

Pacific Coast Landslide Repair Constructed in Under Five Months

Duracrete, a precast concrete manufacturer located in Whangarei, New Zealand played a key role in returning a significant roadway to service earlier this year, following a major landslide. By manufacturing and customizing Precast Modular Blocks (PMBs) on a tight deadline, Duracrete was able to provide an innovative precast solution for this challenging cliffside project. Meticulous scheduling, dedicated staffing, and teamwork were key in making this project a success, providing a solution that was constructed in under five months.

Landslide Requires Emergency Repair

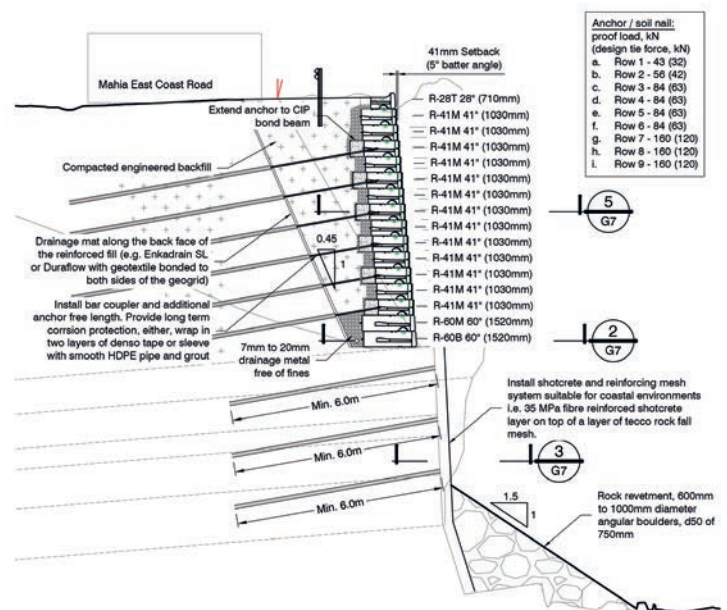
The damage to Mahia East Coast Road in Wairoa, NZ occurred in April 2019 when shoreline erosion undermined an existing wooden crib wall along the Pacific Ocean, causing 49 feet (15 meters) of the road above it to drop into the sea. The main challenges in repairing the roadway included:

- Designing a tall retaining wall structure to support the road with limited horizontal space for construction
- Keeping one lane open to traffic during construction
- Maintaining the existing footprint of the road to avoid disturbing a nearby ancient indigenous burial ground

Developing a Solution

When the road slip occurred, Wairoa District Council partnered with Land Development and Engineering (LDE) and Quality Roading and Services (QRS) to design and implement a practical and affordable solution. To keep traffic moving during the project, a temporary prefabricated bridge was placed to facilitate traffic over the damaged roadway.

By August 2020, LDE's design that included a Redi-Rock wall reinforced with rock anchors was approved. "The local authority (Wairoa District Council) made a good decision in being quick to get an options assessment underway, which allowed for development of what became the final design," explained Greg Bush, Civil / Geotechnical Engineer with LDE. To address the space constraints for a retaining structure that could safely support the road, LDE's design team recommended constructing a 24-foot (7.3-meter) high by 46-foot (14-meter) long retaining wall using Redi-Rock blocks in conjunction with soil/rock anchors. Anchor walls optimize load capacity in retaining wall applications that cannot accommo-



The Redi-Rock wall design allowed precast elements to protect the coastline and restore the highway to service in under 5 months from the start of construction.

date excavation; in this case, a cliff face. Once the anchors – or ‘tie-backs’ – are secured into the earth/rock, they can attach to Redi-Rock blocks directly or connect to blocks precast with metal hooks through a cast-in-place concrete waler beam.

The new wall would be supported by an existing bench in the slope which supported the previous failed crib wall. The Redi-Rock wall would be further supported by shotcrete facing and large rock revetment at the cliff base. The Redi-Rock blocks in Ledgestone texture blend beautifully with the area's natural aesthetic.

Diversification Spurs Growth for Duracrete

Redi-Rock has been available in NZ since 2015, when pre-caster Duracrete took on the challenge of diversifying its product line. The company has specialized in precast wastewater tanks and sewage treatment systems since the 1960s, mainly serving residential markets.



Installation of this retaining wall at the edge of a cliff required close coordination between the precaster, government officials, engineers, and installers.

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Duracrete customized the Redi-Rock anchor blocks to facilitate the quick repair of the highway. The standard Redi-Rock forming system can be modified to produce a broad array of products.

"As a strategic part of our company's growth, we identified that we needed to diversify our product range to sustain cash flow in the event the housing market declined. Diversification into the infrastructure market made good sense," explained Ric Garry, second generation owner and manager of the family's business.

