ROCKFALL PROTECTION MEASURES FOR THE MGENI VIADUCT
UMGENI RIVER,KZN

ROCKFALL PROTECTION SYSTEMS
Drapery Systems

Editorial published in:
Construction World, September 2007

A specialist slope stabilisation project for the Mgeni Viaduct, spanning the Umgeni River in Kwa-Mashu, north of Durban and forming part of the new Main Road P577, has been completed using a passive system intervention.

Design engineers involved with issues around slope stabilisation for roadway embankments, natural cliff faces and cuttings need to consider key factors such as cost optimisation, absolute safety for motorists and pedestrians, lifecycle maintenance considerations, and of course, aesthetics.

For Italian multi-national, Maccaferri, these issues have been researched in-depth and have led to the development and refinement of the company's patented MAC.RO. rockfall protection suite, designed for either passive or active engineered approaches, depending on geotechnical requirements.

The latter systems comply with the "Durability and Construction Products Directive" 89/106/EEC guideline, recommending a minimum design life of 25 years for rockfall protection barriers and drapery systems (passive interventions), as opposed to soil reinforced embankments that are designed with a minimum life of 50 years.

As Adriano Gilli, Maccaferri SA's sales & marketing manager explains, the MAC.RO System is extensive. Key solutions include Maccaferri's simple drapery system Steelgrid MO (an example of a passively engineered intervention); cortical strengthening (an active approach using the Steelgrid BO and/or HEA steel cable panels); rock fences (OM250, OM1000 and OM2000); and rockfall protection embankment solutions using the company's Terramesh doubleface product.

"A widespread and common application in Europe, Maccaferri's Steelgrid MO (Mono Orientated) product is specified where the need is to safely guide falling rock debris to the base of a slope bordering a roadway for subsequent clean-up by maintenance crews," says Gilli. "On very steep or near vertical slopes, the mesh net is anchored at the top and bottom, and left unsecured in between."

Maccaferri's Steelgrid MO is a double twist woven mesh, where the conventional selvedge wires are replaced by 8mm diameter steel ropes. Mono orientation refers to the pathway of the cable, with runs in the direction of the weave, length-wise. The resulting product is midway between a cable reinforced mesh and a steel cable panel. However, the economic benefit comes from the fact that two different products can be installed simultaneously, reducing the overall project costs and Installation time by as much as 50%, " Gilli explains.

Where slope consolidation is required, Maccaferri's Steelgrid BO (Bi Oriented) consists of 8mm diameter steel ropes, in place of the MO's conventional selvedge wire, with a further 8mm diameter rope inserted longitudinally midway between the selvedges. During the manufacturing process, steel ropes are also inserted longitudinally midway between the selvedges. During the manufacturing process, steel ropes are also inserted transversely in the cross direction through the mesh twist and secured to the edge ropes with clips.

"Gilli says that Maccaferri's SteelGrid MO features a standard 3mm diameter Class A Galvanised wire mesh. However, an option exists to specify Galfan coating - an alloy of aluminium and zinc that provides two to three times the lifespan of galvanised mesh, which would be suitable, for example, for corrosive marine conditions.

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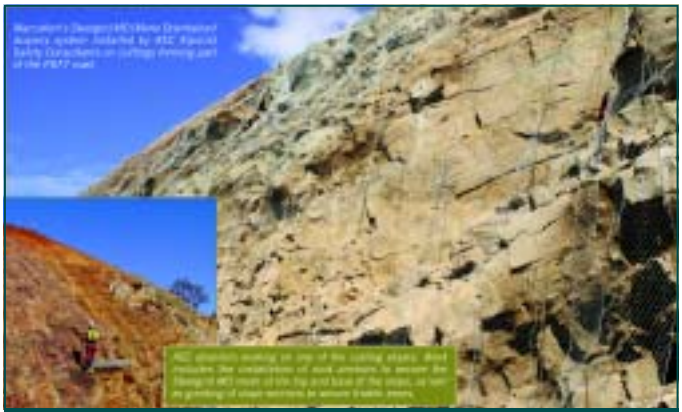

ASC abseilers working on one of the cutting slopes. Work includes the installations of rock anchors to secure the SteelGrid MO mesh at the top and base of the slope, as well as guniting of slope sections to secure friable zones.

