CASE STUDY

Rockfall Products

Project: Sumner Rockfall Protection Embankment
Date: April 2011
Client: Sue Gifford
Location: Christchurch

GEOFABRICS®

GREEN TERRAMESH ROCKFALL BUND

The potential danger of rockfall to houses in close proximity to the 50m high weathered cliff above Wakefield Avenue in the suburb of Sumner, Christchurch was realised in August 2006 when loose rock from the cliff impacted one of the houses prompting the property owner to lodge an application with the New Zealand Earthquake Commission (EQC).

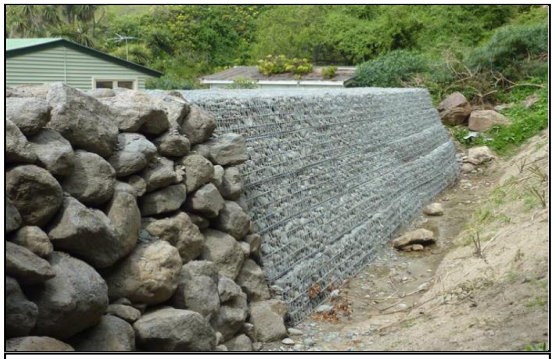
The consulting engineer had to look at possible solutions that would prevent a re-occurrence of damage to the house. The proposed barrier not only had to meet the design requirements for rockfall events at the site but also had to fit within acceptable landscaping criteria for residential properties.

Maccaferri were approached by the designers and suggested a Green Terramesh (GTM) embankment for this site based on the previous performance of these structures in protecting road users in the mountainous regions of Italy that are prone to avalanche and debris flow. This suggestion was adopted by the designers and the final configuration consisted of a 3.0m high embankment on uphill side measured from the base of a ditch excavated for debris collection and maintenance in the event of rockfall. A 1.5m high exposed stone mesh face was located along the full length of the embankment facing the house. Construction began during the middle of June 2010 and was completed in early August 2010.

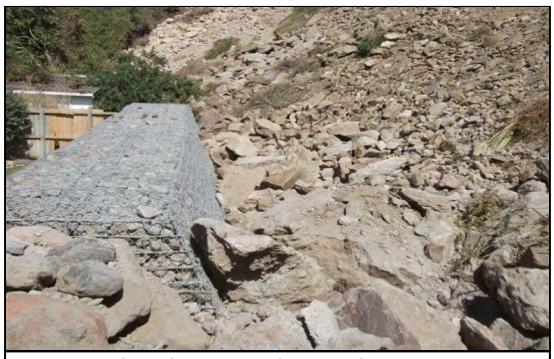
During the September 2010 Darfield earthquake of Mw7.1, a few small rocks were contained by the GTM embankment. This was the first real test for the GTM embankment. Due to the relatively small rock size and low velocity, no penetration of the embankment took place.

The major earthquake of Mw6.3 that struck Christchurch in February 2011 resulted in very high ground shaking around the Sumner area which provided a major test for the GTM embankment. The site location is just over 5km away from the epicenter; this has caused dislodgment of rocks from the weathered cliff giving rise to multiple rock falls with the largest rock size estimating to be up to 2.0m in diameter. Site observation confirmed that some penetration of the GTM embankment occurred on the uphill side of between 150mm to 250mm.

