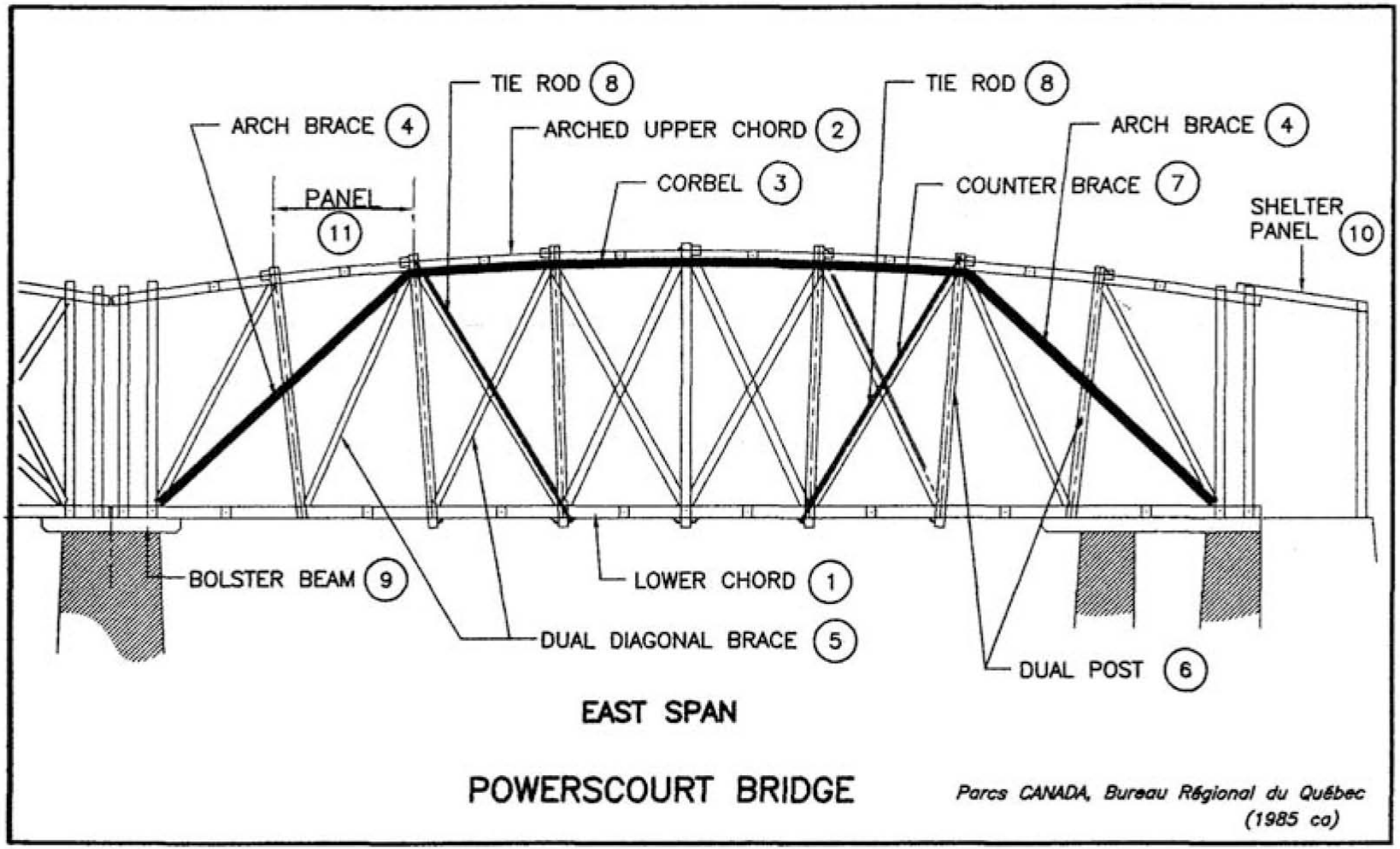
National Covered Bridges Recording Project
National Park Service
United States Department of the Interior

Powerscourt Bridge
Spanning Chateauguay River, Elgin/Hinchinbrook, Huntingdon County, Quebec, Canada
Chateauguay Vicinity　Franklin County　New York

Sheet 7 of 7

Historic American Engineering Record NY-332

2 spans, 80' and 85'. Truss height at ends: 15', at midspan: 17.5'



East span elevation, showing arch brace, corbel (fixed under top chord) and extra pier added in front of abutment

