

New Lake Champlain Bridge Opens in November 2011

Completed in November 2011, the new Lake Champlain Bridge was a fast-track project to replace the previous 1929 bridge that was closed in 2009 for safety reasons.

The Lake Champlain Bridge is jointly owned by the New York State DOT and the Vermont Agency of Transportation. High Steel Structures worked with contractor Flatiron Construction Corporation in Firestone, Colorado to fabricate 4,234 tons of steel for the Modified Network Tied Arch bridge. A metalized thermal coating of 85% zinc and 15% aluminum protects the steel from the harsh winter of the region. The steel design features 40-foot deep rigid frame delta-leg girder assemblies at both ends of the 400-foot arch span.

High Steel began shipping steel to the jobsite in December 2010, with Flatiron Construction erecting the first girders on January 28, 2011. Erection of the approach spans continued throughout the spring



and summer, while the arch span was erected in its entirety offsite on two barges at Port Henry on the lake's western shore. On August 26, 2011, two tug boats pulled the barges two miles across the lake and had the arch at the bridge site by 8 a.m. to begin the process of hoisting it into place. The bridge was opened to traffic on November 7, 2011.

"This project was an emergency replacement with a very aggressive schedule. In order to meet the required delivery schedule we ran portions of the bridge through all of our major fabrication bays," said Kevin Benner, High Steel project manager. "We did the approach spans in the Lancaster plants and the arch span at our Williamsport facility."

The rapid turnaround for the project was a challenge for everyone involved. As Benner noted, complete design information was available when the project was awarded in June 2010, with requested

delivery start set for November 2010. To meet the schedule High Steel used two detailers to complete the shop drawings, Tensor Engineering which detailed the approaches and Candraft Detailing Inc. which detailed the arch main span. A portion of the steel was high performance steel (HPS) with a significantly longer lead time from the steel mill.

"The delta leg girders were challenging, since these were the largest delta legs we had ever fabricated," said Benner, adding that each delta leg girder was comprised of four separate girders field spliced to make one.

The delta legs for the bridge were set up in three stages. In the first stage, High Steel assembled each delta leg in lay-down position for fit-up and reaming. In stage two, High Steel assembled the girder line with the upper portion of the delta leg, along with cross frames, lateral bracing and cross boxes. In stage three, the five delta legs

The History of the Lake Champlain Bridge

The original Lake Champlain bridge was built in 1929 with a lifespan of some 70 years.

It outlived that projection by another decade, but in October 2009, the historic bridge— which had been listed on the National Register of Historic Places— was declared to be unsafe. Dangerous cracks in the concrete piers were found and the bridge was closed for safety reasons.

It wasn't the steel superstructure that had failed, but its supports.

As engineers grappled with how to repair the bridge, they finally determined that the only solution was to build a new bridge. It was a bittersweet day when the old bridge was imploded to make way for the new. With the explosion, the bridge's supporting structure, struts and chord crumbled into the lake, leaving only the ill-fated piers.



"It's a disappointment in any circumstance to lose an important bridge, and that bridge was particularly important to bridge engineering," said Ted Zoli, Vice President, National Bridge Chief Engineer for HNTB and a former resident of the Glens Falls area.

As Zoli noted, the cracking of the concrete piers was being tracked over the years by New York and Vermont DOTs. In 1995, cracks had caused the piers to lose 2 inches of concrete. By 2000, it was 3 inches and by 2005, it was 5 inches. The spalling



accelerated so rapidly that by 2009, it had extended another 14 inches.

Some blamed it on the cold, icy winters that had caused the damage. Some tried to save it. But when it came right down to it, closing and destroying the historic bridge was a safety issue.

The original Lake Champlain Bridge was constructed in 14 months by Fay, Spofford and Thorndike of Boston, opening to rave reviews in 1929. Five years later, the company built the nearly identical General Sullivan Bridge in Dover, N.H. There was one major difference. In the Lake Champlain Bridge, the concrete columns were not reinforced. In the New Hampshire bridge, the concrete piers were reinforced with steel rods and armored with granite to protect them from ice damage.

According to Robert Dennison, former

Chief Engineer for NYSDOT, had the builders constructed the Lake Champlain Bridge with reinforcement, the original bridge might have been saved.

"It was an unfortunate mistake," said Dennison, adding that the shallow shoreline water causes the lake to freeze from the shores to the center resulting in stress from the ice.

"Reinforcement might have made all the difference," he added.

The original bridge was designed in 1927. Total cost, including materials, land, and engineering, was \$1,149,032.63. Construction began on June 14, 1928. The bridge opened to traffic on August 26, 1929 following a ribbon cutting ceremony on the bridge by New York Governor Franklin D. Roosevelt and Vermont Governor John E. Weeks.

