A Tale of Two Bridges

Montreal, Quebec

Amid the fanfare of the 2019 Canada Day official opening of the $5.5 billion New Champlain Bridge, which is projected to have 60 million annual crossings, making it the most expensive and busiest bridge in Canada, is the cautionary tale of the bridge it replaced. The new bridge, the largest in Quebec history, was designed under the dark shadow of the premature corrosion failure of the original Champlain Bridge.

Montreal, an island city with 3.5 million people today, was already quickly outgrowing the three existing bridges that connected it to the opposite side of the mighty Saint Lawrence river back in the early 1960s. In response, a new bridge was built, but unfortunately mistakes in its conception doomed it to fail prematurely and taxpayers were exposed to untold risk and expense. A French design concept gaining favor at the time, pre-stressed longitudinal concrete truss and pre-stressed road deck, was used.

The bridge was constructed with unprotected rebar and tensioning cables throughout including the piers and caps, and painted steel on the cantilever section of the main span. The corrosion solution was to simply specify no de-icing salt be used on the bridge. Given Montreal has one of the coldest, dampest climates of any major city on Earth, it was

After less than 50 years in service, the busiest bridge in Canada had "an unacceptable and indeterminable risk of catastrophic collapse" due to advanced corrosion of its unprotected rebar.

not surprising the very first snowfall after it opened led to hundreds of accidents. The rapid current of the river under the bridge prevents full freezing, but even when there is no precipitation, the cold wet mist of the river regularly ices the bridge through the winter. So, the "no salt" rule was quickly abandoned, and every November to April since, de-icing salts were spread continuously.

By its 30th birthday, the Champlain Bridge was already facing major corrosion problems. The entire concrete road deck and jersey barriers of the cantilever section required emergency replacement due to severe rebar corrosion. The piers and caps were also suffering from the same degradation, so the replacement deck and barriers were made of hot-dip galvanized steel rather than concrete to reduce the dead load on the weakened piers.

By 2009, the bridge was deemed to have "an unacceptable and indeterminable risk of catastrophic collapse" due to advanced corrosion. The pre-stressed concrete design revealed an even more dangerous circumstance, not only could the trusses not be replaced of repaired, but their design also prevented even proper inspection of their tensioning cables that were also most likely corroding. At this point, hundreds of millions of dollars had been spent on emergency repairs and constant maintenance and inspection. A few ➡

Galvanizer
Corbec Inc. - Montreal

Engineer
WSP

Fabricators
Soudure Camille Castonguay Inc.
BPDL Inc.
Acier AGF Inc.
Pro-Mec Elite Inc.
Canam Ponts
Structures C.P.I Inc.

Specifier/Fabricator
Pro-Ballast (Genilux)

Other
Signature sur le St-Laurent

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years later, one of the huge longitudinal concrete trusses cracked due to tension cable corrosion leaving two of the three lanes in that direction closed for months while many other trusses were found to have smaller cracks from the same problem.

By 2013, hundreds of millions of more dollars were required in emergency repairs including 94 externally rigged steel support trusses and six major shoring projects for corroded piers. The bridge also had 375 sensors installed in the hope of detecting minute indicators of pending catastrophic failure as well as 50 full-time employees charged with continual maintenance and inspection. Thankfully, despite the financial costs, the bridge was replaced before any lives were lost to corrosion induced failures.

Due to the imminent risk of collapse, the New Champlain Bridge was built at breakneck speed, but also considered the lessons learned. The design life of the new bridge targeted 125 years of reliable service. The 2.5-mile span, over the highest water flow river on Earth, was planned to hold six traffic lanes, two dedicated bus lanes and two light rail lines.

Since the construction of the original bridge, hot-dip galvanized steel has been used extensively throughout the province in many sectors. Hot-dip galvanizing's time-proven performance and rapid turnaround, as well as the availability of many large, modern galvanizing plants to meet the timeline of the mega project led to more than 15,000 tons of steel being galvanized in the project. All structural steel that could physically fit in the local kettles was hot-dip galvanized, along with all railings, anchors, signage and wind braces. Furthermore, all rebar that was within a certain distance from an outer concrete surface was either galvanized or made of stainless steel.

So, with the help of galvanized steel, the New Champlain Bridge was completed 18 months ahead of schedule and will safely transport more than 100 million people a year across the Saint Lawrence River for decades longer than the bridge it replaced. This cautionary tale of two bridges highlights the monumental dangers and costs of infrastructure corrosion and multifaceted benefits of long-lasting hot-dip galvanized steel. ■