



CASE STUDY:

SLOPES & WALLS

**Maffeys Rd
Debris Flow Protection**

**CHRISTCHURCH
NOVEMBER 2016
CLIENT: CHRISTCHURCH CITY COUNCIL**

**GREEN TERRAMESH
PROTECTION BUND**

FEATURES & BENEFITS

- The fixed face angle and vertical lift simplifies construction of the reinforced soil slope.
- When combined with geogrid, Terramesh and Green Terramesh structures can exceed 50 m in height.
- Maccaferri Terramesh features a Galvan-coated wire mesh, protected by a polymeric barrier made of PVC. This improves corrosion resistance and enhances the system's durability.
- Maccaferri Terramesh has a permeable front face to allow drainage of the backfill.
- It is structurally safe in the face of fire and reduces environmental impacts by incorporating vegetation on the front face.
- The Maccaferri Green Terramesh system has independent technical approval.

Following the 2010/11 Canterbury earthquake sequence, loess slope below Maffeys Road was identified as one of the areas with high risk of mass movement.

Potential failure mechanism was identified as shallow sliding of overlying loess on top of the basalt bedrock surface. Instead of stabilising the slope; it was decided that in an event that the loess slope fails; the slope mass shall be deflected, intercepted and contained behind a protection barrier; mitigating the risk of impacting the properties and infrastructure down slope. Limited space available between the slope and properties meant that a reinforced soil protection bund had to be used to reduce the footprint and increase the containment volume.

In addition to footprint consideration; the design considerations of the reinforced soil bund have to fulfil a number of technical requirements:

- The protection bund has to be able to withstand without toppling failure the dynamic impact of debris flow impact at 5m/s
- The protection bund must be able to be partially repaired or patch should any of the section being impacted
- The protection bund must have proven records of use
- It has to be durable (typically >50 years)
- There has to be very minimum maintenance required

> Maffey's Rd Debris Flow Protection Case Study – Continued.

The Green Terramesh reinforced soil bund was adopted meeting all of the above design requirements. Among others, one of the design consideration is to ensure that the protection bund must resist the dynamic impact load from the mass soil movement. This mass soil movement was treated as debris flow consist of impact waves developing dynamic forces and consolidation of the material on the upslope side developing static forces. Based on a velocity of 5m/s with estimated saturated soil weight of 20kN/m³, the dynamic pressure was calculated to be approximately 100kPa through the use of an empirical formula provided by Hong Kong GEO “DN1/2012- Suggestions on Design Approaches for Flexible Debris-resisting Barriers”.

This dynamic pressure is further reduced since it will be impacted on a 70-degree inclined face up slope.

In this case, wave height has to be assumed and by using a slope stability software e.g MacStars several phases of the dynamic and static load cases can be simulated. Figure 4 shows a snapshot of the internal stability analysis result with accumulated static debris load and dynamic pressure acting at the up-slope side of the bund.

The actual alignment of the GTM bund with an apex nearer to the source area was to divert and deflect the soil mass to both sides of the apex. This approach by the engineer ensured that by diverting the soil mass the height requirement of the bund would be significantly reduced.



GREEN TERRAMESH BUND

During construction

Below: Side view of Green Terramesh



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Constructing the apex near the main source area meant that it intercepts with the land mass at a much shorter distance hence reduces the dynamic impact pressure. The long curve shape layout of the bund left and right of the apex is at an angle to the impact direction, this further reduces the dynamic impact pressure. The long bund layout helps to contain the debris volume allowing for clearing as well as minimising the height of the bund.

The apex structure in the centre is a reinforced soil structure with considerable total height of 14.4m. Seismic and static internal and global stability analysis have been performed to ensure the structure is self-stable under its own weight with surplus safety factors allowed for.

The GTM bund construction took the contractor - Fulton Hogan approximately 1 year to complete. It was completed in early August 2016.



COMPLETED
Green Terramesh Bund at Apex

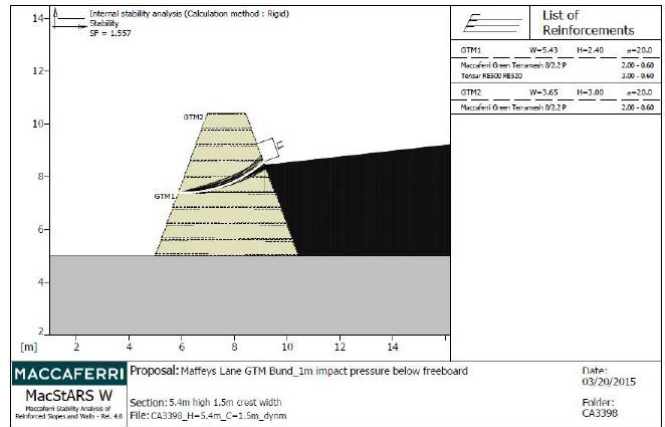
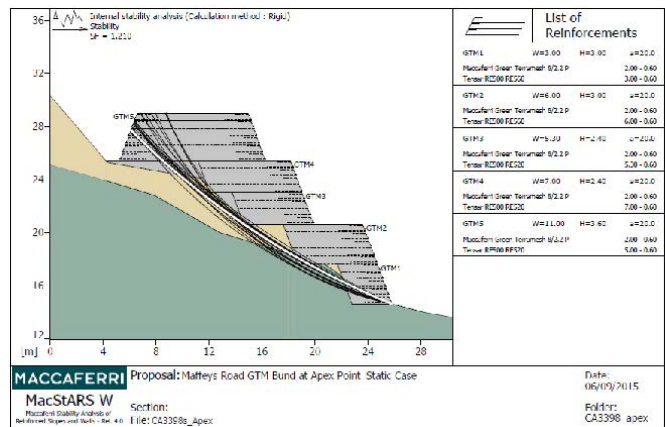


FIG 4. MACSTARS

Stability analysis for dynamic impact and internal stability for static and seismic load cases



MACSTARS

Software screenshot

CONTRACTOR: FULTON HOGAN
CONSULTANT: AECOM