Lake Champlain Bridge: A Timeline

▶ August 2006

- The New York State Department of Transportation (NYSDOT) and Vermont Agency of Transportation (VAOT) hold a public meeting on the bridge's deteriorating condition.

▶ April 2007

- NYSDOT initiated a capital improvement project to address the condition of the bridge.

▶ June 2007

- The first organizational meeting of the Project Advisory Committee (PAC) was held.

▶ March 2008

- A design consultant was designated.

▶ July 2009

- The design consultant initiated work on the project.

Designing a Bridge for the Future Based on the Past

When it came time to design a new Lake Champlain Bridge, engineers looked to the past.

The original bridge had, after all, stood since the 1920s, amid the natural beauty of Lake Champlain. That design had fit in perfectly with the lake's breathtaking scenery and rich history.

The Lake Champlain Bridge Coalition was formed as a grass-roots organization unifying New York and Vermont to determine what the new bridge should look like. As it turned out, more than 2,000 people wanted the new bridge to resemble the old one.

In meetings with the public, five concepts were presented and four were rejected. The only one that was favored had an arch reminiscent of the former bridge. That's when a team of engineers, led by Ted Zoli, Vice President, National Bridge Chief Engineer for HNTB, revised the plans to come up with a sixth design— a Modified Network Tied Arch Bridge.

It was a hit.

The modified bridge uses a frame to support the span and arch, similar to the old bridge. The earlier bridge used a truss and a web of triangular beams to give the structure strength and grace. The new bridge would integrate the look of the old with the structural design of the new.

The new bridge design was an evolution of a conventional tied arch bridge. Instead of vertical cables and hangers, the bridge would use inclined hangers that cross twice. As a result, the inclined hangers that crisscross the side of the arch help to redistribute the weight of the main span throughout the structure.



"The design has redundancy, which makes it safer," said Zoli, noting that if one part fails or is damaged, there is a backup.

Other safety redundancies were built into plans for the new bridge. The bridge is metalized to protect the steel from corrosion and the piers use footings layered with granite to help protect against ice damage.

One change that people liked was that the new bridge was more open. From either side, the view was more transparent than the old bridge, which was harder to see through.

Another advantage of the new design was that it took less than a year to complete, as compared to 27 months for another design. Since rebuilding the bridge needed to be accelerated, this was important to both New York and Vermont, which shared the cost of the project.

The Lake Champlain bridge was, after all, vital to the economy and tourism—both for business commuters and travelers to the area.

Although ferries were used while the bridge was built, it was an added cost for both states and not ideal for people trying to get to work. In winter, the frozen lake presented its own challenges.

Even though the project was awarded to Colorado-based Flatiron Construction Corporation, one of the largest bridge-builders in the nation, the workers and materials were more localized. The bridge was constructed in parts, with construction of the arch taking place in Port Henry and carried on a barge to the location of the bridge. Trucks and vessels were used to deliver the spans.

The new bridge design was intended to look similar to the old bridge, with important design improvements.

The old bridge had lasted well beyond its 70-year life span. The new bridge has a projected life of 100 to 150 years. The old bridge had a weight limit of 70 tons, while the new bridge has no weight restrictions.

The Modified Network Tied Arch design is both simple and complex. It is simple in its appearance, but is computer-designed for redundancies that will make it safer. Furthermore, any repairs that may be needed in the future will be possible while the bridge remains open.

"I think that simplicity often leads to good design, long-term performance and safety, all of the things we want good bridges to be," said Zoli.



Vermont and New York Celebrate a Vital Connection

When the new Lake Champlain Bridge reopened to traffic on Nov. 7, 2011, it was cause for a grand celebration.

For nearly two years, the connection between Crown Point, N.Y. and Addison, Vt. had been cut off. People who lived and worked on opposite sides of the lake had been forced to rely on ferries to take them across. Even tourism had been affected by the missing link between the two states in the picturesque lake region.

The ribbon-cutting for the brand new \$76 million, 2,200-foot Lake Champlain Bridge was officiated by New York State



Lieutenant Governor Robert Duffy and Vermont Governor Peter Shumlin, amid cheers from the residents, business owners, employees, local officials and everyone involved with the project to restore a bridge to Lake Champlain.

Rising from the deep blue waters of the chilly lake, the new Lake Champlain Bridge resembled the old bridge with its graceful arches and essential shape. The new bridge is cleaner, sleeker and more transparent, allowing for a breathtaking view of the lake. The new design is a modified network tied arch, giving the bridge greater redundancy, longer life and no weight limits.

The project was completed in less than two years, as the states of New York and Vermont worked together through the New York State Department of Transportation (NYSDOT) and the Vermont Agency of Transportation (VTrans), and their designers, contractors, fabricators and erectors.



It was certainly a reason to celebrate.