State of bridge during 2007 inspection

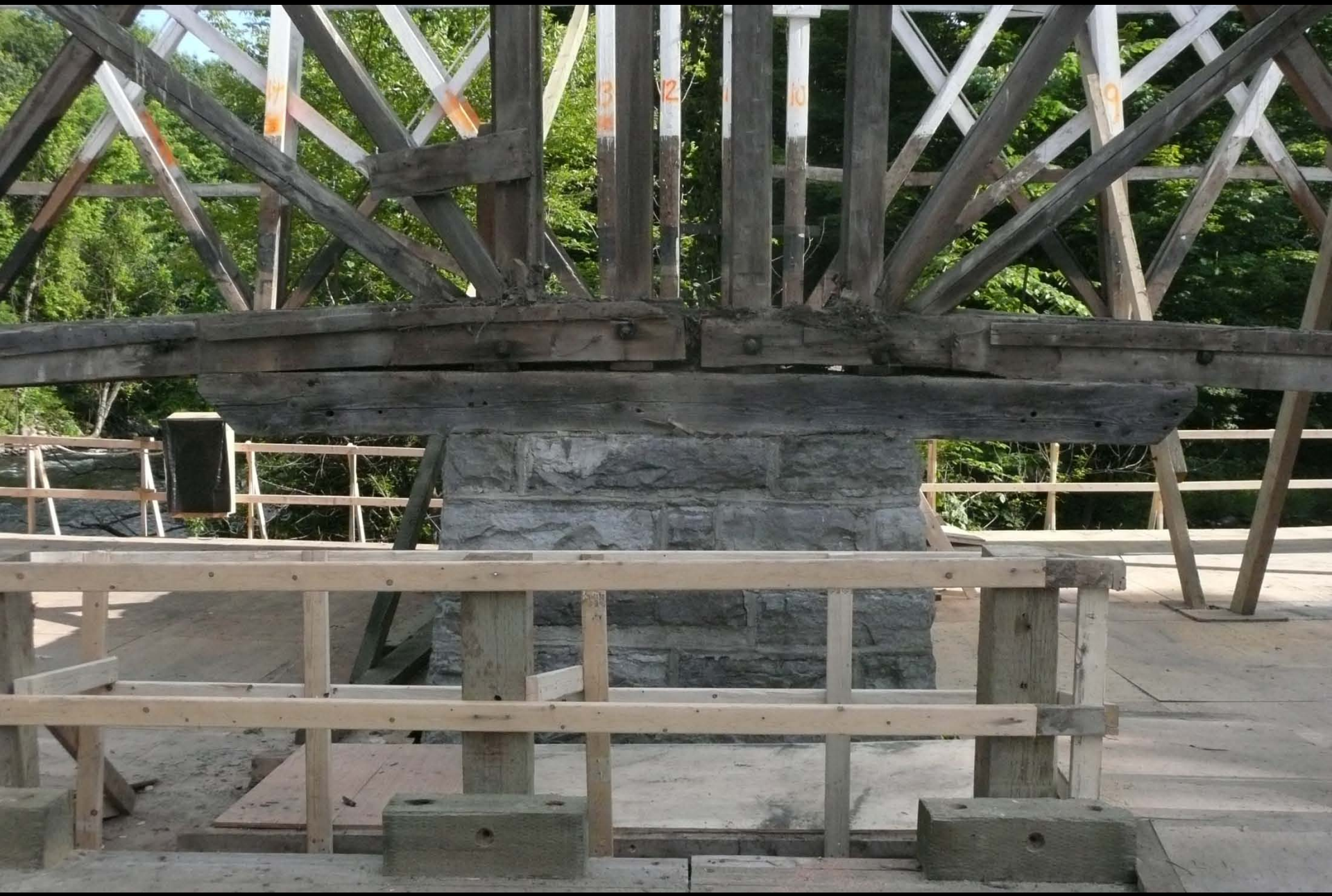
Major splay at east entry, 2007

Slipped joint (poorly located) in lower chord, 2007.
(Steel floor beams inserted in 1980s.)

Rotating shear keys in lower chord, 2007

Upstream nose of central pier on small island, 2007

Dismantling, summer 2009



Dismantling, summer 2009

Dismantling, summer 2009

Dismantling, summer 2009

Dismantling, summer 2009

East span removed; note lack of containment road materials at east abutment

Deteriorated bottom chords at east abutment, 2009

Transport to Heirloom Timber framing yard 3.5 miles up the road, 2009

Disassembly in yard, 2009

New and conserved members, ready for reassembly, 2009

Rebuilding west abutment, Supplementary 1960s pier in foreground

New bolster beams at central pier, 2009

Rebuilding the bridge, 2009

Completed portal, 2009. Powerscourt Bridge known as Percy locally.

