

A photograph of a bridge over a river. The bridge has a concrete support structure and a steel deck. The river is turbulent with white water rapids. The background shows a forest of trees under a cloudy sky. A text overlay is present in the center-right of the image.

Reconstruction of the Bridge over the Mistassini River

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Consortium Stantec|SNC-Lavalin Joint Venture

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Total mass
of the steel structure
1 600_t

Longest span
ever in **Québec** for this
type of structure

Innovation

Reconstruction of the bridge along Route 169, above the Mistassini River, involved replacing the existing, obsolete bridge, which dated back to 1948. Erected above the narrowest part of the river, the bridge's alignment hampered road functionality and no longer met visibility and road safety requirements.

To improve road functionality, traffic flow capacity, and road safety, a new structure was built downstream of the old bridge. The concept entailed building a reinforced concrete slab bridge on steel girders (262 metres long, with a central span of 100 metres) — the longest span ever in Quebec for this type of structure. Its development had to follow the site's natural topography, with the construction of piers in the river, while meeting the requirements associated with the watercourse's very high natural flow (9 m/sec), especially during flood season.

The current configuration includes two traffic lanes heading to Dolbeau and one lane toward Mistassini. The 18.1-metre-wide bridge deck is separated by a concrete median barrier, to reduce the risk of accidents. Complementing the structure is a 2.75-metre-wide multipurpose path. The downstream sidewalk allows pedestrians to

take in a view of the Chute-des-Pères waterfall. The bridge can also be reconfigured to accommodate four traffic lanes, if needed.

The new bridge has been classified as «essential» by the Ministry, with the older bridge categorized as a «lifeline bridge» (per CAN/CSA standard S6). Central to this category is that it takes into account heightened seismic intensity at the design phase. Seismic isolators have replaced conventional bearings. Seismic isolation ensures traffic maintenance while lowering repair costs after a major seismic event. This design improves the structure's seismic behaviour during earthquakes and reduces construction costs of river piers, thus promoting sustainable development.

The project included the design of two new sections of road (372 and 288 metres long) at the approaches, to connect with the existing road, and construction of a new section of the «Véloroute des bleuets» bicycle road on the Mistassini side. A temporary detour road was built to maintain two-way traffic as well as access to businesses in this very busy urban environment (AADT of 15,000 vehicles).



Complexity

Due to the structure's scale, the design itself was challenging in that there were no similar projects to serve as a reference. The structure's design was developed based on available construction processes. Modelling was therefore carried out using two commercial software programs, in order to validate each one's results against the other.

Another technical challenge related to the seismic isolators' design. Monitoring of laboratory tests on these bearings, as required by CAN/CSA standard S6, was especially demanding. However, doing so enabled us to achieve a final result that met the highest possible standards, to our client's advantage.

This equipment type ensures good behaviour of the structure during usage in extreme temperatures and thereby limits material damage.

Although relatively complex in design, the proposed Y-shaped river piers provided added value in terms of this large-scale structure's aesthetics. Its specific shape was also advantageous in that it improved the bridge's seismic behaviour. Careful attention was given during the design to facilitate the installation of formwork and rebar at the construction site, in an aim to improve worker safety during construction.

Social/Economic Benefits

The new bridge is a wonderful example of sustainable development for the Dolbeau-Mistassini region. The reconstruction made it possible to greatly improve road functionality and user safety. The curve at the structure's western approach was completely reconfigured, with barriers added to separate the two traffic lanes. A wide sidewalk facilitates access for reduced-mobility users, while affording a fresh view of the Chute-des-Pères waterfall. The bike path was also reconfigured to benefit its users.

With construction costs at \$20M, this structure was considered particularly cost-effective compared to similar-sized works. This competitive price is partially explained by the design choices, which facilitated construction at the site, i.e.,

by positioning river piers in easily accessed locations that did not involve the need for substantial temporary structures. Several of the design's aspects were optimized, such as minimizing the number of steel girders without the contractor having to resort to unusual or unaffordable construction methods.

This project highlights the natural beauty of the river and provides better shoreline access. What's more, the bicycle road's new alignment has vastly improved cyclist safety, by eliminating the former level crossing on lanes along Route 169. The «Véloroute des bleuets» bicycle road is a major tourist attraction for the Lac-St-Jean region, and this change will boost traffic and ensure economic spinoffs for the area.



Environmental Benefits

The decision to develop a 100-metre central span helped significantly limit the project's environmental impacts; in fact, it greatly reduced the encroachment by temporary works in the river. The works' gentle footprint on the river far exceeded the standards of laws and guidelines in effect, without complicating the bridge's construction or increasing project execution costs. Furthermore, distancing the piers from the water current turbulence is expected to substantially improve their durability, as the piers are thereby less subject to being altered by nature's damaging forces. Pier columns will generally stay dry then throughout

their service life, except during flood periods.

The choice of unpainted weathering steel as the material for the metal framework is proving to be a durable alternative for the site being studied. Given that this option helps avoid the need to repaint the girders every 25 years, it also minimizes the risk of pollution emissions in the watercourse. Weathering steel is an impressively durable material when used under proper conditions.

Meeting Client's Needs

The project to rebuild the bridge along Route 169, above the Mistassini River, was undertaken because the structure no longer met current road design requirements in terms of visibility and road safety. To summarize the client's main objectives:

- ⇒ Replace the existing structure with a new one, while:
- ⇒ Improving the structure's functionality for all users
- ⇒ Minimizing the impact of works on users
- ⇒ Minimizing environmental impacts and maximizing structural durability
- ⇒ Being economical

Our design—calling for a modified curve at the western approach, additional safety barriers, increased number of traffic lanes, expanded sidewalk width, and reprofiling of the bike path—

made the new structure safe for all users.

Since the new bridge was built and put into service before the older bridge was destroyed, users experienced very limited impacts from these works.

Impacts to the environment were minimized by significantly reducing the river works, thanks to the choices made during the design period. Durability was our guiding factor when choosing the bearing system, which had to be both simple and resilient, as well as the addition of seismic isolators to minimize post-earthquake repair risks.

In short, compared with similar-scale projects, the construction costs for this project were deemed to be low.

The bridge delivered by the Stantec–SNC–Lavalin joint venture fully met the client's objectives in every respect.