

THE CHAMPLAIN BRIDGE AND THE BONAVENTURE EXPRESSWAY

Introduction

The Champlain Bridge, opened to traffic on June 29, 1962, was named in honour of explorer Samuel de Champlain, who founded Quebec City in 1608. The Bonaventure Expressway, which is part of the north approach to the bridge, was opened to traffic on April 21, 1967.

The Champlain Bridge links the municipalities of Brossard and Verdun, and is approximately 6 kilometres in length. It carries 6 lanes of traffic separated by a median. The main span, cantilever type, is made of steel. It supports an orthotropic steel deck with a bituminous asphalt pavement. Clearance above the surface of the St. Lawrence Seaway is approximately 49 meters. The remainder of the bridge consists of prestressed concrete beams supporting a prestressed concrete deck covered with asphalt pavement.

Traffic on the Champlain Bridge is estimated at approximately 49 million vehicles per year.

Historic

Announcement of a Toll Bridge Construction (1955)

On August 17, 1955, the Honourable George Marler, federal Minister of Transport, announced that a toll bridge would be built over Nuns' Island to the South Shore. The bridge would connect the city centre and the South Shore of the St. Lawrence River. At the time, three bridges linked the Island of Montreal and the South Shore - the Victoria, Jacques Cartier and Honoré Mercier - but they had become inadequate to carry the growing volume of traffic. In June 1955, the National Harbours Board was placed in charge of the project. Financing was provided through advances from the federal Department of Finance.

Choice of the Bridge Location (1955)

Decisions on the location of the bridge and its approaches were made at meetings organised in the fall of 1955 by the National Harbours Board, which set up a Technical Committee with representatives of the provincial Department of Roads (today the Quebec Department of Transport), the St. Lawrence Seaway Authority, Hydro Québec, the City of Montreal and some South Shore municipalities.

Expropriation of Lands (1956)

In 1956, the river was sounded. The location of the bridge was determined and preliminary designs were studied. Expropriation procedures also got under way. Originally, a four-lane bridge was planned, with the possibility of widening it later to six lanes, but after studies showing the enormous development potential of the South Shore and cost analyses were received, it was decided to go ahead with a six-lane bridge immediately.

Hiring of the First Professionals (1957)

In 1957, the National Harbours Board hired Dr P.L. Pratley as the consulting engineer for the project. His son, H.H.L. Pratley, took over and completed the job after his father died in 1958. The Board also hired engineer Philippe Ewart as an expert in traffic flow, and engineers Lalonde and Valois as consultants for the Montreal approaches and to oversee the concrete work. National Harbours Board employees were put in charge of electrical installations and construction of the administration building and toll plaza.

Bridge's Official Name (1958)

When the project began, the bridge was called the “*Nuns’ Island Bridge*” because it crossed over St. Paul Island, better known as Nuns’ Island. In 1958, it was officially named the “*Champlain Bridge*” in honour of Samuel de Champlain, who founded the city of Quebec in 1608.

Opening of the Bridge (June 28, 1962)

The bridge was opened on June 29, 1962 without an official ceremony. At that time, the only approach to the bridge was via Wellington Street (section 2).

Opening of Section 1 (December 7, 1964)

Two years later, on December 7, 1964, section 1 was opened to traffic.

Construction of the Bonaventure Expressway (1965)

In the interval, discussions were carried out between the National Harbours Board and the City of Montreal regarding the construction of a third approach to the bridge that would bring traffic into the downtown area. As a result, it was agreed to build the Bonaventure Expressway under the following conditions:

- a) All land required would be expropriated by the City of Montreal and would remain its property.
- b) The National Harbours Board would make available, without cost to the City of Montreal, all land owned by the federal government.
- c) All construction costs, including engineering fees, would be divided as follows:
 1. From Notre Dame Street to the centre of the Lachine Canal: to be paid by the City of Montreal;
 2. From the centre of the Lachine Canal to the Champlain Bridge: to be paid by the National Harbours Board.

This proposed approach took on a whole new dimension when plans for Expo 67 were unveiled, as it became apparent that the Bonaventure Expressway would be the main access to the Expo site! The expressway was designed with this in mind and the construction contract was awarded on August 6, 1965.

Inauguration of the Bonaventure Expressway (April 21, 1967)

On April 21, 1967, seven days before Expo 67 opened, the Bonaventure Expressway was officially opened by Guy Beaudet, Manager of the Port of Montreal, and C.A. Boileau, Director of Public Works at the City of Montreal, in the presence of representatives of the National Harbours Board, the City of Montreal, the consulting engineers, the contractors and a number of other people who had worked on the project.

