

2025 Outstanding International Project

# How Zolula is Redefining Large-Scale Slope Stabilization in South Africa

By Adriaan Havenga

In the rugged terrain between Grahamstown and the Fish River Pass, where steep cuttings slice through unforgiving rock formations, engineering precision is not a luxury — it is a necessity. Along this demanding stretch of the National Route N2, Zolula (Pty) Ltd has quietly delivered one of the largest and most technically advanced slope stabilization projects South Africa has seen.

Over two years, across remote and mountainous

Eastern Cape landscapes, Zolula executed an immense lateral support scope involving 39,000 m<sup>2</sup> (420,000 ft<sup>2</sup>) of shotcrete, 14,000 m<sup>2</sup> (150,000 ft<sup>2</sup>) of mesh drapery, and nearly 9000 rock anchors — all while coordinating with earthworks, blasting, and road construction teams under tight sequencing constraints.

What emerged is not just a stabilized road corridor, but a benchmark for modern slope stabilization in Africa.



Rock anchor installation Cutting 6: Bench 2



Bulk excavation for final bench Cuttings 6 & 4

## A ROAD REIMAGINED

The N2 upgrade between Grahamstown and the Fish River Pass forms part of a broader national effort to improve safety, capacity, and long-term resilience along one of South Africa's most important transport arteries. The project required significant horizontal and vertical realignment of the road, forcing excavation through steep, geologically complex terrain.

Three major cuttings were identified as high-risk zones — areas where traditional slope treatments would not provide sufficient long-term stability or durability. Instead, the design called for modern, low-maintenance slope stabilization systems capable of performing over decades with minimal intervention.

Zolula was appointed as the specialist lateral support contractor, tasked with delivering solutions that balanced safety, constructability, sustainability, and scale.

## ENGINEERING THE SLOPES: DESIGN WITH INTENT

The stabilization strategy divided each cutting into two distinct zones — each engineered to respond to its unique risk profile.

### UPPER SLOPES: CONTROLLED DRAPERY

The upper portions of the cuttings were designed at a 1:1.5 slope, stabilized using mesh drapery systems pinned by 3 m (10 ft) rock anchors. These anchors were installed in rows, with 16 mm (0.63 in.) anchor cables tensioned to create a continuous stabilizing network over the rock face. The mesh was then progressively rolled down the slope, secured with galvanized plates and nuts at each anchor row.

This approach allows controlled movement of small rock fragments while preventing larger failures — an ideal solution for weathered rock zones prone to ravelling.

### LOWER SLOPES: STRUCTURAL SHOTCRETE

Below, the geometry steepened dramatically to 1:0.7 (approximately 80°). Here, stability demands were far higher.

The solution combined:

- 3 m, 6 m, and 9 m (10 ft, 20 ft, and 30 ft) rock anchors
- Reference 395 welded reinforcing mesh
- 100 mm (4 in.) thick wet-mix shotcrete layers

The result was a reinforced structural façade that not only stabilized the cut face but also protected the road from rockfall impacts originating higher up the slope.

Separating the two systems was a 3 m wide summit drain, finished either in shotcrete or stone pitching depending on access constraints — a critical detail in managing long-term water control.

## WATER: THE SILENT ENEMY

In slope engineering, water is often the most destructive force. Recognizing this, the design incorporated aggressive drainage measures throughout.

Two rows of 20 m (66 ft) drainage adits, drilled at a 10° upward inclination, were installed to relieve water pressure trapped within the rock mass. These were complemented by geotextile band drains positioned at 45° behind the shotcrete face, leading to weep holes that allow controlled



Lateral support on Cuttings 4, 5, & 6 nearing completion

discharge of groundwater.

The emphasis on drainage ensures that the stabilization system remains effective long after construction crews have left the site.

## BUILT FROM THE TOP DOWN: PRECISION IN SEQUENCE

Construction followed a disciplined top-down benching methodology, advancing in 2.5 m (8.2 ft) vertical increments. Each stage required seamless coordination between drilling, blasting, earthworks, mesh installation, anchoring, and shotcrete application.

Shotcrete operations were critical to maintaining momentum. Once applied, areas could typically achieve 70% of design strength within two working days, allowing crews to safely drop to the next bench without delaying adjacent activities.

