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"Planning for the Lake Champlain Bridge began in about 1923, when the legislatures of Vermont and New York adopted separate commissions to investigate the need for a bridge across Lake Champlain to replace the ferry service, and those two separate commissions jointly studied different locations, met with different towns, and considered various advantages and disadvantages to different locations along the lake.

In 1925, that commission issued its report, making recommendations for the site that was ultimately chosen, and then both New York and Vermont legislatures adopted a ratification or a compact of those reports, and established a joint commission, the Lake Champlain Commission, and then that compact was ratified by Congress, and the Lake Champlain Commission was actually formed in 1927, and that Lake Commission then began the process of planning the design for the bridge.

Bridge commission takes charge

The commission selected the location, because of the advantages of the bedrock that was at that site, and for the particular bridge design, that bedrock was – had several – made several – offered advantages. In addition, it was in a way a compromise: southern versus northern location crossing the lake. This was the first highway bridge across the lake, and the commission considered the various traffic routes that would be used by people in automobiles, and this was this most convenient of the locations. So there was quite a bit of discussion about different alternatives, and some lobbying by various communities, but this site seemed to have the most advantages.

Each of the governors of the two states, Vermont and New York, appointed three members of the commission. Mortimer Ferris was elected chairman of the commission, and the role of the commission was to begin developing designs for the bridge, itself, and ultimately take ownership of the bridge, and supervise its maintenance, and collection of tolls and oversee the financing for the bridge.

The bridge commissioners didn't design the bridge collaboratively; they began inviting proposals from various engineering firms, and worked very closely with a Boston firm, Fay, Spofford & Thorndike. Charles Spofford and Frederic Fay were the two principal engineers in that firm, who worked with the commission. Fay was the person who really coordinated with the commission, and was very active in overseeing the actual logistics of building the bridge, but Charles Spofford was the designer of the bridge, and the records are a little bit hazy on exactly how that firm was chosen, and we don't know enough about that process. The archives for the Lake Champlain Commission are very complete. There's lots of correspondence, a lot of records, all the original plans, a lot of old photographs, but the correspondence is a little bit weak, and the – in telling us how exactly Fay, Spofford & Thorndike were chosen. We know a little bit about the background of that firm. All three

engineers – Frederic Fay, Charles Spofford & Thorndike were graduates of MIT, and formed a partnership. Spofford went on to teach at MIT, and really became the firm's designer. Fay was sort of the lead administrator of that firm. Spofford is also an author of a number of important treatises, and was really a leading designer of his day."

A design to fit site

The bridge was designed to accomplish, or to address a number of concerns. The Lake Champlain Commission was interested in having, or recognizing that the bridge respond to the area's scenic qualities, and they were concerned about having a very large bridge that interfered with those scenic qualities. And from the very start, Spofford provided a series of different alternative designs, and I think in part those early alternatives may have been one of the reasons why their firm was selected. They were sort of ahead of the rest of the crowd in offering different design alternatives. They considered a number of different bridge types, including suspension, arch, and truss bridge types, and selected what is called an arching truss bridge as the best of those alternatives.

The arch bridge is visually attractive; the arching form is very appealing, but at this site the bedrock was too deep in order to really provide a good support for an arch bridge, and the same was true for the suspension bridge. The truss bridges offered more economical alternatives, and to some extent were less obtrusive, visually, than the other types of bridges, principally because the other types of bridges would have – would have had to have been so much larger, but the truss bridges sometimes aren't – are not as aesthetically appealing as the arch forms, and so the beauty of Spofford's design is that he introduces curving forms to the truss bridge design, and that was one of the principal reasons why the that particular design was selected.

An ambitious project

This is really an ambitious project. It's the first highway bridge to cross Lake Champlain. It's built during an era when automobile traffic is increasing dramatically, and the lake had provided a substantial barrier to automobile traffic moving across from the Adirondack Mountains to the Green Mountains, and on to the White Mountains, and even the coast of Maine. And so this was a key part in that effort to link northern New England, and it joined Route 22 in New York with Route 7 in Vermont, which in turn linked major cities – Albany, Montreal, New York – and so, it's a key – key piece to automobile travel – touring, tourists – tourism in northern New England.

In addition, the bridge's size is important. This is a major bridge project for its era. It's Just the length of the span, the height of the channel crossing, and all the other engineering considerations made it a major engineering project during its day.