Abolition of the Toll (May 4, 1990)

The toll, which was payable from the time the bridge was opened in June 1962, was abolished on May 4, 1990.

The Bridge

Geographic Situation

The Champlain Bridge spans the St. Lawrence River and Seaway, and is located between the Honoré Mercier and Victoria Bridges, some two miles (3.22 km) upstream from the latter.

On the South Shore, the bridge has direct connections with Highways 132, 10 and 30. Beginning at Nuns' Island, to which it is connected by access and exit ramps, the bridge separates into three approaches onto the Island of Montreal. The first connects it to Wellington Street in Verdun, the second links up with Highway 15, leading to the Atwater Tunnel, the TransCanada Highway (Highway 40) and Highway 20, and the third approach, namely the Bonaventure Expressway, brings traffic into downtown Montreal and onto the Ville Marie Expressway.

Traffic

The Champlain Bridge is the busiest bridge in Canada. Since it opened in 1962, the number of vehicles travelling over it has increased constantly. From an annual average of 7,300 vehicles in 1963, traffic rose to 33,400 vehicles in 1968 and 109,700 in 1989. In 1999, the daily average was 134,000 vehicles, of which 9% were trucks.

Traffic Lanes

The Champlain Bridge has six lanes, three in each direction, with a concrete separator in between.

Since 1982, a reserved bus lane travelling counter to traffic has been operating on the Champlain Bridge during rush hours. *The Agence métropolitaine de transport*, the provincial government agency in charge of public transit for the Greater Montreal region, manages the reserved bus lane. Statistics provided by the agency indicate that some 30,000 public transit users travel in the reserved lane every day of the week.

Lighting System

The lighting system consists of high pressure sodium lamps attached to steel poles. An electrical sub-station located in the administration building supplies the power needed to light the bridge and its approaches.

Bridge Sections

For the purpose of easier identification, the bridge and its north and south approaches were divided into 12 sections:

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- Section 1 Includes the approaches leading to and from the Atwater Tunnel and La Vérendrye Boulevard in Montreal and the Bonaventure Expressway access ramps. It is 4,290 feet (1,308 m) long;
- Section 2 Consists of the approaches to Wellington Street in Verdun and is 2,264 feet (690 m) long.
- Section 3 Known as the *Nuns' Island Bridge*. It extends from the west abutment to the east abutment of the Nuns' Island Bridge and is 1,536 feet (468 m) long.
- Section 4 This section is 3,060 feet (933 m) long and includes the administration building and access ramps to Nuns' Island and the Bonaventure Expressway.
- Section 5 Extends from Nuns' Island to the steel structure of the bridge. The longest section of the bridge, it measures 7,053 feet, 4 inches (2,050.4 m) and has 40 spans, each one 176 feet, 4 inches (53.7 m) long. Starting at Nuns' Island, the bridge slopes 0.85% up to the following section, placing section 6 at 120 feet (36.6 m) above the St. Lawrence Seaway so vessels can pass under freely.
- Section 6 The bridge over the Seaway has a clearance of 120 feet (36.6 m) over the entire width of the channel. This section includes the main span, a 1,477-foot, 9-inch (450.5-m) steel structure consisting of three arms, including a centre cantilever arm 706 feet, 9 inches (215.4 m) long.
- Section 7 Bridge between the steel structure of section 6 and the South Shore abutment. This section has ten spans, including four that are 176 feet, 4 inches (53.7 m) long, two that are 168 feet, 8 inches (51.4 m) long, three that are 172 feet, 4 inches (52.5 m) long and one that is 172 feet, 10 inches (52.7 m) long, for a total length of 1,733 feet, 1 inch (528.4 m). This section slopes 3% downward to the South Shore.
- Section 8 South Shore approaches. They measure 2,322 feet (708 m).

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- Section 10 The elevated section of the Bonaventure Expressway. Located between the Victoria Bridge and the edge of the Corporation's land next to the Lachine Canal, it is 4,428 feet (1,350 m) long.
- Section 11 The section of the Bonaventure Expressway along the St. Lawrence River between the Clément Bridge (section 13) and the elevated expressway (section 10). It is 3,644 feet (1,111 m) long.
- Section 12 Located between section 11 and section 2 of the bridge. It begins at the north end of the Clément Bridge and ends just before the Wellington Street exit in Verdun. It is 5,123 feet (1,562 m) long.
- Section 13 Part of the Bonaventure Expressway that connects section 4 to section 11, including the Clément Bridge and an overpass. It is 2,309 feet (708 m) long.