The opening of the bridge was the first of many celebrations marking the renewed connection. The official celebration is yet to come. The Lake Champlain Bridge Coalition has planned an official Grand Reopening Celebration on May 19 and 20, 2012, joining the two states together with festivities, food and fun.

The Lake Champlain Bridge Coalition is an unfunded community organization that was created to plan and lead the public celebration for the new Lake Champlain Bridge.

Sue Minter, Vermont Deputy Secretary of Transportation, called the project a “remarkable achievement” to build a new bridge in less than two years during a particularly harsh winter.

“It is clear that transportation is about more than roads and bridges,” Minter told the crowd. “It’s about building community, and it’s about connecting our state and people.”

As Shumlin and Duffy cut the ceremonial ribbon on a Monday afternoon in November 2011, the link between the two states and communities was restored. And the celebration had just begun.

Lake Champlain Mystery: The Legend of Champ

Back in 1609, French explorer Samuel de Champlain recorded the sighting of a 20-foot serpent with a horse-shaped head in the lake that was later named for him. Ever since, the legendary lake monster—affectionately known as Champ or Champy—has been the subject of fascination for Lake Champlain. Earlier sightings date back to the Abenaki Indians. Champ was spotted in 1819 near Port Henry, N.Y. and again in 1873 by a railroad construction crew. Hundreds of sightings later, there are only a few fuzzy photographs. One of them, taken in 1977 by Sandi Mansi, shows a Loch Ness monster-like Champ rising from the waters of the deep lake. A relative of Nessie? A long-lost plesiosaur dinosaur? Or Lake Champlain’s own unsolved mystery?



October 2009

- The bridge was closed due to structural deterioration.

November 2009

- Rehabilitating the bridge was ruled out and plans were announced to demolish the bridge.

December 2009

- The old bridge was demolished.

April 2010

- Bids were opened for the bridge project.

May 2010

- The bridge project was awarded to Flatiron Construction Corporation.

were assembled with one on the ground and the other in the air. While fabrication and assembly of the arch was uneventful, the fabrication accuracy was crucial to have all four girders accurately assembled and reamed in High Steel's yard to fit into final position. The knuckle girders on the arch were some of the most complicated girders High Steel has ever fabricated. Due to their shape and size, they were very difficult to move and position properly for welding.

Since the bottom chord tie boxes were trapezoidal rather than 90-degrees, they needed to be inclined 10 degrees to match the basket handle arch incline. High Steel had to assemble the structure and trial fit the connections to ream the holes to full size. The massive size of the structure required multiple assemblies to meet these requirements.

Transportation required 163 loads, with the 17'6" wide delta legs as "superloads." A ferry delivered some of the steel to the Vermont side, while most were off-loaded on the New York side by barge.

The Modified Network Tied Arch design was selected from several alternatives proposed by design consultant HNTB. Similar to a Network Tied Arch, the

JUST THE FACTS:

Bridge:	Lake Champlain Bridge
Bridge Type:	Modified Network Tied Arch
Steel Tonnage:	4,234
Steel Type:	Grade 50W and Grade 70
Coating:	Metalized
Project Owner:	NYS DOT and Vermont Agency of Transportation
Contractor:	Flatiron Construction Corporation
Design Consultant:	HNTB
Detailer:	NY and VT Approaches - Tensor Engineering
Arch:	Candraft Engineering
Steel Fabricator:	High Steel Structures Inc.



modified design allowed for enhanced redundancy, efficient use of steel, a replaceable deck, a lighter weight superstructure and reduced construction costs.

"Working with High Steel, the technical ability and coordination of the job made it possible to meet deadlines on a very challenging project," said Mark Mallett, project manager with Flatiron Construction.

Dramatic Float-In Marks Final Stages

In the final stages of the Lake Champlain Bridge construction, a dramatic float-in operation put the grand arch in place. It was late August 2011 when the arch was set afloat by Flatiron crews.



According to project manager Mark Mallett, the harsh weather caused flooding that put the assembly yard under water for several weeks. A smooth lake surface was needed so that four tugboats could tow the arch on deballasted barges. At the same time Hurricane Irene was barreling up the East Coast. Timing was everything.

"We had an hourly schedule prepared. So that even if the lift went slower than anticipated, we would be structurally secure before the storm hit," said Mallett.

At dawn on August 26, the breathtaking 8-story arch skimmed across the glassy surface of the lake. Navigating around two sunken shipwrecks, the journey was



completed in two and a half hours. Crews hooked the arch onto four massive jacks and the arch was raised into place.

They had beat the storm and by November the new Lake Champlain Bridge was completed and opened to traffic.

June 2010

- Groundbreaking was held for the project.

January 2011

- The first steel girder was set into position.

August 2011

- The center span arch was floated and lifted into position.

November 2011

- The new bridge opened to traffic.



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