The bridge was originally used for automobile traffic, and it still – that still is its primary function. There haven't been too many changes, or there weren't too many changes to the bridge from the time it was built until the time that it was demolished. It survived very much intact. The travel width became a little wider, but the deck system was replaced in

the 1970s, and a pedestrian walkway was added, but other than that, the bridge was pretty much in its original form when it was demolished.

The Lake Champlain Commission was fairly close in anticipating how much traffic would use the bridge. As I said, The Depression created some decline, but not as much as one might think today, and the traffic that used it –– the number of people using the bridge were – it was close to what the commission predicted.

Significant historic landmark

The bridge is really a significant historic landmark for a variety of reasons, some of which involve engineering, some of which involve the – its role in evolving automobile traffic, and some of which just involved the location, itself, the scenic quality of that – of that area. Some of the engineering becomes complex, and the bridge really represents the culmination of evolving technology in several different fields – a particular truss type that we call "continuous truss design," and also the use of cantilevers, which helped to increase bridge span length, and also reduced construction costs.

The bridge also is a culmination of a debate occurring within the engineering community about the aesthetic quality of bridges, and that debate becomes increasingly important as automobile traffic increases. Automobiles provided, or allowed access to scenic locales, and as automobile traffic increased, new highways needed to be built, and new highways needed new bridges over, in many cases, increasingly wide bodies of water, rivers or bays, and those large bodies of water were often in scenic locales, and so it became necessary for engineers to design bridges that somehow responded to these scenic locales.

At the same time, river traffic is also important, and obtaining clearance – sufficient clearance above the waterway is essential. And to do that, bridge size has to increase, and so it's a struggle to achieve a balance between minimizing the bridge size, as a way to minimize visual impact in scenic locations, and at the same time create sufficient height for waterway traffic. And the Lake Champlain Bridge became the prototype for solving that problem, and it was the first of its type in America, and it became a model that was used by engineers throughout the remainder of the 20th century, and there are bridges still being built, using that basic idea.

Overcoming design challenges in 1929

When the Lake Champlain Bridge was built in 1929, the engineers who designed it confronted a number of difficult challenges, including the need to establish sufficient height over the channel span, a height that was established by the Army Corps of Engineers, and also a need to sink the piers that were built all the way of bedrock, and in addition to build the channel span without any false work. In other words, the channel area had to be kept open. That was one of the requirements for, or by the Army Corps of Engineers. And so – and also, too, the depth of the lake at that point – 100 feet – made construction of the piers difficult, and so the original plans for the bridge, which are part of the archives of the Lake Champlain Commission, don't show the piers in finished –

don't show a finished design for the piers. They left the channel piers unfinished, allowing the successful contractor for the substructure to bid based on various proposals, and the design that was ultimately used for the channel span was called an "open cofferdam process," and they poured the concrete in the wet, as it's called.

They built a cofferdam all the way down to bedrock, and used a steel frame to support that cofferdam, and then poured the – that steel frame became a series of steel cages that went all the way to bedrock, and then the concrete was poured around those steel cages, all the way up to a level slightly below the water level of the lake, and then from that point on for those channel piers the cofferdams were pumped dry, and the concrete was poured in that dry area. So, those were important challenges, or important difficulties that the designers faced, and the bridge piers at the time became some of the tallest piers to use the open cofferdam process.

Another of the challenges that the engineers faced concerned the construction of the channel span without the use of false work. In other words, a substructure to support the bridge during its construction phase, and again, that was necessary because the channel had to be kept open for lake traffic. So, the engineers devised a system of cantilevers mounted on the channel piers, and suspended each of those cantilevers outward to the point where they actually met. In other words, a final steel beam was installed to join the two approaching cantilevers, and then that – those – that steel – those steel parts became riveted to become what we call a "continuous truss.

That cantilever structural system was also innovative. Railroad engineers had been developing cantilever designs for some decades. Cantilever designs can both extend spanned length, and also reduce construction costs, which is what was valuable here. And so, that, too, is part of the historic significance of the bridge's engineering.

