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HUESKER

GROUND ENGINEERING

REINFORCED SOIL EMBANKMENTS– TERMINAL 5 HEATHROW

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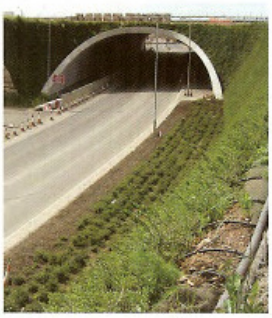
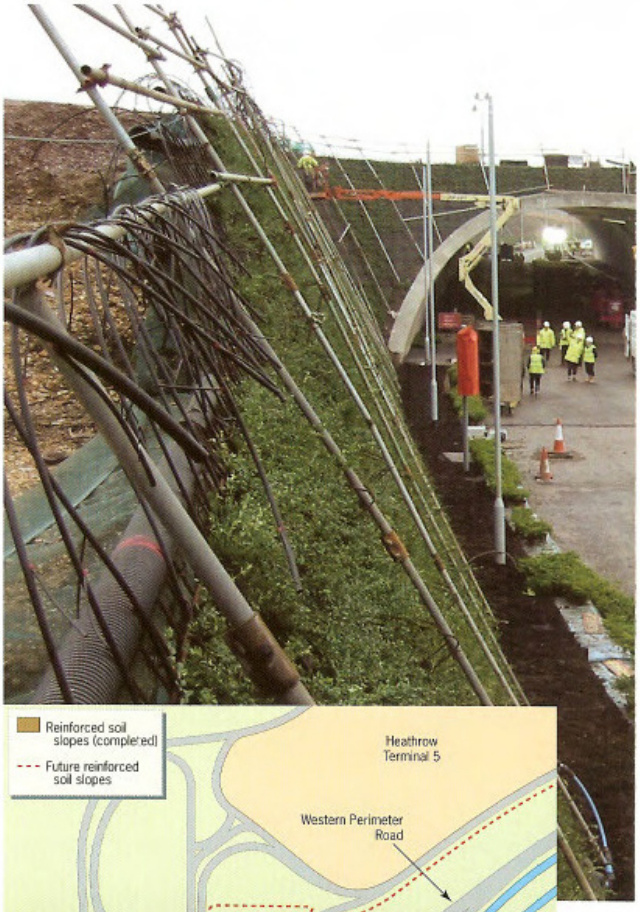




SLOPE ENGINEERING

WELCOME SIGHT

The approach roundabout for Heathrow's Terminal 5 is an unusually sophisticated use of reinforced soil.

Reinforced soil has gained widespread acceptance in the UK as a specialist engineered solution providing a creative, green approach to slope support and earth retention.

This is certainly the case with Keller Comtec's recent project to build reinforced soil slip-road embankments for the Welcome Roundabout for Heathrow Airport's fifth terminal.

The roundabout, at the end of the new spur of the M25 dedicated to Terminal 5, is 9m above the surrounding ground level, straddling the Western Perimeter Road. The road runs below the roundabout in a precast concrete arch tunnel with reinforced soil embankments rising up to encase the structure.

Client BAA wanted "exceptionally high specification planting" on the reinforced soil slopes, which includes 300mm of topsoil and a sophisticated irrigation system.

There will be five off-slip embankments at the roundabout. The slope of the two completed so far increases from 26° to 64° as the embankments rise along their 140m length.

Keller Comtec senior design engineer Stuart Mortimore says the most difficult detail on the project was forming the crown of the arch – with the slope angle of the curving face changing from 64° to 50° and back to 64° across the width of the tunnel openings.

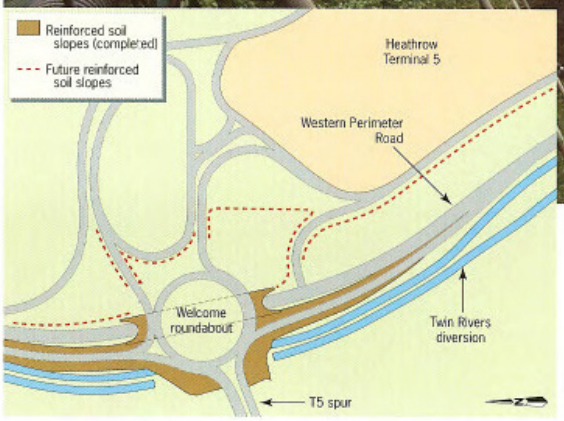
He says very tight control was needed over the setting out of the embankment by main contractor Laing O'Rourke and Keller's construction supervisor. "The key thing was getting the line and level spot on so that we ended up at the right place," he adds.

