

# ROCKFALL PROTECTION

## CASE STUDY:

### Kaikoura SH1 Rockfall/ Shallow Slips Protection: Site SR32

KAIKOURA

JULY 2017

CLIENT: NCTIR

CONTRACTOR: ROCK CONTROL LTD

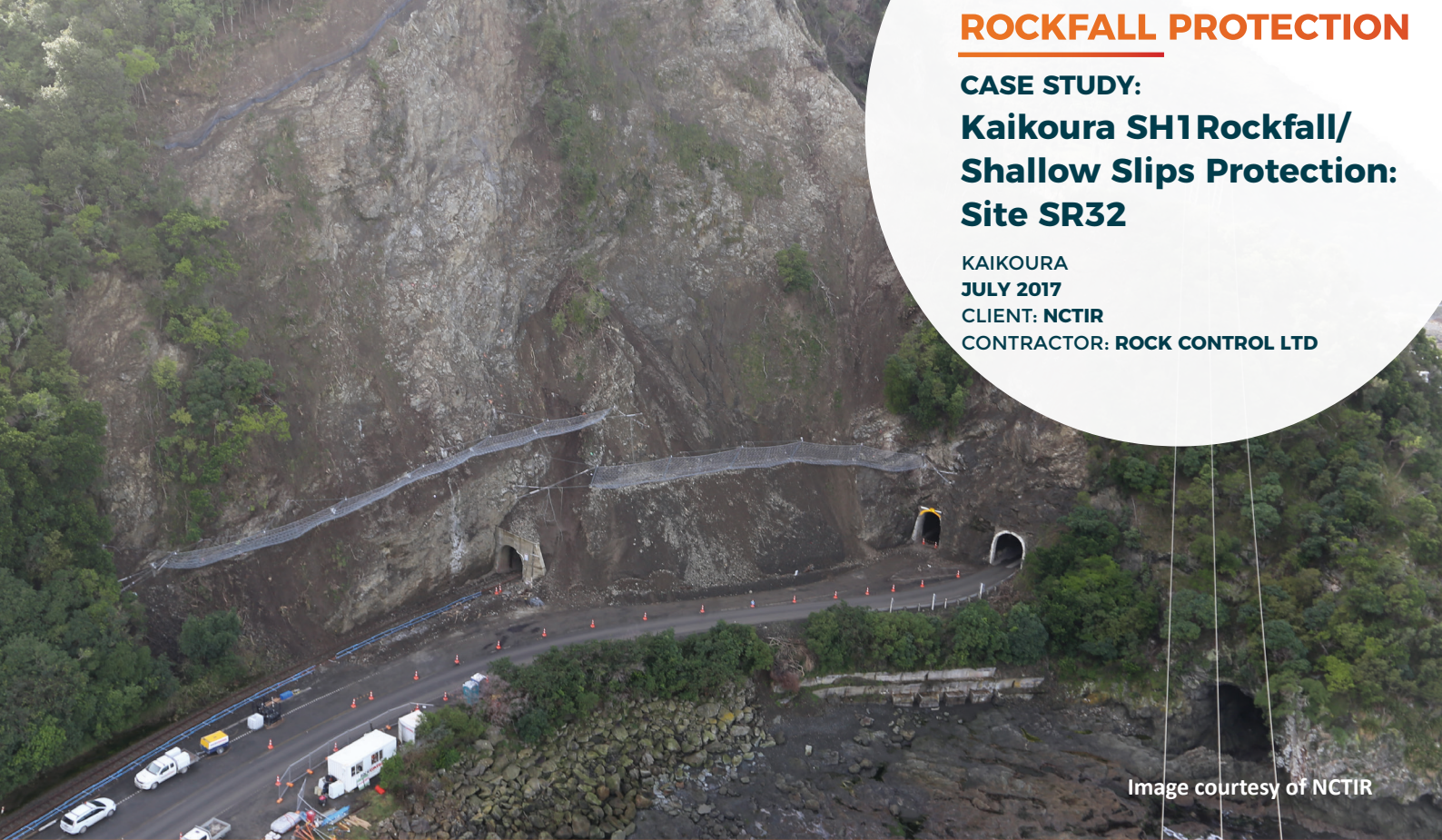


Image courtesy of NCTIR

## WHAT IS ETAG 027

ETAG 027 – Guideline for European Technical Approval of Falling Rock Protection Kits is a document containing a guideline for full scale testing of rockfall fences. This guideline standardises the test methods and allows a manufacturer to specify the energy level the fence is capable to withstand as well as an indication of the performance in terms of residual height and expected deflection. All Maccaferri fences are ETAG 027 certified exceeding Category A performance i.e. residual height >60%\*.

\*ETAG 027 requires >50% for Category A fence

Kaikoura is a coastal town in the north Canterbury region of the South Island of New Zealand. It is a popular tourist destination known for its abundant wildlife and its year round sperm whale population. The region was badly affected by an earthquake in the November 2016.

The magnitude 7.8(Mw) earthquake caused landslides and rockfalls along the coastal road of State Highway (SH1). SH1 links the Kaikoura town north to Blenheim and south to Christchurch and at the same time serves as a major tourist route with its scenic view along the coast. A rail corridor adjacent to SH1 is used as a major transportation mode to bring goods in from Picton was also affected by the earthquake.

There was an extraordinary effort in response to this extraordinary seismic event: 21 faults had ruptured, generating the strongest ground shaking ever recorded in New Zealand. The South Island itself moved, thousands of landslides came down, land rose and slumped along the eastern coast.