The firm that supplied the steel was one of the country's largest manufacturers of steel, the American Bridge Company, steel for bridges. The American Bridge Company had been formed as a conglomerate of bridge companies in the early 1900s by JP Morgan, and eventually American Bridge Company became part of the US steel empire. During the late 1800s, bridge manufacturers were located in major cities throughout the country, and during the late 1800s, a period of consolidation occurred in a lot of different industries, including the bridge industry, and JP Morgan began acquiring all of these separate bridge firms, consolidated them into a single company – the American Bridge Company – and began operations, principally in Ambridge Pennsylvania, which is not too far from Pittsburgh, and then eventually sold his business to US Steel.

Its engineering significance

One of the important aspects of the bridge's historic significance as an engineering landmark concerns its design, and there are really four different technological developments that converge at the Lake Champlain Bridge: truss bridge design, cantilever technology, the concern about visual quality, and increasing use of automobiles.

As to the first, the development of continuous truss technology, a truss bridge is a series of triangular frames that are joined together to form a single beam. A truss functions in the same way that a beam functions, but without all of the central mass in a beam that does little to support loads. Most of the stresses that beams must absorb are at the top of the beam, or at the bottom of them beam, and by removing that middle area, and replacing it with diagonals, or a series of triangular frames, the weight of that beam is reduced, and the length of the span can be increased. So, that is – that explains a little bit about how truss bridge technology functions.

For a simple span bridge, that has to cross a fairly extended length, piers are built at different – at different locations. And so if you have a four-span bridge, what you have is really four separate simple span bridges. That works, but it's structurally inefficient in the sense that the stresses that that bridge has to address aren't distributed very efficiently. We can replace those individual beams with a single long beam across those same four spans, and in doing so create much greater structural efficiency. The stresses are distributed much more evenly, and that in turn, reduces the amount of materials required, the weight of those materials, and their costs.

And so, with the development of what is called "continuous beam" or "truss" technology, cost savings begin to develop, and of course it's – the railroad engineers are the first to begin experimenting with continuous beam or truss technology, and continue to develop that. But there are problems, and one of the problems is that it's very difficult to calculate how those stresses are being distributed throughout either this long continuous beam, or this long continuous truss. Ultimately, a method for calculating those stresses is established by the late 1920s, early 1930s, and that's why the Lake Champlain Bridge becomes so important. It uses – it's really the first bridge to use that continuous truss technology, but to use it in a special – for highway bridges – but to use it in a special way, and to – to create a graceful transition between the approach spans, and the arching through span, and it's – and that, too, is tied to the cantilever system. It's the cantilevers that make that – that arching transition between the deck truss, and the channel span through truss possible.

I should probably explain the difference between a deck truss, and a through truss. In a deck truss, the structural support system is located below the roadway. In a through truss, that structural system is located above a highway. The through truss offers advantages in terms of providing greater channel height. The deck trusses offer advantages in terms of lower costs for the approaches. The pier height doesn't need to be as – as tall. And so, you have potential for a bridge with low deck truss approach spans, rising to a through truss channel span. But at the juncture of those two types, the deck truss and the through truss, there is a very visually awkward transition, and the Lake Champlain Bridge solved that problem, solved that visual problem by creating the curving form from the deck truss to the through truss, using cantilever anchors that not only allowed that curving transition, but also reduced the construction costs by eliminating the need for false work in the channel span.

Opening day was a big event for both states, and thousands of spectators attended; a large parade with lots of floats crossed the bridge; the governors of both states attended, and really celebrated the union of the two states that had been separated by this wide lake.

Well, the whole process of two states adopting a joint compact to construct a bridge between the two states is unusual, and an interesting part of the story. And that compact needed to be ratified by Congress, adding complication to the situation, and so it's – that's an important part of the story, too, that the two states were able to work well together, and build a bridge in really an incredibly short period of time is, I think, a good indicator of the way that the state's two legislative bodies collaborated.

Funded by tolls

Toll collection was an important part of the bridge's design. The Lake Champlain Bridge Commission was very proud of the fact that the bridge was designed and built at no cost to taxpayers. It was funded by bonds and the tolls were necessary as a means to repay the bonds, and remarkably not long after the bridge opened the stock market crash occurred, and the country's economy began to decline. The calculation of the amount of bonds needed to fund the bridge, and repayment of those bonds was based on the amount of automobile traffic that would use the bridge, and almost immediately the – those figures, the number of automobile travelers fell below what the commission had predicted, and so they weren't able to – they fell behind their schedule, but – and this is the interesting part, too – during the 1930s, even though the economy – the country's economy was in decline, highway construction really thrived. It was one part of – of American industry that really wasn't affected that much by The Depression, and highway traffic traveling by automobile, people interested in touring, all of those – all of that continued – remained fairly steady during the 1930s, and so the commission was able to generate sufficient tolls to repay the bonds.

