

CASE STUDY

Modular Blocks

Project: Turnbull Bay Keystone TW3 Retaining Wall
Date: April 2015
Client: Dunedin City Council
Designer: MWH Dunedin
Contractor: Downer Dunedin
Location: Portobello Rd Otago



Keystone TW3 Wall

Portobello Road is the main access route out of Dunedin to the Otago Peninsula. This relatively narrow and winding road is used by commuters, residents, tourists and cyclists to access the city and peninsula. The popularity of albatross colony and yellow eyed penguins adds to making this road a popular tourist route.

The section of road that passes through Turnbull Bay suffered from major slips during the June 2013 rainfall event. A total of four slips and extensive cracking at the road edge affected a 200m long stretch of road creating a safety hazard for road users.

The Dunedin City Council commissioned MWH to develop a solution for this damaged section of road. Their requirement was for a robust engineering solution that provides a long term design life in an exposed coastal environment.

A number of wall systems and facing option were considered at the preliminary design phase stage. The **Keystone TW3** modular block wall system incorporating **Tensar RE500** geogrid was selected as best meeting the demands of this challenging site. Among others, the near vertical (89.4°) wall face angle and the positive connection system for attaching the **Tensar geogrid** to the modular block was important to meet the site geometric requirements and achieve an efficient design. The use of 30MPa concrete in the block manufacture ensures that the durability of the facing is addressed in this exposed location. An aesthetically appealing face type was also desirable since this would become a highly visible piece of infrastructure in the area once complete.

Keystone TW3 retaining wall system incorporates a mechanical connector for attaching the geogrid reinforcement and this positive connection has undergone full scale shaking table tests in Vyborg, Russia. The results showed that this connection system is capable of resisting a maximum seismic horizontal acceleration of up to 0.63g with <2mm of residual deformation.

The **Keystone TW3** wall system has also been independently certified for use in retaining walls and bridge abutment in accordance with the HAPAS Certificate 14/H217.



Slip prior to repairs



Site excavation



Keystone TW3 wall construction

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Geofabrics New Zealand's technical team provided the initial design assistance and support during the early stages of design with the use of TensarSoil™ software. Further detailed design was carried out using MSEW software by the designers with the use of verified connection strength data between **Keystone TW3** and **Tensar geogrid** from Geofabrics team.

Training in the construction of the **Keystone TW3** wall system was carried out by Geofabrics staff prior to the first block being laid. This contributed to Downers becoming very proficient in the construction of this type of wall system.

The project was not without its challenges with the contractor having to keep one lane open to vehicular traffic on this very busy road including tourist buses and trucks and continue to work in a safe manner up to 7m below the road level. The exposure of previously unknown organics during excavation of the site resulted in further design and an increase in the amount of earthworks and soil reinforcement to complete the project.

The construction process started with the excavation and laying of a concrete levelling pad. The placement of the Keystone TW3 blocks followed along with the incorporation of **Tensar RE** geogrid within the compacted granular backfill sourced by the contractor to meet the project specification. Blue moulded connectors were placed around the **Tensar RE** geogrid transverse bar to create a high efficiency connection to the **Keystone TW3** modular block.

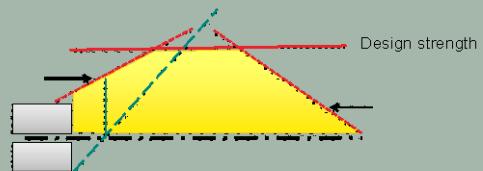
In addition, the contractor Downer NZ was able to train up unskilled labour on site in safe construction practice and they contributed to completion of this impressive 200m long and approximately 7m wall which the locals have named "The Great Wall of Turnbull Bay". This solution incorporating the near vertical **Keystone TW3** wall system not only resulted in the reinstatement of the outer road lane but also allowed for a 3m wide path for cyclists and pedestrians along this scenic stretch of coast.



Completed Keystone TW3 Wall

The attributes and differences between the 'Frictional' and 'Positive' connection for modular block walls facing:

- **Frictional Connection**



- Rely on confining stress of the block
- Geogrid strength is not fully utilise at the front of wall
- For low height and static load case retaining wall

- **Positive Connection**



- Rely on mechanical connection
- Geogrid strength is fully utilise at the front face
- For taller and seismic load case retaining wall

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