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KLOHN CRIPPEN BERGER
2022 AWARD SUBMISSION

Photo credit: Michael Wach



Construction, 1931



Dam nearing completion, 1931



Dam spillway, circa 1950



Calgary flood, 2013



Improved bridge deck, 2021



Rehabilitated dam, 2021



GLENMORE DAM

INFRASTRUCTURE IMPROVEMENT | CALGARY



Kohn Crippen Berger

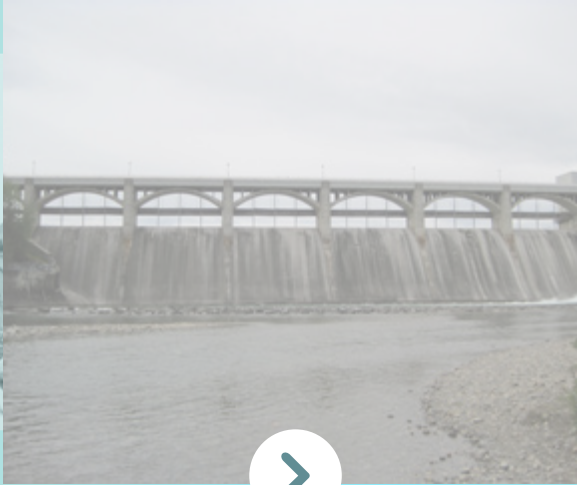
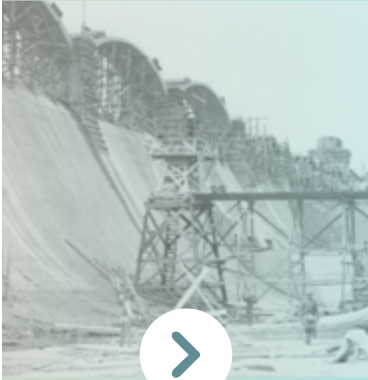


Photo credit: Michael Wach



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PROJECT TITLE	Glenmore Dam Infrastructure Improvement
LOCATION OF PROJECT	Calgary, Alberta
CATEGORY OF ENTRY	Water Resources
PROJECT OWNER / CLIENT	City of Calgary

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PROJECT OUTLINE

Glenmore Dam was created in the 1930s to provide a reliable source of water for Calgary and much needed employment during the great depression. The iconic concrete dam has stoically withstood the test of time but required improvements to extend its service life and storage capacity. The City of Calgary retained Kohn Crippen Berger to design a space that combined industrial functionality with enhanced recreational amenities, while preserving the architectural significance of the historic dam.



Photo credit: Michael Wach



Photo credit: Michael Wach



PROJECT HIGHLIGHTS

INNOVATION

Glenmore Dam is a 30 m high, 320 m long concrete gravity dam situated within the heart of the City of Calgary. The dam impounds the Glenmore Reservoir which is a critical source of raw water to the adjacent Glenmore Water Treatment Plant that supplies potable water to the communities in south Calgary. The dam, which began operations in 1933, is also important for mitigating more frequent flood events within the Elbow River. In addition to the dam's utilitarian functions, the bridge deck along the top of the dam links the City's highly used regional pathway system and the reservoir allows for boating activities.

Recent dam safety reviews and inspections identified several deficiencies with the dam facilities. These included the need for replacement of the manually operated timber stoplog system and deteriorated bridge deck, and repair of damaged concrete on the dam.

Klohn Crippen Berger and its subconsultant GEC Architecture were retained by the City of Calgary to provide geotechnical, hydrotechnical, structural, mechanical, and electrical engineering and architectural services for rehabilitating and improving the capabilities of the dam and replacing the bridge deck.

Detailed inspections and investigation programs were used to categorize the damaged concrete areas and develop targeted demolition and repair solutions. This information was also used to determine the improvements needed to accommodate the proposed rehabilitation works.

For replacing the stoplogs, twenty-one vertical lift steel gates that can resist ice loads were provided. Each gate has an electric hoist that allows for on-demand operation.

KCB used three-dimensional (3D) finite element dynamic analysis for seismic modelling of the dam given its height. The 3D model was also used to facilitate the design of the new structural elements including the intermediate piers within the gate bays and the elevated hoist platform. Stability analyses confirmed that post-tensioned anchors extending through the concrete dam into the rock foundation were also required.