Construction

Construction Cost

It cost roughly \$35 million to build the Champlain Bridge, \$52 million if the approaches and Bonaventure Expressway are included.

Construction Call for Tenders (1957)

In 1957, once the plans were completed, the National Harbours Board put out a call for tenders for a project, with plans supplied to the tenderers. However, the project authorised the submission of different alternatives subject to well-defined conditions. In all, 14 firms submitted 28 proposals.

Section 6 Piers (July 25, 1957)

The first contract was awarded on July 25, 1957 to Atlas Construction Company Limited to build the four piers supporting the steel structure in section 6. The contract was awarded earlier than originally planned so that the two piers within the Seaway, which was under construction at the time, could be built before the channel was flooded.

Piers and Abutments on the Montreal's Side, Temporary dams (1958)

In 1958, three contracts were awarded for construction of temporary dams, fill work on Nuns' Island and construction of the piers and abutments on the Montreal side.

Unlike the approach taken for most bridge piers, none of the pneumatic caissons for the Champlain Bridge were built on land. Instead, they were assembled in the St. Lawrence itself. They rest on a bed of shale at an average depth of 39 feet, 4 inches (12 m) below the high water mark and are between 11 feet (3.35 m) and 85 feet, 3 inches (26 m) in height. The circular shape of the piers and their size were dictated by resistance to ice pressure, which is 30 tons per linear meter of pier width measured perpendicular to a direction forming a 30° angle with the longitudinal axis of the section.

Piers and Structure Section 5 and 7 (June 25, 1959)

The largest contract (\$8,319,000) was awarded for the construction of the piers and the 8,096-foot (2,468-m) structure in sections 5 and 7 to three companies that formed a partnership known as MKD: McNamara (Quebec) Limited, The Key Construction Inc. and Deschamps & Bélanger Limitée.

The contract included 46 spans, each with seven prestressed concrete girders roughly 176 feet (53.6 m) long and supported by T-shaped piers resting on a bed of shale. The time required to build the piers varied considerably. The easiest ones could be constructed in 15 days, while the most difficult ones required 49 days, with an average of 28 days of work per pier. They were built at an average rate of 6.5 per month. At the time, using prestressed concrete to build bridge beams was a recent development and this contract was the most significant application of prestressed concrete in the country, both in terms of scope and quantity of work.

Work under the contract began in July 1959 and was completed in November 1961, one day before the scheduled completion date, for a total of 22.5 months of activity after subtracting the winter months of 1960 and 1961, when all work at the site was suspended.

Bridge Girders - Canadian First

For the first time on a major structure in Canada, prestressed concrete girders with Freyssinet-type tension cables, which give the structure great additional strength, were used.

A yard was set up on Nuns' Island to build 476 prestressed concrete girders, 322 of which were used in sections 5 and 7. The site included a handling area housing eight bases for pouring concrete, and an area to build reinforcements. It took ten hours of work per day to build three girders. A tower crane moved between the different activity areas on the site. Because of the size of the job, a mechanical facility was set up for building the prestressed cables. The girders were then transported 1.5 miles (2.5 km) by two travelling cranes on rails. A 370-foot, 7-inch (113-m) long gantry crane weighing more than 250 tons was used to install the girders. At the peak of the work, the contractor was installing two complete girders a week.

Section 3 Structures (July 1959)

In July 1959, the contract for the structures in section 3, that is, 12 spans of seven girders, each 128 feet (39 m) long, was awarded for \$1,044,000. These girders, like all the others, were prefabricated on Nuns' Island.

Superstructure and Concrete Roadway Section 6 (October 1959)

The contract for the steel superstructure and concrete roadway in section 6 was awarded to the Dominion Bridge Company Limited on October 1, 1959 for \$5,907,000.

The contract covered the three main cantilever arms straddling the Seaway, which were 1,477 feet, 9 inches (450.5 m) in length, and the four lateral trusses, each with a span of 256 feet, 9 inches (78.2 m), for a total length of 2,504 feet, 9 inches (763,6 m). Construction of the 1,477-foot, 9-inch (450.5-m) cantilever arm and the suspended span required 15 months of non-stop work between June 1960 and September 1961; the work continued even during the winter months because steel, unlike other materials such as prestressed concrete, is unaffected by weather conditions. In total, 11,000 tons of steel were needed to build the girders, which were produced at the Dominion Bridge Company's Lachine plant.

Proportionally speaking, this section is only a small part of the total project, but the complexity of the problems that arose during its design and construction make it the most important. The drawings required an entirely clear span 706 feet, 9 inches (215.5 m) long between the main piers. In addition, the steel deck had to be 120 feet (36.6 m) above the water. Since the St. Lawrence Seaway was already open for shipping, falsework and floating equipment were not permitted in the channel, so the centre spans were erected cantilever style from the two main piers on each side. The work progressed into space from each side until the two sections finally met and were joined together.

