

MIXED RSS FOR THE RRESHEN-KALIMASH HIGHWAY
ALBANIA

SOIL REINFORCEMENT & ROCKFALL PROTECTION

Product: Terramesh® System, ParaLink® 300, Steelgrid® MO, MacMat® R, Rockfall Barrier

Problem

What is thought to be amongst the tallest reinforced soil structures ever to be built in Europe forms part of the new Rreshen to Kalimash motorway.

The 103 km long motorway is a key connection between Durres Port, Albania's primary harbour on the Adriatic Sea and Kosovo. Journey times of between six and ten hours will be reduced to two by this new road and the new route will serve to stimulate the economy in Albania's North Eastern region.

The 61km long central section of the route travels through some of the most isolated areas of the country. It includes dual carriageways of 2 x 3.75m lanes, supplemented with 2.0m emergency shoulder lanes through the challenging topography of the mountainous terrain at an altitude over 1,000m. This section of the works ultimately included 29 bridges (4.4km total length), 5.5km of tunnelling and 70 retaining walls totalling 6.4km in length.

Due to the mountainous topography of the area, many sections of the motorway run alternately through large steep embankment fill sections and slope cuts, with soil reinforcement, rock-fall protection, erosion control and re-vegetation measures required. The availability of large quantities of rock fills generated by the slope excavations made the choice of embankment fills a more cost effective alternative to the construction of viaducts.

Of the 70 retaining walls required, those up to 15m high were constructed of concrete. However, the 30 walls over 15m high were designed as reinforced soil structures to re-use site won fill and reduce the visual impact.

Solution

Bechtel-Enka brought in geotechnical specialists, Officine Maccaferri in a partnership arrangement to provide engineering design solutions for the walls.



The first courses of the tallest wall being constructed



Laying Paralink primary reinforcement

Client:

MINISTRY OF PUBLIC WORKS & COMMUNICATIONS ALBANIA

Main contractor:

BECHTEL-ENKA JOINT VENTURE

Scheme Engineer:

EGIS ROUTE-ITALCONSULT

Element Designer:

ALBANIA DRAHT / MACCAFERRI

Products used:

TERRAMESH, PARALINK, ROCKFALL BARRIERS

Date of construction

2008 - 2010



BBA Certified Paralink can accommodate many fill types

Maccaferri's responsibility encompassed the design assistance, structural calculations and construction drawings for the 30 walls. For 20 of the walls, Maccaferri also provided supervision and construction management through its local partner Albania Draht.

The 30 composite reinforced soil structures have a total facing surface area of more than 35,000 m², with the maximum wall overall height of 40 m. The walls, where a steep (84°) facing was required, have been constructed using a hybrid reinforced soil system, combining two Maccaferri products;

- Terramesh[®] System, a double-twisted steel wire mesh unit which forms structures with the aesthetics of gabions but with the reassurance of soil reinforcement
- ParaLink[®] 300, a high strength polyester geogrid (primary reinforcement)

The ParaLink[®] was spaced at 1 or 2m vertical centres depending upon the design requirement. These walls are amongst the highest of their type constructed anywhere in the world.

Ground conditions on the site varied from rock that was in parts competent to frequently shattered and fractured in others. In areas where the rock was at its most competent, the slopes were simply cut back to near vertical with rock ditches created to catch falling material.

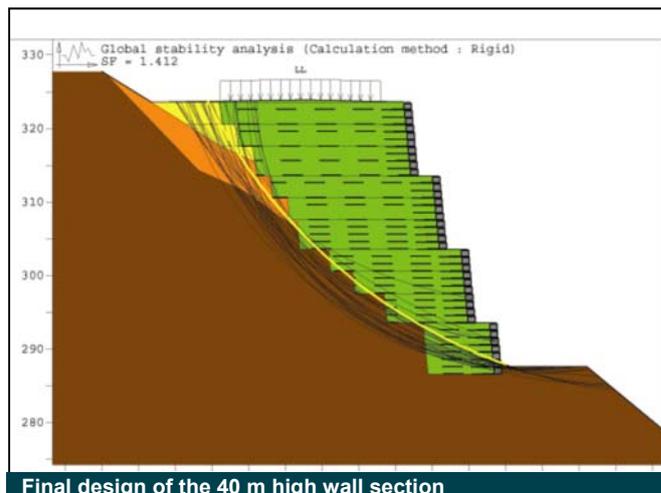
On the slopes up to 45° angle above some of the walls, rockfall protection, erosion control and re-vegetation measures were installed to protect the motorway below and to promote rapid establishment of stabilising, vegetative cover. Maccaferri MacMat[®] R was used to stabilise the slope face and reinforce the vegetation.

