TenCate Miragrid® XT
Reinforced walls & slopes, Greenhithe NZ

The Upper Harbour Corridor was designed as a traffic dispersal system for the North Harbour region of Auckland, New Zealand's largest city. The alignment of this highway dispersal system resulted in a number of grade-separated highway interchanges, while a number of steepened slopes were utilised to ensure land acquisition was kept to a minimum for the earthworks construction. A series of reinforced soil walls were constructed at grade-separated highway interchanges, and a series of reinforced fill slopes were constructed on the side slopes of the embankment fill sections.

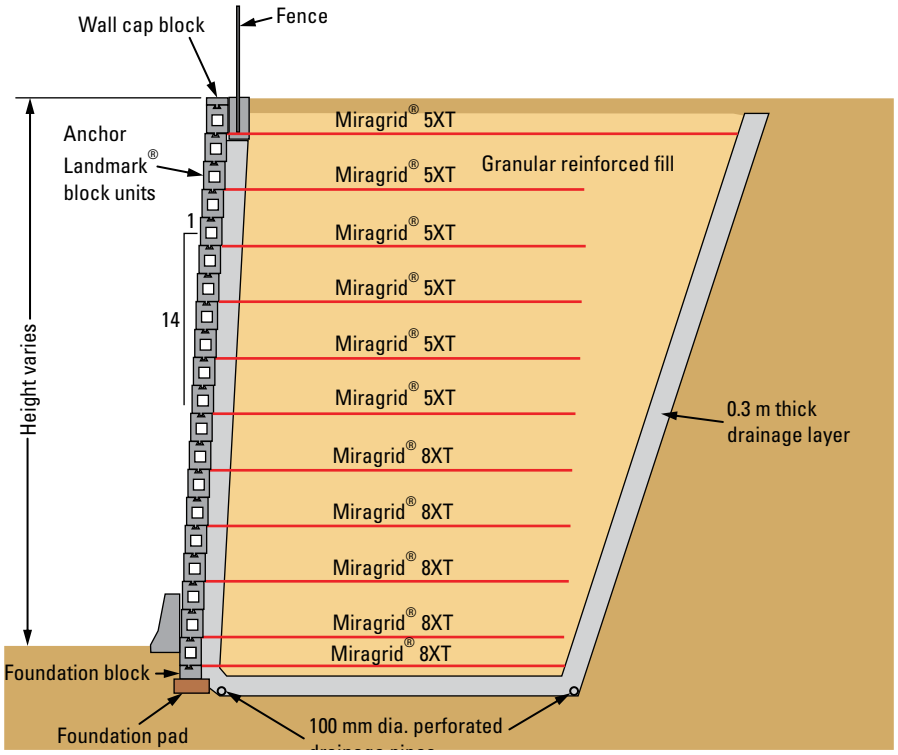
Reinforced soil walls

The walls had to be designed to accommodate both static and seismic loadings, as the area is prone to seismic activity. For performance and economical reasons it was decided to use Anchor Landmark® segmental block units for the wall facings as these provided a full positive connection with the Miragrid® XT geogrid reinforcement, and were easy to install. The design was performed using a limit equilibrium approach taking into account static and seismic loadings, the specific properties of the Anchor Landmark® blocks and the Miragrid® XT geogrid reinforcements. Wall heights varied up to 9.5 m in height.

The granular reinforced fill used was a fine-crushed rock with high frictional characteristics, and this material was easy to compact under variable weather conditions. The wall toes were embedded 0.4 m below ground level to provide good toe stability. To facilitate good groundwater drainage a 0.3 m thick granular drainage blanket, encapsulated in a Mirafi® 140NC geotextile filter, surrounded the reinforced fill zone. This drainage layer was extended up behind the wall face to ensure no groundwater would seep through the Landmark® block facing.

Following completion of the retaining walls, on-ramp and off-ramp road exits were constructed on top of the walls.

