



EDMONTON

Incorporating climate adaptation
measures into the Quesnell Bridge
design

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Source: City of Edmonton

THE SCIENCE

Infrastructure assets across Canada are aging and strained due in part to population growth and the expansion of our communities. Beyond the increased pressure put on Canadian municipal infrastructure as a result of higher population density, climate change effects often force high pressures or conditions on the infrastructure that it was not initially designed to support. As such, municipalities are frequently faced with high investments in maintenance and repair to ensure their infrastructure can continue to serve the community. Designing, building, and rehabilitating current infrastructure into climate-resilient ones has the potential to improve the reliability of service provision, increase asset life, and protect asset returns. As more investments are being made to design and build infrastructure in a way that anticipates and adapts to changing climate conditions, municipalities can expect to be faced with less costly retrofitting needs and a reduced risk of their infrastructure asset becoming prematurely obsolete.

THE TRIGGER

The Quesnell Bridge is one of nine roadway bridges crossing the North Saskatchewan River in the City of Edmonton. It was originally designed in 1968 as a five-lane structure to accommodate local traffic. However, since the bridge was originally built, Edmonton's population has more than tripled, and traffic volume has increased considerably. In order to alleviate current traffic congestion on the Quesnell Bridge, the municipality decided to undertake a rehabilitation of the bridge to include two additional traffic lanes. The City of Edmonton wanted to ensure that the bridge would be retrofitted in a way that would ensure its structural performance over the next 50 years and, as such, decided to undertake a climate change vulnerability assessment under the Public Infrastructure Engineering Vulnerability Committee (PIEVC) protocol to assist with the design process. The framework of the PIEVC protocol allows to define, evaluate, and prioritize information and relationships around the potential impacts of climate change on specific infrastructure.

THE APPROACH

The vulnerability assessment of the Quesnell Bridge followed the framework identified in the PIEVC protocol to define, evaluate, and prioritize information and relationships around the climate change impacts faced by the infrastructure being assessed in an effort to make recommendations around its rehabilitation. In order to define potential climate risks faced by the bridge over the next 50 years, a list of climate parameters of interest was created to further evaluate potential stressors on the structure, including future changes in temperature, precipitations, wind speed, ice, hail, and frost. For the bridge, the main risk revolved around greater temperature swings, which involve more movement of the bridge itself as materials expand and contract, as well as more extreme precipitation events that could lead to an increased flood risk.

In addition to the climate data collected in the nearby weather stations, the team conducting the assessment also considered future climate projections and potential



Figure 23: *The City of Edmonton decided to conduct a PIEVC assessment of the Quesnel bridge prior to rehabilitating it in an effort to ensure its design would be adapted to current and future climate risks.. (Source: City of Edmonton)*

extreme weather events. The impact of the climate data collected by the assessment team was considered for all components of the bridge, including abutments, piers and approach slabs. The objective was to rebuild the bridge to anticipate current knowledge about the future climate anticipated over the lifetime of the bridge. This forward-looking approach was essential to ensuring optimal performance of the structure.

The analysis revealed that two infrastructure components were showing greater vulnerability to future climate risks: The first involved the wearing surface of the deck system. The second was the drainage system, which includes the deck drainage and the retention pond. Given that these components were being replaced during the rehabilitation, the team evaluated the potential of proposed alternatives for the replacement to improve the performance of the bridge and extend its useful operational life. Although failure of these components would not lead to catastrophic failure of the bridge, the ability of these components to have consistent performance could be compromised if not properly designed.

THE OUTCOME

The PIEVC assessment allowed the City of Edmonton staff to design the rehabilitation of the Quesnell Bridge in a manner that would ensure its structural performance over the next 50 years under changing climate conditions. Throughout the assessment

process, the hired consulting firm worked in partnership with City staff to ensure they had gathered field perspective to produce a comprehensive analysis.

The rehabilitation of the Quesnell Bridge was completed 10 years ago and there have not been any issues, neither has City staff identified any concerns with the structure since the completion of the construction, despite some extreme weather events such as extreme heat in the summer of 2021. While the bridge is on an annual maintenance cycle, there have not been any emergency issues or concerns raised by the building inspectors since the rehabilitation.

A WORD FROM EDMONTON

When asked what advice he would give to other municipalities looking at undertaking a similar project, Mark Scanlon, Bridges Supervisor with the City of Edmonton, emphasized the idea that investing in the proper rehabilitation of key municipal infrastructure can have immense environmental and financial benefits for communities. "I'm a strong believer that the most resilient and environmental structures are the ones in place, the more we can do to protect them, the more sustainable and less costly they will be over time," said Mr. Scanlon. The investment made in Edmonton for the rehabilitation of the Quesnell Bridge was aligned with this philosophy and has only brought limited maintenance cost to the municipality since the project was completed.