Preparing for Vancouver's Growing Neighborhoods—The New Mount Pleasant Hydroelectric Substation

By Brian MacNeil

Within the ever-evolving construction industry, better products and building practices are making it easier than ever to tackle some projects once deemed impossible. Unprecedented techniques and situations are approached with valuable new research, testing, and insight, creating more durable and sustainable cutting-edge infrastructure. The increased reliability in overall project performance that these new techniques support allows developers to feel more confident in going forward with investments previously deemed too risky.

At an estimated cost of $201 million, mitigating risk was something that BC Hydro was actively conscientious of for their Vancouver City Central Transmission (VCCT) project. Part of the project included a new sub-station in the Mount Pleasant area of Vancouver, enhancing the reliability of power to the rapidly growing area. As environmental sustainability is a strong focus to new infrastructure in Vancouver, as well as for BC Hydro, the Mount Pleasant sub-station has been designed to meet strict LEED (Leadership in Energy and Environmental Design) standards.

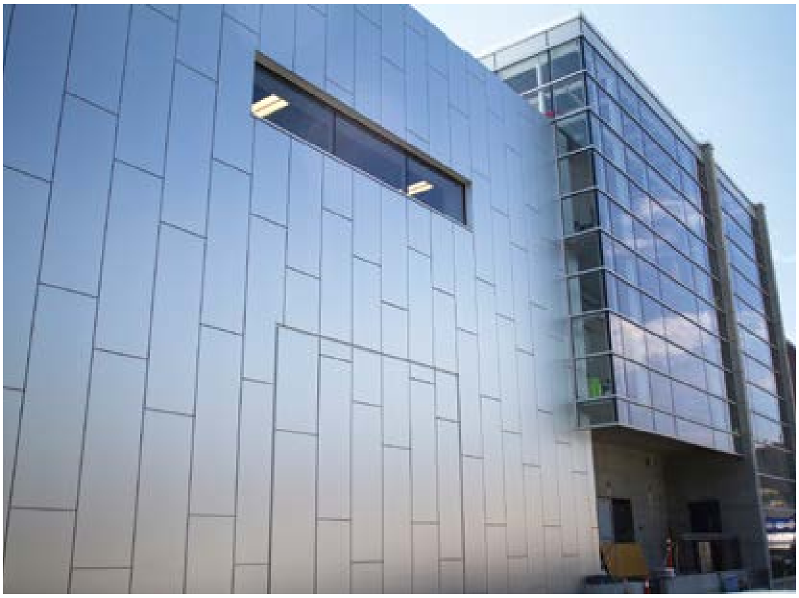

Fig. 1: The Mount Pleasant facility meets post-disaster construction requirements and is designed to achieve a LEED® Silver rating Photo courtesy BC Hydro

Not only was sustainability taken into account, but durability as well. Vancouver sits near a fault line and sits in a risk zone for a potential coastal earthquake. In an attempt to mitigate damage should such an event occur, the sub-station was designed to meet 100-year seismic standards with heavily reinforced 24 in. (600 mm) thick concrete walls.

The site itself offered particularly unique challenges to the construction. The building sits at the bottom of a slope, with the water flow rate entering the area from as much as 500 to 1500 gal. (1900 to 5700 L) of water per day. To keep the structure from floating, the engineers designed it to sit on a 3.28 ft (1 m) thick raft slab.

To assist with handling the ground water flowing below the slab, an extensive system of perforated drainage pipes was installed beneath the slab and around the perimeter of the building, called a drain mat system. The system was connected to a sump which had a three-unit pump station connecting to the city's storm sewer system.

The project's most critical construction factor was the strict requirement for the high-voltage machinery within the below-grade areas to be kept completely dry. The station cannot be shut down to repair leaks, so the waterproofing solution had to be permanent as there would be zero tolerance for leaks and moisture.

There were many factors to consider when selecting a concrete waterproofing solution that the project team could be confident in. One concern was the fact that one of the walls could not be placed using two-sided forming, therefore three walls would be built using cast-in-place (with two-sided forming), and the fourth wall with structural shotcrete by Torrent Shotcrete Structures.

Fig. 2: Preparing to shotcrete the wall. The heavily congested reinforcing bar required for seismic reinforcement made application challenging. Photo courtesy Kryton International Inc.

As the walls were to incorporate the drain mat system around their outer perimeter, close attention to joint details and placing of the four walls would be critical. The system needed to be completely sealed, which was especially challenging where the shotcrete wall met the cast-in-place walls (refer to Fig. 2).

The wall placed by shotcreting involved a number of challenges. To begin with, the wall was much larger than normal at 120 x 30 ft (36 x 9 m), needing four stories of scaffolding for the shotcrete placement. Additionally, as the structure was reinforced to seismic standards (leaving it essentially bomb-proof), the heavily congested reinforcing bar made for more difficult placement to ensure complete compaction without voids.

Commonly used sheet membranes are often problematic where cast-in-place meets shotcrete. As a sheet membrane had originally been specified for the project, the team began to search for a more compatible waterproofing solution that would provide assurance that the building would remain watertight.

After much research and consultation, the construction team selected Kryton's Krystol Internal Membrane (KIM) concrete waterproofing admixture to waterproof the below-grade areas, and the Krystol Waterstop System to fully seal the joints against water penetration. These areas would include the 3.28 ft (1 m) thick raft slab and all below-grade walls. The Kryton Waterproofing System was used to supplement an externally applied sheet membrane, as the sheet membrane could not be trusted as the only waterproofing solution for this high-risk project.

Comprehensive training on the application of the Waterstop System was provided by Kryton's Technical Team, and multiple site support visits were made. Because construction was completed in early 2014, the substation has been working as a key part of an ambitious portfolio of hydroelectric and transmission projects completed by BC Hydro to meet the projected growing energy needs of the province.

***Brian MacNeil** is the North American Regional Manager for Kryton International Inc. He has worked more than 25 years in the construction industry, with the last 15 focused on mitigating the risk associated with concrete waterproofing and protection. He has worked on both cast-in-place and shotcrete waterproofing projects across Canada and the United States, from tunnels and wine caves to large foundations and water containment projects. Sea walls and marine applications are no problem.*