Glenmore Dam is unique, not only because of its remarkable history, but because of its multi-purpose nature as a part of the City's critical infrastructure and pathway network. The integrated designs by KCB and GEC created a functional public space that not only improves the dam's industrial performance but preserves the architecturally important attributes of the iconic dam.

The many experiences gained from the Glenmore Dam Improvement Project can be used as a model for other high-profile sites where public amenities and historical interest must be intertwined with industrial functionality.



COMPLEXITY

The project, completed over three years, presented many challenges with sequencing and scheduling. Work on the dam and bridge deck had to be coordinated with high and low river inflows, changing reservoir and ice levels, maintaining adequate water storage to meet demands and preventing any contamination, avoiding environmentally sensitive periods on the Elbow River and impacts on migratory birds (primarily swallows). KCB also worked in close collaboration with multiple City departments to identify the risks and mitigation measures that would allow for the dam rehabilitation work to proceed in a cost-effective manner while reducing the potential impacts on water supply, flood mitigation, and recreational reservoir use to an acceptable level. The risk factors and mitigation measures were incorporated into the development of the construction contract and this proved to be invaluable in terms of proactively managing the risks.

As the detailed design work was progressing, the City of Calgary was subjected to an unprecedented and devastating flood in June 2013. Immediately following the flood, KCB carried out inspections of the dam and expedited the identification and evaluation of possible options that would allow for increased flood mitigation capabilities. The optimum solution of increasing the height of the proposed vertical gates to create additional flood storage was incorporated into the design.

SOCIAL AND/OR ECONOMIC BENEFITS

The capital investment of approximately \$47 million for the dam rehabilitation and bridge deck replacement works created more than 363,000 hours of employment for construction workers at the site, and the total investment of \$80 million for the entire Glenmore Dam Improvement Project has been an important stimulus to the local, Alberta and Canadian economies.

The rehabilitation of the dam and bridge deck extends its lifespan by 50 or more years and improves its capabilities to supply water and mitigate floods, maintains its architectural history, and enhances pathway connectivity and recreational boating activities for future generations of Calgarians. Water supply storage has nearly doubled to 15,000 dam³ and flood storage has been increased by 4,600 dam³.

The new bridge deck doubles the previous pathway width from 3 m to 6 m. The added width allows for the separation of sidewalks and bicycle lanes thereby improving its overall safety. Other safety and security features included lighting and security cameras. Users and visitors are also now treated to unobstructed views of the Elbow River valley, the downtown Calgary skyline and the Glenmore Reservoir which was previously not possible due to the large diameter watermain pipe located on the original bridge deck.

ENVIRONMENTAL BENEFITS

KCB's approach focused on repairs to the existing concrete which minimized demolition at the dam. All demolished parts, including concrete, rebar, and metalwork, were separated on site, and taken to Calgary recycling facilities. The timber stoplogs were salvaged.

With the doubling of the water storage capacity, the City will be able to store water during periods with higher flows in the Elbow River rather than during low flow periods. This will reduce the adverse impacts of reduced riparian flows on the downstream aquatic environment. The City is also examining potential opportunities for using some of the increased storage to manage reservoir releases to enhance the aquatic environment.



MEETING CLIENT'S NEEDS

The dam rehabilitation and bridge deck replacement were part of the Glenmore Dam Infrastructure Improvement Program, initiated in 2012. The Program goals included maximizing year-round water supply, increasing resilience against floods and droughts, preserving its architectural history, providing recreational amenities, and enhancing the downstream aquatic environment.

Maximized Year-Round Utilization and Increased Resiliency

The new gates allow the City to operate the reservoir up to its full supply level during the low inflow winter season thereby doubling the volume of water available to the Glenmore Water Treatment Plant.

The gates incorporate an additional one metre of height for increasing the available flood storage, meaning less risk to downstream residents and businesses on the Elbow River. The electric hoists allow for better management of floods through timely operation of the gates from the control room at the Glenmore Water Treatment Plant or from local control panels at the dam.

Improved Recreational Experience

The replacement bridge deck provides greater width, improved lighting and security, and aesthetic enhancements that greatly improve the experience of cyclists and pedestrians. The bridge deck completes the City's 27-km pathway system around the reservoir, and now provides unobstructed views of the downstream Elbow River valley, the downtown Calgary skyline, and the Glenmore Reservoir.

Enhanced Downstream Aquatic Environment

The gates allow for filling the reservoir when excess water is available in the Elbow River and for passing river flows during low flow periods to enhance the downstream aquatic environment.