Originally, the tolls were a dollar, and they were collected at a little booth in the middle of a toll collection plaza on the New York side, and adjacent to that plaza the commission constructed a toll keeper's house, which is still standing.

The tolls were concluded in 1987, because the two states agreed to divide the two bridges that crossed Lake Champlain, one at Rouses Point, and one at Lake – and the side at Chimney Point. New York obtained the Lake Champlain Bridge, and Vermont acquired the Rouses Point Bridge, and the toll system became unnecessary at that point. The Lake Champlain Bridge Commission was dissolved, and tolls were unnecessary.

People used the bridge for a lot of different reasons. Tourism was one – was one important use, but I think people on one side of the lake began traveling to the other side for a great many reasons, including work, just casual day excursions, a great many different reasons.

Through the years

During the 1970s, changes – very minor changes were made to the deck of the bridge; the engineers were able to squeeze a little more width out of the travel lanes, and to create a more adequate pedestrian walkway. In the bridge's original form pedestrians were forced to walk on a two-foot wide concrete surface that was elevated slightly above the curbs, and that was the – that was a disadvantage to the original design, and also the travel lane widths in its original design were narrow. They were still narrow, even after those changes, and that was one of the difficulties that today's engineers faced in trying to decide what to do with the old bridge. There just weren't many ways to widen the bridge successfully to accommodate larger size of vehicles using it.

The commission and the engineers that designed the bridge couldn't have anticipated how much traffic would continue to use the bridge today. In fact, the history of highway and bridge engineering throughout the 1920's, 30's and 1940's is very much a story of engineers try to keep pace with the increasing volume of automobile traffic and the increasing speed of that traffic and the ways in which that speed and volume affect the actual design of both highways and bridges. So it would have been very, very difficult for the engineers to anticipate the volume of traffic and speed through the years in the future.

A difficult decision

Regarding the – the demolition process, the engineers made a call that the bridge was unsafe for workers to really work on the bridge, and that's a difficult choice, a difficult decision, and ultimately they had the best evidence about the bridge's structural weaknesses, and that's the type of decision for which they are best suited. And so, it's not so much a question of either agreeing or disagreeing with the decision to blow up the bridge, as it is leaving the matter of safety to the engineers who have the information about whatever structural weaknesses existed in the bridge.

It's a very difficult issue, and certainly those of us who wanted to preserve the bridge wanted to explore ways to do that, and look for all the possible – or examine all the possible alternatives for preserving it, and there's a certain threshold that we have to cross to be satisfied that all of those alternatives for preserving the bridge have been thoroughly explored. On the other side, the engineers have to be satisfied that the bridge is structurally adequate for whatever work is going to be conducted, and ultimately if they are wrong in their decision, and someone is injured, responsibility rests with the engineers who made that decision. So it's a – it's a difficult – difficult problem. And I think that they reasoned that demolition or implosion was the – or I should say explosives where the best means for doing that.

When we learned that the bridge was scheduled for demolition, the immediate reaction was one of concern, because it's such an important landmark, and once a bridge is gone, there really aren't any ways to adequately commemorate that bridge. It's – the bridge, itself, is a commemoration of the engineering innovations it represents, and so it became important to us, I think, to look for ways to – to try to preserve it.

Design of new bridge

The new bridge that is being built, as we speak, is a very different bridge type from the Lake Champlain Bridge, so in that sense it doesn't really pay homage to the old bridge. On the other hand, I think that the intense debate that developed around the loss of the Lake Champlain Bridge focused everyone's attention on the visual merits of the Lake Champlain Bridge, and helped to generate interest in creating a new design that also responded to the scenic quality of the area in the same way that the Lake Champlain Bridge was designed to respond to that scenic quality. And so, in that sense the two have some type of relationship. The arching form is the – is the critical part of that visual quality, and the arching form is visually similar to the arching form of the truss bridge, but it's important to remember that the two bridges are – represent two different types of engineering. An arch is – is a different type of bridge than a curving truss bridge, or an arching truss bridge.

