

PIANC-World Congress Panama City, Panama 2018

NAVIGATION IMPROVEMENTS FOR THE WELAND CANAL

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EXTENDED ABSTRACT

The St. Lawrence Seaway Management Corporation (SLSMC) has recently completed two improvement projects for the Niagara Section of the St. Lawrence Seaway System on the Welland Canal in Ontario, Canada. Approximately \$120M CAD has been spent on these facilities to improve transport for Seaway vessels and safety for ship and Seaway operations staff.

There are eight locks and five reaches in the Welland Canal, and three of those locks are twinned for simultaneous passage. The canal runs from Lake Ontario in the north to Lake Erie in the south, and the modern canal was built in the 1950's and 1960's. In addition to the eleven lock chambers, there were concrete approach walls and timber tie-up (open quay) walls constructed as part of the Seaway navigation system.

The main purpose for the walls is to allow for vessels sliding into position for entrance and exit from the locks. Other functions include provisions for vessel to tie-up for traffic control through the locks, mooring of vessels during bad weather, ship maintenance or inspection and access for service vehicles. Mooring has been accomplished using ropes tied to bollards and winches.

The Welland Canal is regularly closed during the winter Non-Navigation Season each year, typically between the dates of January 1st to March 20th, although closure and opening times may fluctuate depending on vessel traffic and weather and ice on the Seaway. During the Non-Navigation Season, some of the canal reaches may be dewatered to facilitate construction, inspection and maintenance of marine infrastructure, including the quay walls. The year-to-year schedule for the dewatering of specific reaches is established by the SLSMC based on requirements and priorities.

During a closure period in 2010, a partial collapse of a portion of the quay wall at Lower Lock 2 initiated a four year repair program that was contracted yearly by the SLSMC. Due to the deterioration of the tie-up walls a more aggressive 4-year replacement program was then contracted for design to the Bergmann Team, which also included Moffatt & Nichol, ELLIS Engineering, Quartek Group and Terraprobe as subconsultants.

The scope of this new program included the removal and replacement of four (4) reaches of the open-quay walls totaling 1.88 km during the non-navigation seasons of 2014 – 2017. The design was completed in August of 2013 and the project, with all four wall replacements, was tendered later that month. Early procurement was also begun then for long-lead items such as sheet piling and rubber fenders.

Over the next four navigation closure periods (Jan. 1 – March 20) one reach of roughly 500m of wall was replaced with more modern steel and concrete structures using prefabricated sections and creating more resilient structures. The last of the wall replacements was constructed in early 2017, and the renewed docking system is now in full operation.

This project was initially presented and documented with a paper at the 2014 PIANC World Congress in San Francisco, USA for work through design and the construction period for the first segment of wall that previous season. This presentation will include updates and lessons learned from the next three (3) construction seasons, as well as a summary of the project success story. This project was also selected in 2017 for the Province of Ontario Concrete Project of the Year Award.

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The second Seaway modernization project was also begun in the same period by the SLSMC, and included the installation of a hands-free mooring (HFM) system within the lock chambers on the Welland Canal, as well as in locks in other sections of the Seaway System. Following the design and installation of a system by the SLSMC in Lock 3 in 2013 and 2014, the balance of the HFM system design was contracted to the Bergmann Team in 2014.

Concurrent with the reconstruction of the tie-up walls in the St. Catharine region of the canal, a new hands-free mooring (HFM) system was designed and installed within nine of the lock chambers on the Welland Canal also by the Bergmann Consulting Team. The HFM system installed is a prototype manufactured and supplied by Cavotec Moor Master Limited, Kaiapoi, New Zealand. The purpose of the magnetic suction-type system is to make tying up inside the lock chambers easier for the vessel and safer for the deck line-handlers, since no lines would be necessary. The HFM system is also estimated to save roughly seven minutes per lockage.

In order to install the HFM system in a lock chamber, slots at three locations and roughly 15'-9" wide by 5'-8" deep by 65' to 72' high in dimension, with rails installed vertically in each side of the slots, were installed in each lock. In the 2015 closure period, the HFM system was installed in Locks 1, 2 and 7. In the 2016 closure periods, the HFM systems were installed in the western lock chambers of the flight Locks 4, 5 and 6; followed in 2017 by installation in the eastern lock chambers of those flight locks. Each lock installation cost in the range of \$2.4M - \$2.8M CAD for single locks to \$3.8M CAD for each twin lock, excluding the Cavotec unit and controls which were purchased by the SLSMC under separate contracts.

The presentation will provide some of the basic design details, analysis methods, system information, and lessons learned for both the tie-up walls and hands-free mooring system projects. Photographs of existing facility demolitions, new construction and finished projects (See Photos 1 & 2 below) will be provided throughout the presentation as well.

Finally, the presentation will also provide information on the design and installation of a similar HFM System for the Eisenhower and Snell Locks in Massena, New York for the St. Lawrence Seaway Development Corporation (SLSDC). The same Cavotec HFM System has been designed for installation by the Bergmann Team (also includes O'Brien & Gere) and is currently in construction at the two US locks, and is scheduled to be completed and in operation by mid-2019.

These improvements to the tie-up walls and additions of the HFM System to the locks will make the full Seaway safer and more efficient for locking through the large 40,000 DWT vessels. Yearly tonnage of vessels in the Seaway system increased in 2017 by 9% and is expected to grow in future years as well, making these investments by both the Canadian and U.S. Seaway partners sound business decisions.



Photo 1: Completed Tie-Up Wall Construction



Photo 2: HFM System in Lock