## HANNEYS CROSSING
#### GROVE, OXFORDSHIRE

### REINFORCED SOIL SLOPES / BASAL REINFORCEMENT
**Product:** Green Terramesh/Paragrid/Paralink/Parawall

### Problem
The Great Western Main Line [GWML] is one of the oldest and busiest in the country, linking London with the Midlands, the south west and west and most of South Wales. Engineered by Isambard Kingdom Brunel, it was originally founded in 1833 and ran its first trains in 1838.

Now, with freight and passenger traffic continuing to grow rapidly, the line is undergoing a £2.8bn process of upgrade and electrification. According to the train operators, these improvements to infrastructure will allow the introduction of faster cleaner and greener rolling stock which will provide a 20% increase in passenger capacity. However, expansion and improvement does not come without its fair share of challenges to overcome. Not least of which is the re-engineering of many of the original overbridges, some dating back more than 150 years.

At one particular site to the south west of Oxford, BAM Rail were faced with the challenge of raising the vertical clearance of a single span overbridge to accommodate overhead line equipment [OLE] as part of the electrification of the Wootton Bassett to Reading section of line—Hanneys Bridge.

"Hanneys Bridge" carries an un-sealed public byway across the line, providing north-south access to a sewerage works from the village of Grove, immediately south of the line. Built in the 1870’s, the bridge required partial demolition and reconstruction to create sufficient OLE clearance. The increase in elevation of the bridge deck from 4.00m to 5.25m from top of rail head to soffit, meant that the approach ramps at each side of the structure also had to be raised to meet the new bridge deck level.

To achieve Eurocode compliant design criteria and accommodate the required 40 tonne vehicular loadings, the old ramps had to be cut down and completely replaced with new structures.

### Main Client:
**NETWORK RAIL/OXFORDSHIRE CC**

### Consultant
**TONY GEE & PARTNERS**

### Main Contractor
**BAM RAIL**

### Products used:
**GREEN TERRAMESH, PARAWALL, PARALINK**

### Date of construction:
**MARCH-JUNE 2016**
**Building Information Modelling [BIM]**

The geometry at the interface with the bridge abutments and the new ramp structure was highly complex, requiring significant use of 3D BIM modelling to determine the configuration of the various reinforced soil elements used. This geometrical complexity arose from the re-use of the existing abutments and installation of a narrower bridge deck.

To overcome this complex interface geometry, the Green Terramesh system was also adapted so it could be used to form an 85 degree slope rather than the more usual 70 degree. To allow for this and to avoid compaction works taking place over the railway, the Green Terramesh units at the interface were backfilled with lean-mix concrete. This allowed for the tops of the abutments, which were exposed due to the installation of a narrower bridge deck, to be utilised in the design and allowed for an aesthetically pleasing brickwork cladding to be specified.

With an increase in elevation of road level at the bridge of some 2.0m, it was necessary to similarly increase the level of the approach embankments while maintaining an adequate factor of safety of the abutments.

This issue was addressed by constructing stress relief reinforced soil walls (Parawall), immediately behind the abutments, so that the forces exerted by the new structure onto the abutments were sufficiently low.

Reconstruction of the Hanneys Bridge approach ramps began in late March 2016 and completed in June. Throughout the works, the GWML remained open to traffic.
Ground surveys undertaken by BAM Rail identified predominantly soft surrounding soils, highlighting the need for major reconstruction. In light of these findings and because of close previous working relationships and extensive experience in such conditions, BAM brought in geotechnical specialists, Maccaferri to propose a value engineered solution based on the construction of new reinforced soil approach ramps.

On the plus-side, the surveys revealed that the original Victorian brick abutments to the bridge were still in excellent condition and would only require stabilisation and relatively minor reinforcement to increase their height and bearing width to accommodate the new raised deck. As the line had to remain operational throughout the reconstruction, the original bridge deck was removed and replaced over the Christmas period 2015. Two new cill beams were installed on the raised and deepened abutments and the new deck was craned into position.

**Solution**

The solution proposed by Tony Gee and Partners with detailed design work undertaken by Maccaferri, required the complete removal of the original ramps and the construction of a pair of replacement ramp structures. As there was no land-take, the design was to be undertaken within the footprint of the existing embankments. A number of options were considered but a reinforced soil solution was adopted, using the Maccaferri Green Terramesh and Paragrid system over a load transfer platform done with Paralink.

BAM excavated the subgrade beneath the exiting ramps to a depth of up to 400mm and a mix of Paralink 400 and 600 grade were placed to improve embankment stability. This reinforcement provided the additional strength needed to achieve the equilibrium state, increasing the safety factor against catastrophic failure.

The new reinforced soil approach ramps were constructed using the Green Terramesh system and installed by BAM Rail under the guidance of Maccaferri.
Courses of Green Terramesh units combined with Paragrid were placed back to back, between approximately 10.0m and 14.0m apart at the base of the structure, to form the opposing faces of the 60.0m long approach ramps, with a maximum height of 6m.

The backfill used to construct the ramps was a well graded granular material in compliance with specification for highway works. The material however, exhibited a sulphate content five times higher than normally allowed for 6I/6J material. Kesternich testing to ISO 6998, undertaken on the durability of the polymeric coated woven wire mesh on the Green Terramesh units adequately demonstrated the high level of resistance to sulphate attack of the products, as declared on their respective BBA certification. Also the Paralink and Paragrid will resist to high pH as declared on the BBA with a durability up to 120 years.