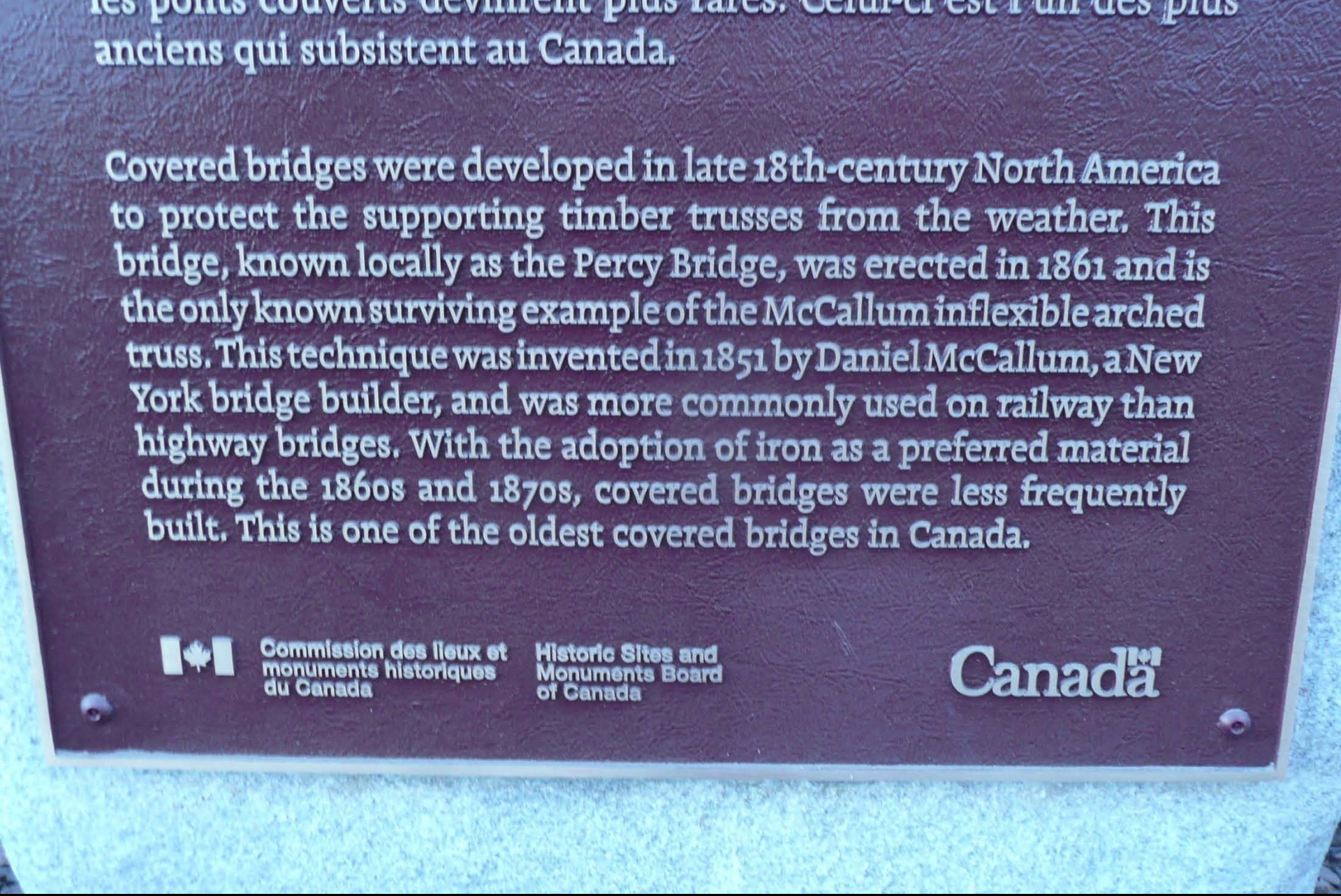
Modified roof structure with former tie rod

Laying cedar shingles over membrane and cedar breather


1861
Le Pont
PERCY
Bridge

Stone faced abutment side wall

Bridge reopened with reduced lane width. Posted for 3 ton load, 10kph, with strong camber warning



Powerscourt (Percy) now recognized as the oldest surviving covered bridge in Canada