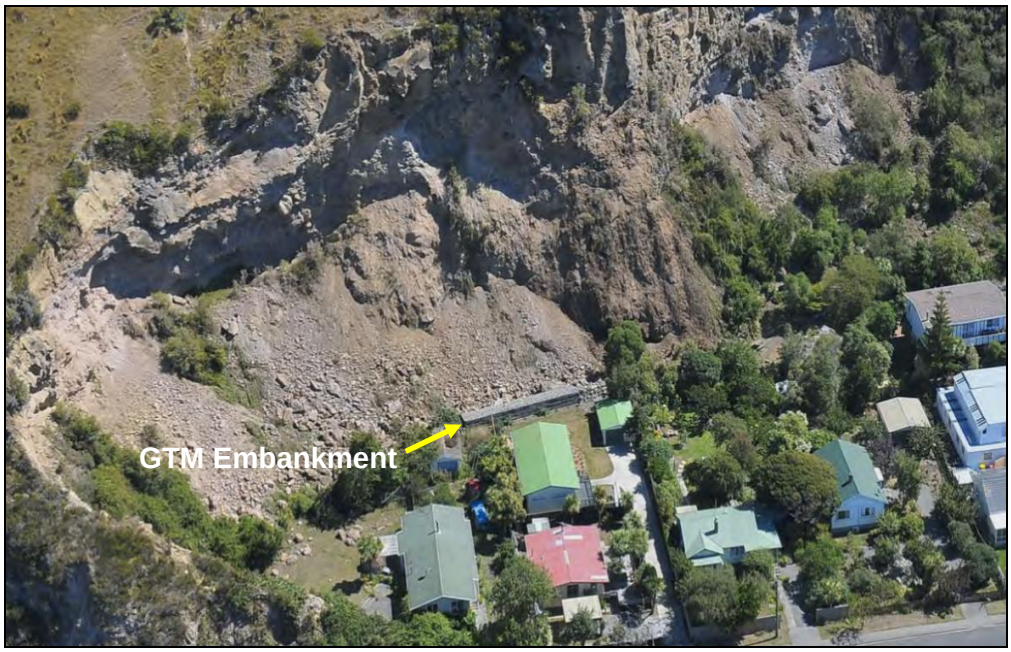
Completed GTM embankment with rockfall face



GTM embankment after September 2010 earthquake



GTM embankment after February 2011 earthquake



Aerial view of GTM embankment below cliff (GNS Photo-GTH_5700)

This indicates the very high energy absorption capacity of the embankment. Energy levels high energy absorption capacity of the embankment. Energy levels of between 700kJ to 2,600kJ have been estimated based on the height of the cliff and rock sizes collected by the GTM embankment.

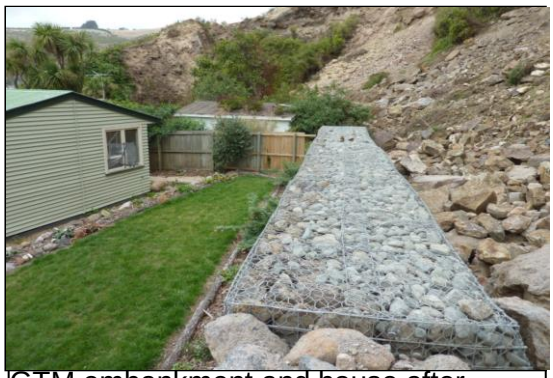
The GTM embankment showed no sign of movement and all the mesh was observed to be intact even in areas of rock penetration. No major structural damage of the house was observed with only one broken window which was caused by smaller rock fragments hitting the debris piled up to the crest of the GTM embankment and then bouncing over.

The ground shaking experienced in the February event would have exceeded the requirements of the earthquake loadings code at time of the GTM embankment design. It is however clearly evident that the GTM embankment has proven to be a savior to the property and lives of the occupants living there.

The full extent of the rockfall can be seen in the aerial photo of the site. Large rocks can be seen on adjacent properties beyond the line of the GTM embankment. (Refer to GNS Science Immediate Report Job Number 460W6303 dated 2 March 2011)

The subsequent aftershock in June 2011 with recorded Mw of 5.3 has resulted in further rock falls at this location. To date, none of this further rock falls have caused any damage to the house.

GTM embankments for rockfall protection have been designed and constructed successfully worldwide and are a reliable solution. They allow very high energy absorption with multiple rock impacts. In addition, these structures require limited maintenance in response to low energy impact when compared to energy fences.


GTM embankment and house after February 2011


Penetration of the GTM embankment