The shotcrete placement followed a meticulous sequence:

1. Rock face cleaning using compressed air
2. Anchor installation via DTH drilling with 30 MPa (4300 psi) grout
3. Drain installation
4. First 50 mm (2 in.) of 25 MPa (3600 psi) wet-mix shotcrete layer
5. Installation of reinforcing mesh and load-distribution spiders
6. Final 50 mm shotcrete layer with nozzle finish

All shotcrete was placed using two Putzmeister P718 TD pumps, operating over hose lengths exceeding 100 m (330 ft) and elevation differences greater than 10 m (33 ft) — a testament to both equipment reliability and crew expertise.

## SCALE BY THE NUMBERS

By completion, the project delivered quantities rarely seen in South African slope stabilization:

- 39,000 m<sup>2</sup> of shotcrete
- 14,000 m<sup>2</sup> of mesh drapery
- 6900 3 m anchors
- 950 6 m anchors
- 350 9 m anchors
- 525 drainage adits

All steel components were hot-dip galvanized, ensuring long-term corrosion resistance in harsh environmental conditions.

## SUSTAINABILITY IN PRACTICE

Beyond structural performance, the project stands out for its pragmatic sustainability.

All shotcrete was batched on site using a Karoo batch plant, with aggregates sourced from quarries within a 100 km (62 mi) radius. This significantly reduced trucking requirements, fuel consumption, and CO<sub>2</sub> emissions when compared to conventional ready-mix supply chains.

Equally important is longevity. Shotcrete systems,

when correctly designed and installed, require minimal maintenance over their lifespan — reducing future disruption, repair costs, and environmental impact.

## CHALLENGES THAT DEFINED THE OUTCOME

The project was not without its complexities. Working in a remote area demanded logistical precision. Limited access meant creative pumping solutions, extended hose runs, and constant coordination with blasting and earthworks teams. These constraints essentially became proving grounds for us — reinforcing the value of experience, adaptability, and planning.

As one observer noted, this was “quality infrastructure delivered at a scale rarely seen before in South Africa.”

## BEYOND CONCRETE: BUILDING COMMUNITIES

While the engineering achievements are tangible, the human impact is equally significant.

The project employed more than 50 local workers, providing skills transfer and economic upliftment in a rural region where such opportunities are scarce. Exposure to modern slope stabilization techniques has left a lasting

## 2025 OUTSTANDING INTERNATIONAL PROJECT

*Project:*

**National Route N2 Slope Stabilization**

*Project Location:*

**Eastern Cape, South Africa**

*Shotcrete Contractor Company:*

**Zolula (Pty) Ltd\***

*Architect Company:*

**Bosch Projects**

*Engineer Company:*

**AGES-Group**

*Materials Supplier Company:*

**WBHO Construction**

*Equipment Manufacturer Company:*

**Putzmeister\***

*General Contractor:*

**WBHO Construction**

*Additional Team Members:*

**Civils2000**

*Owner:*

**South African National Roads Agency SOC Ltd**

\*ASA Sustaining Corporate or Corporate Member

legacy — one that extends well beyond the road itself.

## A BLUEPRINT FOR THE FUTURE

The N2 slope stabilization project stands apart in Zolula's experience — not just for its size, but for what it represents. It is proof that:

- Large-scale infrastructure can be delivered sustainably.
- Specialist engineering can thrive in remote conditions.
- Local communities can benefit meaningfully from major projects.

And perhaps most importantly, it demonstrates that South African geotechnical expertise is capable of world-class execution.

In an industry where success is often buried beneath the surface, Zolula's work on the N2 ensures that stability, quite literally, stands the test of time.



**Adriaan Havenga** is the Managing Director and Founder of Zolula (Pty) Ltd, an industry-leading specialist geotechnical contractor in South Africa. With 17 years of experience, he is known for delivering relationship-driven solutions, guided by a future-focused mission to be the partner of choice for all geotechnical solutions across South Africa. Zolula has grown into a relationship-driven, technically focused contractor known for delivering in challenging environments. Supported by a compact leadership team and industry leading equipment, the company operates with the agility of a specialist and the capability of a major player. Zolula's B-BBEE Level 2 status further positions it as a preferred partner on both public and private sector projects across Southern Africa.

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