Mgeni Viaduct
For Cape Town based consulting engineering firm, Melis & Du Plessis, working as sub-consultants to BCP Consulting Engineers, their experience as the rockfall design consortium member on the Chapman's Peak Drive coastal route, which required extensive mountain slope rehabilitation, motivated the firm to specify Macceferri's Steelgrid MO for the Mgeni Viaduct No. 2908, which will span the Umgeni River in Kwa-Mashu, north of Durban. The latter project forms part of the new Main Road P577. Coincidentally, ASC Alpinist Safety Consultants - one of the main sub-contractors on the Chapman's Peak project - has installed the Maccaferri system.

David Haskins, an engineering geologist with Melis & Du Plessis, expands on the project requirements, explaining that the slope below the eastern bridge abutment was considered to pose a potential rockfall hazard to Piers 1 and 2, both during construction (to labour and equipment) and to the piers themselves during the service life of the structure.

For this reason, a suite of stabilization measures was proposed to eliminate this hazard. These measures included barring down loose material from the slope, stabilising key blocks using rock bolts and the installation of Maccaferri's Steelgrid MO to control any further rockfalls from the slope.

The construction requirements for the contractor demanded that the entire road prism be utilised for bridge construction purposes - including the proposed rockfall drop zones, Haskins explains. "This required the construction of temporary rockfall protection systems to prevent this hazard from affecting the bridge construction area."

The excavation for pier foundations 1A and 1B was undertaken by the main contractor. The excavation was made in a series of cuts measuring approximately 2 to 3m in height until the required foundation level for the piers was achieved. Following each cut, it was a requirement to stabilise the excavation face by clearing and barring down, rock bolting and applying a shotcrete and mesh lining (where necessary), as well as lower the drapery mesh into place over the newly cut face.

Stabilisation phases
Three cuts were made for the excavation, requiring three separate stabilisation efforts. The repairs to any damage to the drape mesh caused by the blasting for the pier footing excavation was included in this process and undertaken by ASC Alpinist Safety Consultants as part of this work.

The first stabilisation phase included work done along the approach box cutting to the bridge abutment where rock barring, rock bolting and the installation of pinned drape mesh (SteelGrid MO150) had been carried out. The cutting comprises a northern face that extends to a maximum height of 12m and a southern face which extends to a maximum height of 20m. The uppermost portion of this slope is benched. The length of the affected section of the cutting varies from 80m along the southern face to 50m along the northern face.

The second phase of stabilisation included removing, by clearing and barring down, the existing blast debris piles that had collected on the slope below the bridge abutment from the blasting activities carried out, to make the cutting for the approach road to the bridge. The loose and unstable nature of the blast debris piles necessitated that they be cleared down from the abutment slope before any construction could begin. This clearing was undertaken largely using ASC's abseiling teams.

The third phase comprised stabilization of key blocks or cracked blocks that could not be barred down, but which may over time loosen and dislodge from the slope below the abutment. Stabilisation included pinning back discrete blocks to a stable section of the slope through the installation of a series of fully grouted rock bolts. The heads of the rock bolts are covered with shotcrete to provide corrosion protection as well as to prevent the bolts, washers and faceplates from being vandalised.

Following this phase of stabilisation, a Maccaferri SteelGrid MO drapery net has been placed from the crest of the slope ultimately to the base of the first pier excavation. This mesh has been hung from a top support cable, which in turn is held in position by rock bolts installed at the crest of the slope. A bottom cable pinned to the slope by rock bolts, attaches to the base of the drape mesh to fix it to the slope. Top anchors are 3m deep at 3m intervals, whilst the bottom ones are 2m deep at 9m intervals. Perimeter rock bolts were also installed at discrete locations along the two outer edges of the drape mesh system to tie these down where necessary.

A view across the valley where the Mgeni Viaduct will be constructed over the Umgeni River in Kaw-Mashu.

A view of the route for the Mgeni Viaduct with SteelGrid MO installation in progress.

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