Transport infrastructure was devastated, with coastal and rural communities isolated overnight. The instant disruption to tourism, freight and primary industries was felt nationwide. Almost a million cubic metres of rock and material fell onto SH1 and the Main North Line; while the seabed rose under Kaikōura harbour. Traffic was forced onto narrow mountain roads never designed to carry the load.

Not long after the earthquake, the government established the North Canterbury Transport Infrastructure Recovery (NCTIR), The NCTIR was set up to restore the network, and keep traffic moving on alternate routes. This partnership between the NZ Transport Agency and KiwiRail was new territory, as was the collaboration of Downer New Zealand, Fulton Hogan, HEB Construction and Higgins on such scale. With work sites spread over a large geographical area stretching from North Canterbury to Marlborough - some very



remote - the recovery effort sought to merge the knowledge of local contractors with resources from all over New Zealand.

One of the major restoration works among many that the NCTIR team has to cope with is known as Site SR32. The landslide caused by the slope above the road and rail tunnels have inundated the entire road. While loose surface rocks and debris have been cleared as much as possible, the residual risk will be mitigated by installing ETAG energy certified fences at some distance above road level near to the road and rail tunnel entrances.

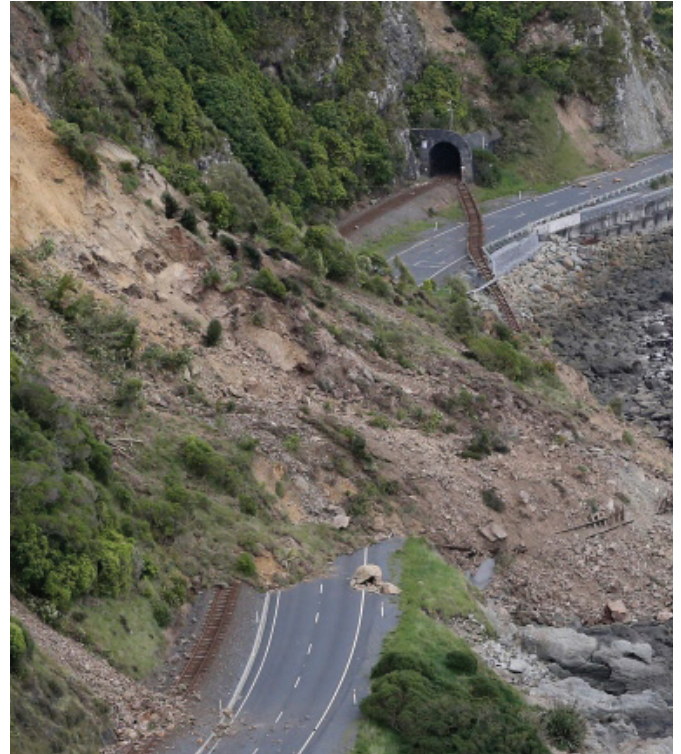
The NCTIR team has identified a minimum kinetic energy capacity of 2000kJ fence manufactured by Maccaferri - RMC200A for this location. Specialist contractor - Rock Control Ltd was assigned to carry out this very challenging job site. There are 3 fences in total for this site, all 4m high posts with section length ranging from 40m, 50m and 60m designed to protect the road and rail below in another rock fall or shallow landslide event.

They are all installed on the slope profile above the road level. Not long after the fence installation before the road reopened, one of the fences was hit by a shallow landslide with an estimated volume of approximately 15m<sup>3</sup> and successfully arrested. The impact energy didn't cause any significant damage to the fence and this debris was later cleared by the contractor.

Geofabrics New Zealand supply the full range of Maccaferri ETAG027 energy certified rockfall fences starting from 100kJ to 8,500kJ. The intercepting component (panels, posts, base plates, upper and lower ropes, energy dissipaters, up-slope and lateral ropes) used in the rockfall fence are fully tested against impact under the stringent ETAG 027 test procedure. The performance of the fence along with the measurements are used to calculate the maximum energy rating and are recorded after which a certificate is issued stating their energy level among others. Up slope and lateral anchor loading requirements are provided to the engineer for the anchor design.

A certified rockfall fences/system significantly reduces uncertainty in the energy capacity of a rockfall protection structure designed by the engineer. The engineer can then put more attention on the design of the remaining component below ground i.e anchors and foundation element.

The Maccaferri rockfall fences are now available in the latest trajectory analysis software - Rockfall produced by Rocscience for modelling purposes.



**A typical scene of road inundated with a landslide along the SH1**

Image courtesy of Rock Control Ltd.



**RMC200A Fence**

Arrested estimated volume of 15m<sup>3</sup> of shallow landslide debris end of 2017. Image courtesy of Rock Control Ltd.



**Impact Performance of the RMC200 Fence:**

On 20th Feb 2018, the Kaikoura region was badly affected by ex-cyclone Gita. This resulted in further landslides along the coastal transport corridor. Site 32 was not exempted from the damage done by ex-cyclone Gita where an estimation of 200 tons of rocks and saturated soil debris collapsed from the upper slope source area. The entire volume of debris impacted one of the fences and was successfully arrested by the fence. The fence was originally designed for rockfall impact but in this instance the fence has demonstrated its ability to intersect a shallow land slips or debris flow situation.

The debris was later remove by the specialist contractor - Rock Control Ltd and the fence reconstructed to meet its intended function for another potential impact to protect the rail and road infrastructure.



**RMC200A Fence**

Impacted fence after ex-cyclone Gita Feb 2018



**RMC200A Fence**

Impacted fence after ex-cyclone Gita Feb 2018