The Rehabilitation of Quebec’s Powerscourt Bridge

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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
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 Huntington 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 stength 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.

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 Oliver, Chief), a division of the National Park Service, U.S. Department of the Interior. The Federal Highway Administration funded the project. Jean-Pierre Jérome and Christian Culmer 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, Lois Bennett, HAER Historian and Magdalena Karakova, US/ICOMOS, Slovakia. Large-format photography was produced by Jet Lowe, HAER Photographer.
McCallum Patent - Graham Construction Comparison

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 transferred past the lower chord and into the abutment, the force is being transferred through the lower chord. The lower chord may not be properly sized or the proper material to absorb the compression forces at this point. Additionally, the diagonal braces designed to transfer 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 members.

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.

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.
Slipped joint (poorly located) in lower chord, 2007. (Steel floor beams inserted in 1980s.)
Upstream nose of central pier on small island, 2007
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
Modified roof structure with former tie rod
Laying cedar shingles over membrane and cedar breather
Stone faced abutment side wall
Bridge reopened with reduced lane width. Posted for 3 ton load, 10kph, with strong camber warning
Covered bridges were developed in late 18th-century North America to protect the supporting timber trusses from the weather. This bridge, known locally as the Percy Bridge, was erected in 1861 and is the only known surviving example of the McCallum inflexible arched truss. This technique was invented in 1851 by Daniel McCallum, a New York bridge builder, and was more commonly used on railway than highway bridges. With the adoption of iron as a preferred material during the 1860s and 1870s, covered bridges were less frequently built. This is one of the oldest covered bridges in Canada.