AWARD OF EXCELLENCE

WATER SYSTEMS CATEGORY

Chats Falls Generating Station

FITZROY HARBOUR, ONTARIO, CANADA

SUBMITTED BY KING PACKAGED MATERIALS COMPANY

Fig. 1: Barge and deck

The Chats Falls Generating Station is located near the village of Fitzroy Harbour, Ontario, and spans the Ottawa River. The dam was originally constructed by the Chats Falls Power Company. Following a comprehensive survey of the surrounding area and landscape, construction of the dam began in 1929 and was put into service during 1931 and 1932.

Today, the facility is jointly owned by Ontario Power Generation (OPG) and Hydro Quebec. The concrete portion of the dam, which was a tremendous undertaking at the time, is approximately 2.9 miles (4.6 kilometers) in length, making it one of the longest dams in North America. The dam includes five spillways which allow OPG to effectively control the water levels that flow through the eight massive turbines housed in the generation building. These eight turbines have the capability of producing up to 192 megawatts of clean renewable energy.

CHALLENGES AND SITE VISIT

The Chats Falls Dam spans the Ottawa River and lies in both the Ontario and Quebec provinces, with the larger portion lying on the Quebec side. The only road access to the dam is from the Ontario side. All construction scheduling had to be coordinated with OPG in order not to interfere with the operation of the generating station. A large portion of the construction materials and equipment had to be transported across the Ottawa River. The majority of the river crossings were made by boat and barge (Fig. 1); however, during periods when the spillways were open, some of the materials and equipment had to be transported by helicopter (Fig. 2). While work was being performed on the Quebec side, workers on the project had to travel back and forth daily from the staging area to the work stations using boats.

DAM REHABILITATION PROGRAM

The deterioration of the 80-year old concrete was primarily due to age, water infiltration and freeze-thaw attack. The critical areas requiring intervention were sections of the decks, gravity dam surface areas, downstream vertical walls, and submerged face sections of the dam.

Chats Falls Dam required a significant refurbishment to improve both safety and performance and extend the service life of the dam. The multi-year refurbishment started in Spring 2012 and was completed in Fall 2016. Numerous items were completed such as removal and replacement of portions of the 80-year-old deteriorated concrete, replacement of handrails to bring them up to code, pinning some cracked sections of the dam, underwater epoxy crack injections to mitigate leakage, and required electrical upgrades. Due to the limited access many of the concrete repairs had to be completed working from barges.

Deteriorated and unsound concrete was removed using handheld concrete breakers to a specified ICRI Concrete Surface Profile (CSP), in accordance with ICRI Guideline No. 310.2R, *Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair*, prior to the placement of the concrete repair material. The perimeter of the repair areas was saw cut to a minimum depth of ¾ in (19 mm) and the substrate was cleaned using 4000 psi (2.8 MPa) pressure washers. Galvanized mesh with a 4 in (102 mm) x 4 in (102 mm) pattern was placed in all areas that required only a 3 in (76 mm) overlay, while the 4 in (102 mm) and deeper repair sections were reinforced using epoxy coated dowels and reinforcing steel. The substrate was saturated with clean potable water while leaving the surface dry and free of standing water in order to achieve surface-saturated-dry (SSD) condition for adequate bonding.

The downstream vertical walls were formed and placed with a high performance, pre-packaged, self-consolidating concrete (SCC) mix to provide low shrinkage, low permeability and good compatibility with the existing concrete (Fig. 3 and 4). The 26 in (650 mm) slump flow of the SCC provided a fluid mix without bleeding or segregation. The forms were left in place for a minimum of 7 days for curing. Since there were many large repair sections, it was important to protect the repairs from water evaporation to reduce the potential of shrinkage cracking and to ensure the durability of the repaired concrete. The horizontal top slab of the dam was placed with a high performance, pre-packaged, concrete mix to provide low shrinkage, low permeability and good compatibility with the existing concrete (Fig. 5 and 6). The concrete was trowel finished with magnesium trowels. In total, over 28,250 cf (800 cm) of concrete was replaced.

Various sections of the dam were strengthened with steel reinforcement. Holes were drilled through the concrete and into the bedrock and 1.4 in (35mm) high strength steel pins up to 39 ft (12 m) long were inserted. The pins were then secured

Fig. 2: Helicopter transports materials and equipment

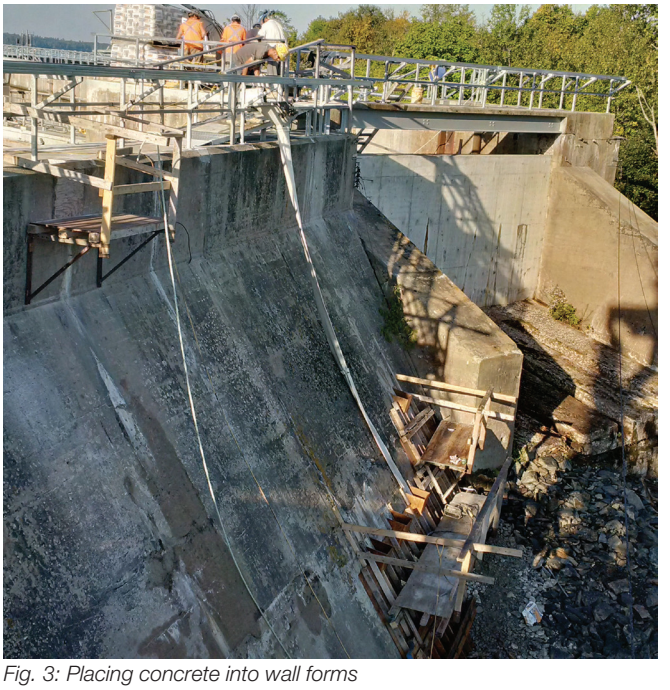

Fig. 3: Placing concrete into wall forms

Fig. 4: Concrete formwork

Fig. 5: Finishing deck concrete

Fig. 6: Placing deck concrete

using an un-sanded, washout-resistant, anchoring grout injected under pressure into the holes to encapsulate the steel.

Numerous underwater concrete repairs were also completed by divers using a washout-resistant, underwater repair mortar. After locating and sealing the face of the below grade cracks, the team of divers would drill into the voids in the concrete and inject a two-part epoxy resin to seal the many hundreds of feet (meters) of cracks that had developed over the long life-span of the structure.

ENVIRONMENT & SAFETY

OPG is considerate of both the environment and other users of the waterways. Protection of the environment was a serious concern during construction and all work was scheduled and completed to not create any negative impact on the surrounding environment. Safety is also a prime concern to OPG and a large portion of the concrete replacement was to facilitate installation of new safety rails along the entire length of the dam. The project served two purposes: to reinstate the structural integrity of the dam and provide many more years of service, and to create a safe working environment for the technicians who manage the water levels and flows according to approved water management plans.

CONCLUSION

Chats Falls Dam generates clean, renewable electricity 24 hours a day, 365 days a year, and is part of OPG's clean energy portfolio which is more than 99 percent free of greenhouse gas and smog emissions. The refurbishment will ensure many more decades of safe and reliable power generation. ■

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Boisbriand, Quebec

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Hydro Quebec
Quebec

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