



## Terrafix 150 blocks as remedial measure for cut slope failure

The geotechnical and conceptual design of the cut slope failure was undertaken as a result of a previous investigation completed by Jeffares & Green in June 2002, which identified problem areas along the route and highlighted this failure as one of two requiring urgent attention.

A topographical survey was undertaken of the failure area and a geotechnical assessment -undertaken by M. van Wieringen and Associates, consulting Geotechnical Engineers and Engineering Geologists - and field investigation completed for the site

### Field report and site considerations

The recent detailed field survey, coupled with observations over a number of years, led to the conclusion that the erosion and collapses at the site were essentially due to the slope being cut at an angle initially stable in terms of wedge or slip circle failure, but not stable in terms of long-term erosion and/or slip failure once weathering sufficiently reduced the surficial strength parameters.

The site comprises a road cutting originally cut at roughly 50° into very soft rock - very highly weathered granite and dolerite - where a dolerite dyke crosses the road. Says Mike van Wieringen of M. van Wieringen and Associates: "Weathering of the face coupled with the convex shape of the slope and diversion of sub-surface water by the dyke, ultimately resulted in planar slip failures with a gradually advancing head scarp of up to 4 m in height, discharging onto the road during the wet seasons."

In addition, it was found that the non-functional surface cut-off drains situated above the cut face also contributed to and accelerated erosion and/or slip failure and lack of regular maintenance has led to silting up of the drain as well as choking by vegetation - with consequential over-topping.

To leave the slope unattended, other than for clearing the debris off the road as and when it collapsed onto it, would result in the gradual eroding back of the slope to a gentler slope. Say Duncan Murphy, civil engineer with Jeffares & Green: "At a point when the erosion intersects the cut-off



In April 2003, The City of Cape Town, Department of Transport, Roads and Stormwater, commissioned Jeffares & Green, a local civil engineering consulting firm, to undertake a geotechnical investigation and propose a design for remedial measures required to stabilise the cut slope failure at Suikerbossie Nek along Victoria Road between Camps Bay and Hout Bay.



Terrafix installed by Dassenberg Retaining

### Finishing Touches

To soften the appearance of the Terrafix blocks, thousands of water-wise indigenous plants as specified by Megan Anderson Landscape Architects were planted by Eco Creations early in spring and it is hoped that late winter rains will provide them with a good start in life.

Ground covers and bulbous species such as Tatragona Fructicosa, Helichrysum Cymosum, Jordancella Louisa, Sparaxis Grandiflora, Metalasia and Aristea Majour should soon relieve the current fairly nondescript appearance of this slope.



Gabions installed by Gabion Construction

drain, it would be likely that a large erosion gully would form in the cut-face. The net consequence could have been the formation of a deep irreparable donga (gully) extending a very long way up the slope."

"Also, the high probability of a significantly sized collapse onto the roadway during a period of high rainfall and low visibility could prove fatal to passing motorists. The size of such collapses could be expected to increase for a time before they gradually reduce to sheet erosion in 20 to 30 years time. Judging by the crack pattern that was present in the head-scarp, such a collapse appeared imminent."

### Design considerations

A number of considerations were taken into account in terms of guiding the selection process and included:

- a) Cost – the less expensive the better.
- b) Aesthetics – it was felt that given the environment in which the site resides the more natural approach with softer irregular lines and allowing concealment with vegetation is more preferable than the hard engineering approach. It was also felt that it would be beneficial, as much as possible, to use methods already used along Victoria Drive in order to develop a degree of visual compatibility along the entire route.
- c) Disruption to traffic – this should be kept to a minimum and, if possible, without any closure of the road. Longer contract periods can be entertained if they imply less disruption to traffic.
- d) Intrusion onto neighbouring property – this to be kept to a minimum in terms of both access and temporary or permanent disturbance to land or vegetation.
- e) Adaptability and extendibility – remedial work needed to be such that it can be easily adapted

and extended without having to demolish existing initial measures implemented. This allows for the minimum intervention now, with the option to extend and easily repair if and when further collapse or erosion occurs.

### Remedial measures considered

The "do nothing" option was considered and rejected for a number of reasons as was the possibility of using light weight erosion control measures.

Options such as gunite and soil nails over portions of or over the whole slope, or a vertical reinforced concrete retaining wall up to 8.5 m high, were discarded for aesthetic reasons; the cutting being visible from a large portion of Hout Bay and adjacent to the Cape Peninsula National Park.

A combination of a near vertical gabion toe wall up to 2,5 m high at the base of the cut, with a 35° Terrafix covered slope above, topped by a concrete-lined cut-off drain, was ultimately selected. The gabions match numerous other gabion structures along Victoria Road and a feature of these particular ones, as developed by Gabion Construction, is the smooth unstepped nature of the face and the top of the wall as it follows the contour of the cut face.

Van Wieringen explains that Terrafix 150 blocks were selected in order to trap the maximum amount of topsoil on the face thus enabling plant growth, to prevent erosion by surface run-off and to retard the weathering process. "Because of the very large area covered on a curved surface, near-horizontal concrete infill walers were introduced at 5 m intervals to take up the uneven spaces developed between adjacent panels."

"These were anchored to the slope with anchor bars in order to reduce any possible downward sliding force coming to bear on the gabion wall. The maximum density of Terrafix laying pattern (10 blocks per m<sup>2</sup>) was used so as to maintain an interlock between blocks against lateral sliding should support from below be disturbed in any way."



### Public participation

A public participation process was undertaken, which confirmed that the recommended option was acceptable to the public. Parts of the remedial works required encroachment on land outside the road reserve. The land on which part of the works would be undertaken was owned by the City of Cape Town, but was managed by the Cape Peninsula National Parks (CPNP). Representatives of CPNP were informed of the project and were met on site to explain the envisaged remedial measures.

Murphy adds that because certain of the works would fall outside the existing road reserve and onto land that is sensitive in nature, it was a requirement that normal environmental impact assessment procedures be followed. "This required the submission of Pre-application Form and Screening Checklist to the national environmental authority i.e. the Department of Environment Affairs and Tourism."

"The application was copied to the provincial authority i.e. the Department of Environmental Affairs and Development Planning (DEA&DP) and CPNP. The necessary Record of Decision (ROD) was obtained from DEA&DP to proceed with the project."

Finally, in February 2006, Vula Indlela Construction was appointed and construction was completed six months later in August 2006. The contract was advertised with the intention to use labour intensive means to complete the works and the EPWP guidelines were utilised in compiling the tender documentation. A total of approximate 40 000 man hours of work was created by the project, with the local community of Imizamo Yethu in Hout Bay benefiting from it. The final construction cost amounted to approximately R3m.