Last Girder (September 21, 1961)

The last girder was solemnly put in place on Thursday, September 21, 1961. Journalists were invited for the occasion. Using a giant crane and enormous hydraulic levers, the 15-ton steel girder was first raised to the top of the steel structure and then bolted in place. All the assembly work, which required great precision, was synchronised by telephone from a central control post. Two workers then raised the Union Jack to the top of the steel structure. The following day, the Honourable Léon Balcer, federal Minister of Ports, visited the bridge.

Lighting, Buildings, Toll Booths (1961 et 1962)

Contracts for lighting, buildings, toll booths and signalling systems were awarded in 1961 and 1962.

Construction of the Second Route (1963)

In July 1963, contracts for the second route, that is, the Atwater Tunnel and La Vérendrye Boulevard approaches, were awarded to Charles Duranceau Limitée and Quebec Engineering Limited.

Bonaventure Expressway (1965, 1966)

The contract to build the first part of the Bonaventure Expressway was awarded on August 6, 1965; the road was particularly useful while the Expo 67 site was being built. Contracts for the second and third parts of the expressway were awarded in February and April 1966 respectively and the work was completed shortly before Expo 67.

Maintenance

Since its construction, a number of ongoing repair programs have been carried out on the Champlain Bridge and Bonaventure Expressway. Some of the major programs involved repairs to the roadway, prestressed concrete girders, steel structures and bridge piers, and cleaning and painting the bridge.

Main Deck

What proved to be the greatest engineering challenge was definitely the replacement of the main deck (section 6) in 1993. Despite the many repairs carried out on the deck of the bridge over the years, it had to be replaced. The work essentially involved replacing the original reinforced concrete deck and some steel support elements and installing a new orthotropic steel deck with an asphalt surface over a distance of 2,505 feet, 11 inches (764 m), nearly 25% of the total length of the bridge. In all, 254 panels had to be installed, the longest ones measuring 63 feet, 11 inches (19.5 m) in length, 26 feet, 10 inches (8.2 m) in width and weighing 42 tons. Approximately 5,000 tons of steel were used to build the panels.

Orthotropic Panels

This project to replace the concrete deck on the main span of the bridge with orthotropic panels was the first time that orthotropic technology was used to repair a bridge in Quebec. Imported from the United States and Europe, the technology has generally been used in bridge construction.

Benefits of this method:

- Lighter and more resistant than conventional concrete decks.
- Increases the structure's load capacity.
- Offers longer life span (approximately 60 years) and requires less maintenance than conventional concrete decks.
- Bridge can remain open to traffic during the work.

The panels were installed at night and at least two out of the six lanes remained open to traffic. In the morning, all six lanes had to be open to traffic by 6 am, or the contractor was fined.

The work began in 1990 and was completed three and a half years later, in the fall of 1993. It was carried out by Simard-Beaudry Limitée at a cost of \$40 million. Engineer-counsel services were provided by Lavalin Inc. (today known as SNC Lavalin Inc.).

Technical Data

It is one of the largest prestressed concrete structures built in Canada, in terms of both length and the number and weight of its girders.

Length of Bridge

From abutment to abutment: 11,273 ft 2 in. or 2.13 miles (3.44 km)

Total Length of Bridge (including approaches)

- From the South Shore to La Vérendrye Blvd at Atwater St. 24,312 ft (7.412 m)
 - Bonaventure Expressway, from the former toll booth to the edge of the Corporation's property 15,000 ft (4.573 m)
 - Link to Section 1 7,200 ft (2.195 m)
 - Wellington Street approach 1,200 ft (365 m)
- 47,712 ft
(close to 9 miles (14.5 km))

Width Between Curbs

- Sections 4, 5, 6 and 7: 76 feet, 6 lanes, with separator
- Section 3: 87 feet, 6 lanes, with separator

Steel Superstructure (Section 6)

- Cantilever type with centre suspended span
- Clear span over Seaway length: 706 ft, 9 in. (215.5 m)
- Anchor arms (2): 385 ft, 6 in. (117.5 m)
- Total length of cantilever section: 1,477 ft, 9 in. (450.5 m)
- Length of steel deck spans: 2 X 256 ft (78 m)
2 X 257 ft, 6 in. (78.5 m)
- Total length of steel superstructure: 2,504 ft, 9 in. (763.6 m)
- Clearance above high water: 120 ft (36.6 m)