On slopes where rocks could detach and fall onto the highway, Steelgrid[®] MO 150, high tensile strength rockfall mitigation mesh was installed in conjunction with anchors and rock bolts to limit rock detachment and contain friable rock slopes. Finally, where large rocks were prone to detachment and meshing was not feasible, Maccaferri's 500 kJ dynamic rockfall barriers were installed as rockfall protection. Specialist design assistance was again provided by Maccaferri.

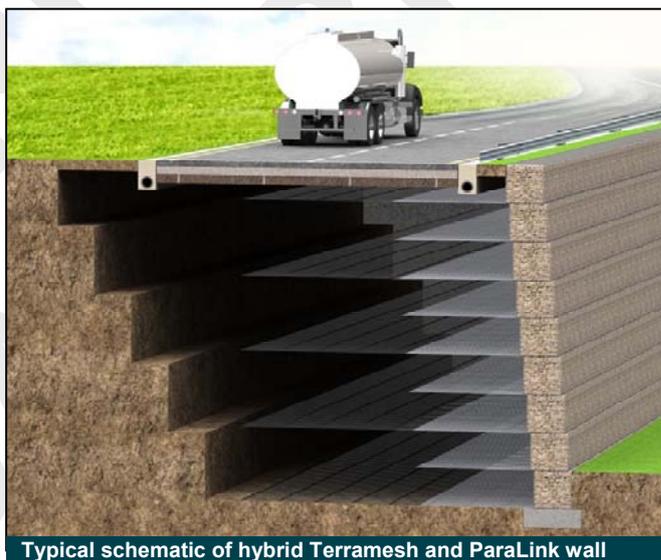
Maccaferri Terramesh[®] is a reinforced soil system for stabilising steep and near vertical slopes. A Terramesh[®] unit comprises a continuous horizontal panel of steel woven wire mesh geogrid with an integral gabion fascia unit. The fascia unit is filled with hard durable rock, identical to a gabion, and the geogrid tail is then sandwiched between layers of compacted backfill material, thereby reinforcing it. Having the geogrid tail integral with the fascia element removes the need for any on-site connection or pinning where errors during installation could occur due to incomplete connection, or reduced pinning frequency. Terramesh[®] is rapid to construct, and can even reuse site won materials when suitable.

Consecutive layers of Terramesh[®] units are then constructed to form reinforced soil retaining structures of almost any height when used in conjunction with high strength ParaLink[®] geogrids. ParaLink[®] is a unique high strength uniaxial geogrid used in soil reinforcement applications as well as in basal platforms over piles, soft ground or over voids in the ground.

Available in strengths up to 1350kN in a single layer of geogrid, ParaLink[®] consists of polyester reinforcement yarns encapsulated within a tough polyethylene sheath. Having been invented and in use since the late 1970's, ParaLink[®] has great pedigree in the geosynthetics market.



Final design of the 40 m high wall section



Typical schematic of hybrid Terramesh and ParaLink wall



The tallest wall nearing completion



Completed reinforced soil structure with slope stabilisation measures above highway

Maccaferri Terramesh® and ParaLink® are BBA Roads and Bridges certified.

The scheme engineers identified a fault zone within the slope above the tallest reinforced soil structure. Accordingly these slopes above the new highway also required stabilisation. This required numerous interventions up to 100m above and beyond the road alignment.

The primary solution was a 30m high combined slope stabilisation solution was designed which included:

- Lower 10m - prestressed geotechnical permanent anchors (double corrosion protected), extending 23m into the slope with a concrete fascia
- Upper 20m hybrid reinforced soil structure with Terramesh® and ParaLink® geogrids
- Dynamic rockfall barrier set back from the crest of the reinforced soil structure

Beyond and above this primary intervention, shotcrete and rock anchors were used to locally stabilise vulnerable outcrops.

Within the slope stabilisation drainage measures were included to manage the water flowing down the slope and preventing it from saturating the reinforced soil.

The successful Bechtel-Enka/Maccaferri partnership arrangement is typical of the projects Maccaferri is increasingly undertaking with complex international projects, reinforcing their global presence, capabilities and experience.



Rockfall mitigation measures being installed



The lower wall nearing completion

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