CASE STUDY

PORT MANN BRIDGE

VANCOUVER, BC CANADA

APPLICATION

Divided into four segments, the Port Mann/Highway 1 (PMH1) project includes nearly two dozen Tensar® Sierra® Slope Retention System and one SierraScape® Retaining Wall System. These structures were installed as part of a massive undertaking to widen the 1.2 mile Port Mann bridge crossing the Fraser River.

THE CHALLENGE

Budget constraints and environmental concerns favored slope solutions that were more cost-efficient and offered greener profiles.

SITE CONDITIONS

Stringent design criteria called for a slope that could accommodate a projected construction settlement of 15 in. (375 mm), a post construction settlement of 8 in. (200 mm), and the ability to withstand a 975-year seismic event.

ALTERNATIVE SOLUTIONS

In 2008, representatives from Kiewit/Flatiron General Partnership, the PMH1 project's Prime Contractor, recognized the potential for an alternative to precast walls even though original drawings indicated vertical precast concrete walls.

THE SOLUTION

The project began with a "test" installation in 2009 – a 10-foot (3 meters) slope built to reinforce a ditch at a road-widening site. It currently peaks, in every sense of the word, with a massive slope running 774 feet (236 meters) in length, climbing to 30 feet (9 meters) in height, with nearly 21,528 square feet (2,000 square meters) of facing. That slope "takes us a couple of steps up the ladder in its level of design and sophistication," said Dan MacDonald, P.Eng., Manager for Nilex at the company's Burnaby (BC) office. MacDonald, along with Tensar Regional Sales Manager John Kerr, P.Eng, and Regional Design Engineer German Cajigas, P.Eng., were asked to review preliminary wall locations and look for opportunities for reinforced slopes. The three met with Kiewit/ Flatiron's Ryan Tones, P.Eng., and Ryan Bonnett, E.I.T. "The original drawings

Kiewit

PROJECT HIGHLIGHTS

Project:
Port Mann Highway 1 - Port Mann Bridge

Location:
Vancouver, British Columbia

Installation:
2009 - 2011

Product/System:
Tensar® UX1100, UX1500, UX1600, UX1700, Geogrid
Sierra Slope Retention System

Owner/Developer:
British Columbia Ministry of Transportation and Infrastructure

Design Engineer:
Kiewit/Flatiron General Partnership

Materials Supplier:
Nilex, Inc.

Nearly two dozen Sierra Slopes were installed as part of the Port Mann Bridge Project. The bridge will double existing lanes from five to ten and will sustain Vancouver's traffic growth over the next two decades.

showed vertical precast concrete walls, and we responded with conceptual drawings of slopes," MacDonald said. Following Kiewit/Flatiron's installation of the ditch reinforcement in 2009, additional slopes were approved. That included the Port Mann Bridge slope – but not before a rigorous evaluation of its proposed design.

Rising 30 feet (9 meters), with a 69-degree inclination at the face, the slope was designed by Tensar's Cajigas in conjunction with Nilex and with technical support from Tensar's Ken Akins, P.E., Willie Liew, P.E., and Brendan Sheppard, P.E., all from the company's Atlanta headquarters. "The initial design was typical," Cajigas said, "but we significantly increased the Factor of Safety, integrating conventional design and numerical analysis to comply with the performance requirements.

"That was the challenge," Cajigas continued. "After all, this was our tallest structure and the highest levels of seismicity that have ever undergone FLAC (Fast Lagrangian Analysis of Continua) analysis. We had to account for differential settlement, construction loading and the presence of the gantry crane on site."

Geotechnical engineering firm MEG Consulting Ltd. was contracted to evaluate the properties of the foundation soils and fill materials, including an assessment of the potential for liquefaction and slope response under the seismic loading design conditions. The slope design was analyzed using FLAC, the numerical modeling program that determines expected horizontal and vertical ground deformations as well as forces in the geogrid during and after a specified earthquake event. The analysis indicated the slope's "flexible response" and its ability to withstand a 975-year seismic occurrence, maintaining the performance requirements established for the project.

With the design approved, A series of stone support columns were first installed at a depth of 66 feet (20 meters). Since concrete footings were not required, the area was then topped with a level granular surface. The Sierra System's welded-wire facing units were then stepped from the granular foundation up and lined with Tensar® Biaxial (BX) Geogrid; the soil was reinforced with the primary placement of Tensar® Uniaxial (UX) Geogrid or with additional BX Geogrid. The geogrid-reinforced zone required 14,387 cubic yards (11,000 meters3) of compacted granular or sand backfill, while the project required 65,398 cubic yards (50,000 meters3) of backfill overall.

To vegetate the slope, two products from Tensar North American Green Erosion Control Systems were used: the EronetTM P300® Permanent Erosion Control Blanket below the 200-year flood level line, and the EronetTM C125® Erosion Control Blanket above. To promote internal drainage, a trench was installed within the slope, and drain gravel was placed within its lower portion. The slope transitions to a two-stage precast wall supporting bridge girders across the existing highway.

ADDITIONAL INFORMATION AND SERVICES

Tensar International Corporation specializes in solutions for site development problems such as grade changes requiring retaining walls and poor soil conditions affecting the cost of roadways, parking lots and building structures. Our solutions use proprietary engineered systems and our own unique products, services and application technologies. Highly adaptable, cost-effective and installation-friendly, they provide exceptional, long-term performance under the most demanding conditions. Our support services include site evaluation, design consulting and site construction assistance.

For innovative solutions to your engineering challenges, rely on the experience, resources and expertise that have set the industry standard for nearly three decades.

Need immediate assistance?

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