In 2014, Duracrete began exploring the Redi-Rock retaining wall system that launched in the United States in 2000. In Redi-Rock, Duracrete saw an opportunity to create solutions for transportation, stormwater, commercial development, and more. The massive wetcast blocks interlock together with patented knob and groove technology to create both gravity and reinforced retaining walls. With solid and hollow-core blocks, as well as the Positive Connection reinforcement system for mechanically stabilized earth walls, Redi-Rock gravity walls can be built to over 20 feet (6 meters) and reinforced walls can be built to over 50 feet (15 meters).

The straightforward production process for Redi-Rock was also appealing. To pour the steel forms with rubber liners that create natural stone textures on the face of the block, they could utilize existing plant infrastructure. As independent units, each form can be moved within a production facility as needed. Overall, the simplicity of production, the ability to be engineered to taller heights, and the natural stone aesthetics made Redi-Rock a good fit for Duracrete.

Duracrete became a Redi-Rock licensed manufacturer in 2015, the first in Oceania to take on the product line. "Redi-Rock has given us a real point of difference and competitive edge in the marketplace. As a result, we are creating a whole new market for ourselves in the infrastructure and land development sector," explained David Hepburn, Business Development Manager for Duracrete.

Duracrete started out with just a few Redi-Rock forms and molds and has grown its operation over time. Today, the company has 52 Redi-Rock forms and molds, including 39 retaining forms, seven freestanding forms, plus various forms to produce accessory products.

The flexibility of the product line allows Duracrete to meet the challenging geotechnical needs of the NZ market, and the company has also been able to customize blocks as needed to tailor solutions.



Every other row of Redi-Rock 41in (1030mm) blocks were precast with metal hooks that joined the blocks to the pre-installed ground anchors, immensely fortifying the wall strength.

Manufacturing Logistics and Precautions

The Redi-Rock blocks for the project were manufactured at Wright Tanks, a licensed agent for Duracrete's tank division in Palmerston North. "They are located in the middle of the North Island and closer to Mahia than we are so it made sense to supply from here and keep transport costs down for the client," Hepburn said. Two to three staff were dedicated to making blocks for the project.

To create the anchor wall solution required for this project, Duracrete manufactured custom blocks. Typical Redi-Rock solid blocks don't have steel reinforcement, but in this project, the blocks were customized by using HD20 rebar to connect the block to the anchors using a cast-in-place bond beam.

The concrete design mix was tweaked slightly to compensate for the nearby salt water environment, explained Hepburn. As the slope bench and base of the Redi-Rock walls sat 23 feet (7 meters) above sea level, neither the blocks nor the metal components of the tie-back system were at risk of saltwater corrosion.

To be thorough in the coastal environment, the design called for concrete to cover steel components and the earth anchors to be galvanized and wrapped with unbonded length densotape prior to installation. The engineering plans from LDE specified that, "Redi-Rock Concrete to have 30% fly ash cement binder with the total binder content to be equal to or greater than 350kg/m³ and water to binder ratio of less than or equal to 0.45."

Coordinating Installation in Challenging Conditions

Duracrete worked closely with the contractor to coordinate the delivery of blocks to the site on requested dates. The blocks were staged at the edges of the roadway.

When construction began in September of 2020, the first step was placing ground anchors, 6.5 - 26 feet (2 - 8 meters) in length, into the cliff wall to strengthen the existing bank. Reinforced mesh was then installed to prevent rockfall during construction.

A skip bin was used to lower blocks to the base. An 8-ton digger also had to be lowered down with heavy equipment atop the cliff. After materials and equipment were delivered and the slope bench proved stable, the crew began securing the cliff face with 204 Redi-Rock gravity units. The wall was composed of multiple courses of Redi-Rock blocks, including two rows of 60in (1520mm) blocks, thirteen rows of 41in (1030mm) standard blocks, and one row of 28in (710mm) Redi-Rock blocks.

The Outcome

As the project came to completion in February of 2021, all those involved in the colossal project had reason to celebrate. Constructed in just five months, the 1,104 square feet

(102.5 square meter) wall had to be carefully constructed in a volatile coastal environment nearly impossible to access.

"Working on a vertical rock face above the sea with a skinny road above and getting it done without incident has been a huge accomplishment," said Project Manager, Mike Wilson. The team's innovative use of Redi-Rock materials and design schemes have produced a lasting solution and one that honors the natural splendor of the NZ coast.

On March 4, 2021, just a few weeks after the completion of the wall, a series of earthquakes struck roughly 620 miles off the coast of both NZ main islands. The largest of the earthquakes registered at a magnitude of 8.1. Tsunami warnings were issued, but the water surge was not as significant as expected and the retaining wall performed well through these events. ■

FURTHER INFORMATION

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