Reinforced fill slopes

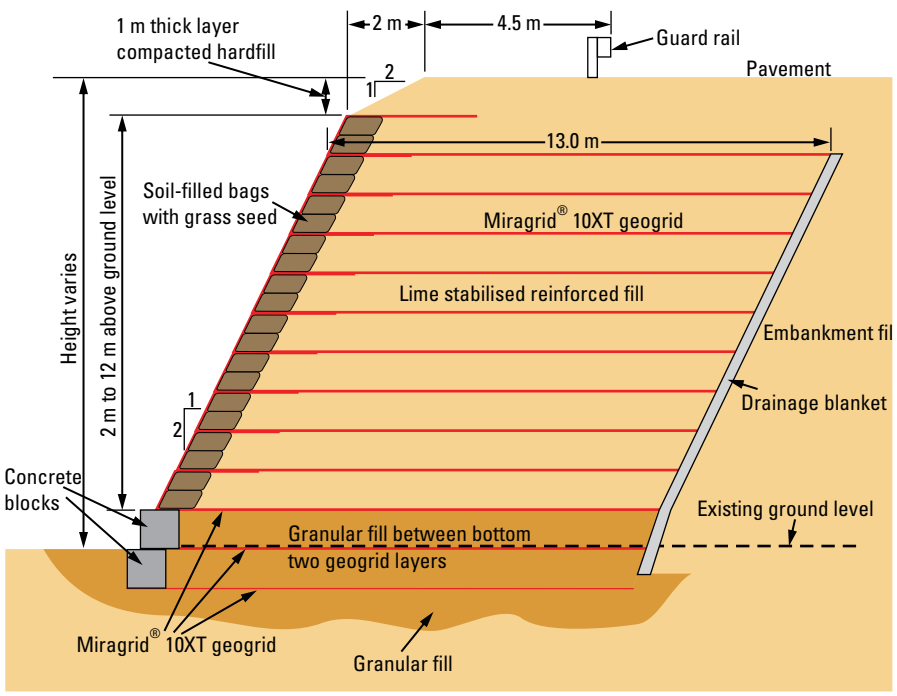


Typical cross section through the reinforced soil walls

Placing Anchor Landmark® segmental blocks for the wall facing

Installing the block facing to specific curve alignments

One wall near completion



Typical cross section through reinforced fill slopes

The construction of reinforced fill slopes at the sides of the embankment earthworks sections enabled the embankment surface area to be maximised, while minimising the amount of land acquisition.

The reinforced fill slopes were designed using a limit equilibrium approach, taking into account both static and seismic loadings. The facings of the slopes consisted of large knitted socks filled with soil, mulch and ryegrass grass seed. The Miragrid® XT geogrid reinforcement extended out of the slope, wrapping around the soil filled socks, and extending into the slope 2 m. Slope face angles were maintained at 2V:1H for all reinforced slopes. Slope heights varied up to 16 m in height.
A major positive point for this type of construction was that the same fill used in the embankment earthworks could also be used as the reinforced fill for these reinforced slopes.

If the foundation was soft at the base of the embankment earthworks, the soft material was excavated and replaced with free-draining granular fill. Where required for surface run-off, concrete culverts were installed across the base of the embankment earthworks. At the toe of the reinforced fill slopes 1 m cube concrete blocks were installed up to the top of the concrete culvert level. These were installed to ensure negligible settlements would occur around the concrete culverts. Compacted granular fill was placed behind these concrete blocks.

The reinforced fill slopes were constructed on top of the concrete blocks. Layers of Miragrid® XT geogrid reinforcement were placed extending out through the face of the slope. The large knitted socks containing top soil, mulch and ryegrass grass seed were placed and shaped along the slope face. The reinforced fill was then compacted up to the face of the slope, and then the extended length of Miragrid® XT geogrid was wrapped around the face and brought 2 m into the slope face, prior to the placement of the next layer of Miragrid® XT geogrid.

Because of continual poor weather onsite it became impossible to adequately compact the embankment fill material. Consequently, this material was combined with 2% lime, and this enabled adequate compaction. The lime stabilised embankment fill material was also used as the reinforced fill in the reinforced fill slopes with the Miragrid® XT geogrids.
To prevent groundwater entering the lime stabilised reinforced fill zone a 0.3 m thick granular drainage blanket, encapsulated in a Mirafi® 140NC geotextile filter, ran down the rear of the reinforced fill zone into the free-draining granular fill at the base of the slopes.

Once the slopes were completed the highway pavement structure was constructed on top where required.

Placement of Miragrid® XT geogrid at base of reinforced fill slope

Construction of one of the reinforced fill slopes

Client: Transit NZ Ltd, Auckland, NZ.