2024 Honorable Mention Project

Slope Stabilization in Kicking Horse Canyon













By Dan Pitts

The Kicking Horse Canyon Highway, part of the Trans-Canada Highway near Golden, British Columbia, has a rich history tied to the region's rugged geography and vital transportation needs. Originally a narrow and winding route carved into the steep canyon walls, it was built in the early 1900s to connect the mountainous interior of British Columbia with the rest of Canada. The route follows the historic Kicking Horse Pass, named by James Hector during the Palliser Expedition in 1858.

Over the decades, the highway has undergone significant upgrades to improve safety and efficiency. Major projects have included realignments, the construction of bridges, and the widening of the highway to meet modern transportation standards. Today, the Kicking Horse Canyon Project continues this work, transforming the route into a safer, four-lane highway while preserving the stunning natural surroundings of the canyon. This shotcrete project was a joint venture between LRutt Contracting Ltd, Ocean Rock Art Ltd, and Kicking Horse Canyon Constructors Ltd.

The Kicking Horse Canyon Highway Improvement Project is one of the most ambitious highway projects in Canada, designed to improve both safety and capacity along the Trans-Canada Highway. This challenging terrain features steep slopes, deep canyons, and rocky outcrops that stand above one of the busiest railway routes. This project required advanced engineering techniques to ensure slope stability and prevent rockfalls. To secure these slopes and create a natural-looking environment, one of the key methods used in this project is shotcrete placement and sculpting it to resemble rock faces.

SLOPE STABILIZATION

Shotcrete is a critical technique for slope stabilization in areas like the Kicking Horse Canyon. The steep slopes of the canyon, coupled with the region's unpredictable weather, make traditional methods of slope stabilization challenging. Shotcrete offers an efficient, durable, and cost-effective solution to mitigate the risks of rockfall and erosion.

For the Kicking Horse Canyon Highway project, shotcrete placement reinforced and stabilized the exposed rock faces. The fast application process allows it to bond immediately with the surface, effectively securing loose material and preventing further rock movement.

MANLIFTS IN APPLICATION

One of the distinctive features of this project was the extensive use of manlifts to facilitate shotcrete placement. Given the

rugged and often vertical nature of the slopes, traditional scaffolding or other forms of access would have been impractical. Manlifts, or mobile elevated work platforms , were used to provide workers with safe, efficient access to the most challenging areas.

The manlifts allowed teams of workers to reach a maximum working height of 56 ft (17 m), maneuvering around tight corners and narrow ledges. This mobility was essential for applying shotcrete in an precise manner, particularly on steep and uneven surfaces. The platforms also ensured that workers could stay safely away from the edge of the slopes, reducing the risk of accidents during the application process.

As the shotcrete was sprayed onto the slopes, the workers carefully monitored the consistency and thickness of the application. Manlifts played a crucial role in allowing workers to adjust their position quickly to ensure even coverage, which is vital for the integrity of the slope stabilization.

SCULPTING A NATURAL ROCK FINISH

While a given thickness of shotcrete alone is effective for slope stabilization, the Kicking Horse Canyon Highway project required an added aesthetic challenge: Creating a natural rock appearance to blend with the surrounding environment. The design team ensured the stabilization efforts would not detract from the natural beauty of the canyon, a significant concern in such a visually sensitive area. The total amount of shotcrete placed was approximately 1100 yd^3 (875 m^3) and included 29,800 ft^2 (90,800 m^2) of rock carved finish.

To achieve the desired aesthetics, the shotcrete was sculpted into a realistic rock texture. After applying the initial coat of shotcrete, our workers used specialized tools to carve and shape the surface to mimic the appearance of natural rock formations. This sculpting process is an art in itself, requiring skilled craftsmen to replicate the random patterns and intricate details found in the canyon's geology.

The sculpting process was meticulous, with workers using a combination of manual tools, trowels, brushes, and stamps to form natural seams, fissures, and textures that resemble the jagged edges and weathered look of the local rock. The finished surface was treated to enhance its durability and weather resistance, ensuring that the sculpted finish would endure the harsh environmental conditions of Kicking Horse Canyon.

ADVANTAGES OF SHOTCRETE AND SCULPTING

Using shotcrete placement combined with sculpting offers several advantages for slope stabilization, particularly in such a dynamic and challenging environment as Kicking Horse Canyon:

- **Speed and Efficiency:** Shotcrete is quick to apply, reducing the time required for stabilization compared to traditional methods like rock bolting or mesh installation.
- **Flexibility:** Shotcrete placement can adapt to various surface types, surface profiles and slopes, making it ideal for the irregular terrain of Kicking Horse Canyon.

2024 HONORABLE MENTION PROJECT

Project
Kicking Horse Canyon Mountain Stabilization

Project Location
Golden BC

Shotcrete Contractor
LRutt Contracting Ltd* / Ocean Rock Art Ltd*

Architect/Engineer
Aecon/Emil Anderson

Equipment Manufacturer
REED*

Materials Supplier
Golden Concrete Ltd

General Contractor
Kicking Horse Canyon Constructors

Owner
Government of Canada

**ASA Sustaining Corporate or Corporate Member*

- **Aesthetic Integration:** Sculpting the shotcrete into a natural-looking rock face allows the project to blend seamlessly into the canyon's landscape, preserving the natural beauty while ensuring safety.
- **Durability:** Shotcrete provides a robust, long-lasting barrier against rockfalls, erosion, and weathering, ensuring that the slopes remain stable for decades to come.
- **Safety:** The use of manlifts reduces the risks to workers by providing safe access to difficult-to-reach areas, minimizing the need for dangerous climbing or scaffolding.

CONCLUSION

The Kicking Horse Canyon Highway Improvement Project stands as a testament to the effectiveness of modern engineering techniques in preserving both safety and aesthetics in difficult terrains. Using shotcrete for slope stabilization, combined with the intricate process of sculpting the shotcrete to resemble natural rock, has not only ensured the long-term stability of the slopes but has also allowed the project to blend harmoniously with its surroundings. The extensive use of manlifts for shotcrete placement and subsequent sculpting of the rock finish allowed a high level of precision placement while maintaining a safe work environment. Using shotcrete placement ensured this project will provide lasting benefits to travelers on the Trans-Canada Highway for decades to come.

Dan Pitts *is President of Ocean Rock Art Ltd. and Partner in Ocean Rock Art US LLC. He is a Certified ACI Shotcreter and proudly serves as a corporate member of the American Shotcrete Association (ASA).*