

### MIXED RSS FOR THE RRESHEN-KALIMASH HIGHWAY ALBANIA

#### REINFORCED SOIL RETAINING WALLS & ROCKFALL PROTECTION

**Product:** Terramesh System, Paralink 300, Steelgrid MO, Macmat R, Rockfall Barrier CTR 05-07-B

#### Problem

What is thought to be one of the tallest reinforced earth 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.

Client:

GOVERNMENT OF ALBANIA

Main contractor:

BECHTEL-ENKA JOINT VENTURE

Designer:

ALBANIA DRAHT / MACCAFERRI

Products used:

TERRAMESH, PARALINK, ROCKFALL BARRIERS

Date of construction

JUNE 2008 - SEPTEMBER 2009



The first courses of the tallest wall being constructed



Laying Paralink primary reinforcement



BBA Certified Paralink can accommodate many fill types

## Solution

Bechtel-Enka brought in geotechnical specialists, Officine Maccaferri (the Italian parent company of Oxford based Maccaferri Ltd) in a partnership arrangement to provide engineering design solutions for the walls.

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 m<sup>2</sup>, 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).

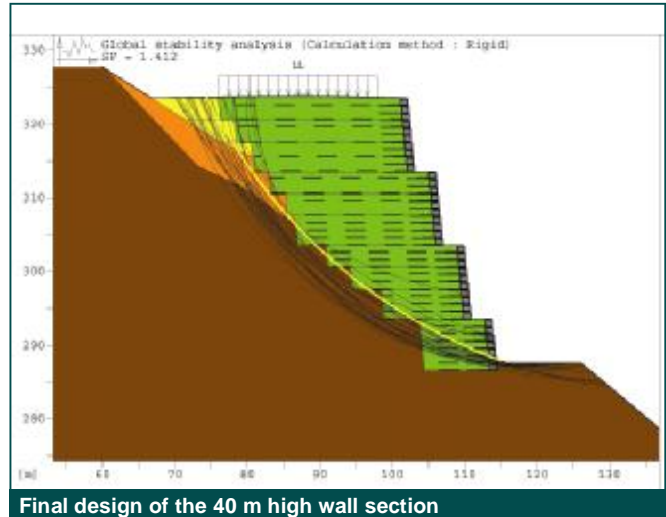
The Paralink was spaced at 1 or 2m vertical centres depending upon the design requirement. These walls are amongst the highest of their type constructed anywhere in the world.

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 is 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 R1 6822 GN was used to stabilise the slope face and reinforce 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 high resistance rockfall barrier (CTR 05-07-B) 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 woven wire steel mesh geogrid with a integral gabion fascia unit. The fascia unit is filled with hard durable rock-fill,





Overview of the highest wall nearing completion

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 basal platforms over piles, soft ground or over voids caused by mine-workings, caves and so on. 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 in use since the late 1970's, Paralink has great pedigree in the geosynthetics market.

Maccaferri Terramesh and Paralink are BBA Roads and Bridges certified.

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.



Steelgrid being lifted into position ready for fixing



High strength Steelgrid being installed on rockface

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