I'm interested in the new design. I'm always interested in the design of new bridges, and I think that among the various bridge types that could have been built at this site, the new bridge does respond successfully to the area's scenic quality. So, in that sense, yes, I'm happy with the design.

Locally and nationally significant

In recent decades, a lot of historians have become interested in bridges, and drawing the public's attention to the historic significance of bridges. There are different categories, or classes in historic bridges, and some are important because of their contributions to communities. Visually, for example, a bridge can be a very strong visual component in a village setting. It can be a – provide an entrance into a village, and be really important to that particular community.

The Lake Champlain Bridge is significant on a national scale. It's really the first of its kind in America, and thus its historic significance needs to be considered in a much broader context. There were two earlier continuous truss highway bridges, both of which were built in Oregon, but the Lake Champlain Bridge is the *first* to use that same continuous truss technology, but to employ what one bridge historian, Carl Condit, calls this "arching, swinging transition between deck truss, and through truss." And it's that visual solution that really blossoms here at Lake Champlain, and it's that visual solution that other engineers adopt, and continue to use throughout the twentieth century, and that's important testimony to the success of this particular design at the Lake Champlain Bridge. Engineers in America had been trying to find a solution to this problem for several decades, and had done so unsuccessfully, but it was Charles Spofford who really found the solution, and that is what gives the Lake Champlain Bridge its great significance, nationally.

Some of the best evidence about the true significance of the Lake Champlain Bridge is – or are the other bridges that engineers built over major river crossings, major bodies of

water throughout the country: The Delaware River, the Susquehanna River, the Hudson River, and it's the fact that so many other engineers accepted the design that Charles Spofford developed at Lake Champlain is really a strong indicator of how successful his design is, or was.

Documenting historic bridges

The increasing interest in historic bridges led to a number of developments, and including a book that was published by – collaboratively by the Vermont Agency of Transportation, and the Vermont Historical Society, and the book is titled *Crossings: A History of Vermont Bridges*. It's really an attempt to increase public awareness of the strong visual role that bridge play in village centers, in local neighborhoods, in rural landscapes, and to draw people's attention to the different types of bridges that exist, some of which are rare.

For example, stone arch bridges are a really good example of a very attractive bridge type that is – has become increasingly scarce. And because there are so few, people aren't aware of this really interesting engineering design that can contribute so significantly to any number of different settings, whether in a small neighborhood, or the center of community such as Keeseville, for example, or just out in the countryside, and so the goal of this book was to – to increase public – the public's awareness of the different bridge types, all the way through – not just including the bridges that are well known, for example, the covered bridges, but also modern types of bridges that have their own interesting engineering history, and interstate bridges, for example.

The whole story of how interstate bridges were built is a really interesting one. It's the engineering departments, and transportation agencies were working just as computerized technology was beginning to become available, and that computerized technology made important changes in the way bridges were designed. And the interstate era represents some of both – both periods, and if you learn how to recognize the different bridge types as you're traveling along the interstate, for example, you can see that shift from earlier simple span technology to more advanced computerized technology.

Valuable paper trail

There are so many different aspects to the Lake Champlain Bridge that are interesting, and the records that have been preserved by the Lake Champlain Commission are very much a part of that. And those records are extremely valuable as a way to document the increasing and changing type of traffic that cross the bridge, and I think that when the bridge was built the commission anticipated it would provide a link or a gateway into or between the Adirondack Mountains, and the White Mountains, and Green Mountains. And they really publicized that aspect of the bridge, and used that as a way to justify the cost of the bridge, and its construction. But over time, the – the use of the bridge evolved, and economic development on both sides of the lake began to depend on the bridge, and ultimately, when the structural failings of the bridge became apparent, the ways in which the bridge use had evolved also became crystal clear, and the loss of that bridge, even

temporarily created enormous economic hardship for people on both sides of the lake. And that, too, is part of the evidence that is important to the bridge's evolving history.

I can't really think of many major bridge projects that are so carefully documented throughout their entire history. It's one thing to have original plans for a bridge, and correspondence regarding the design of the bridge, but to have also the annual reports by the Lake Champlain Commission documenting the amount of tolls taken each month, and the number of people who use the bridge, and to some extent awareness of the changing type of use is really an interesting part of this story, and those archives are enormously valuable."