Keller has built most of the embankment using Textomur, the Swiss system for which Keller holds the UK and Irish licence. This makes use of 5m long by 500mm panels of prefabricated steel mesh which act as formwork during construction. Steel braces maintain the required face slope as the embankment is built up in 500mm lifts.

The "sacrificial" mesh (sacrificial in the sense that it is not accounted for in the long-term design of the embankment) helps to create "crisp" planar faces and a well prepared, stable growing medium. It certainly avoids the "string of sausages" look, commonly seen when using the ubiquitous geotextile wrap-around methods for reinforced soil structures.

Keller used site-won terrace gravel fill to build up the embankments, placing a horizontal layer of Huesker Fortrac geogrid every 0.5m as the internal reinforcement. The final 300mm behind the Textomur face is lightly compacted topsoil.

Textomur has a scaffold handrail that is easily attached to the cages to ensure the safety of the construction team. The handrail is adjusted as the fill operation progresses, Mortimore says.



As it is difficult to build Textomur at slopes less than 45°, Keller switched to a cellular faced reinforced soil solution for the shallower – and lower – slopes.

This also makes use of horizontal layers of internal reinforcement, but without the steel mesh front-face formwork. Instead, Keller compacted the embankment to about a metre beyond its finished profile and then trimmed it back to the required angle.

Precision and care was needed when positioning the internal reinforcement layers, so that the geogrid was just exposed when the slope was cut back to the correct position.

"By over-compacting and trimming back the well compacted fill, we were able to achieve a crisp and sharp angle to the face," Mortimore says.

To meet BAA's specification Keller specified a Geoweb cellular topsoil retention system which had to be specifically manufactured for the job.

"With the high specification planting, which includes shrubs, we needed a more robust soil retention system than for the more usual grassed slopes," Mortimore says.

The Geoweb cellular matting system reinforces the topsoil to its full depth, which is particularly important when there is a requirement for 300mm of topsoil on slopes reaching 50°.

Planting and an irrigation system to help the vegetation to establish

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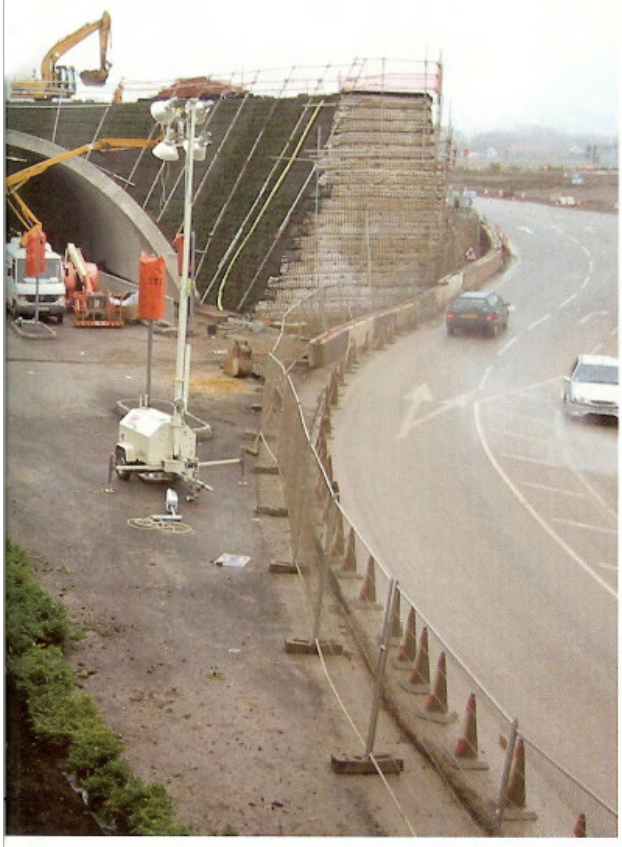

The complex slope profiles vary from 26° to 64° as the embankments near the tunnel under the roundabout.

itself in the first few years is being carried out by landscape contractor Hasmead, under a maintenance agreement with Laing O'Rourke.

Keller designed the embankments for live loading of 15kN/m² to meet Highways Agency requirements. The design had to accommodate drainage runs, signage bases and lamp columns which, Mortimore insists, is not too much of a problem provided they are known about at the design stage. "These sorts of details are more of a problem if they arise as an afterthought," he says.

More unusually, the embankment cuts across the line of a temporary bridge providing the main T5 site access over the Western Perimeter Road. This section cannot be completed until the temporary bridge is removed, in 2006, and so it has two vertical stop-ends where the bridge truncates it.

The bridge itself incorporates an unusual application for reinforced soil. One of the columns is based on a square reinforced soil pad, designed to carry loads of 200kN.

"Apart from the high loading we had to be aware of the permanent geosynthetic reinforcement that will be incorporated into the pad for the embankment slip road in five months' time," Mortimore says.

There are also other vertical stop-ends where reinforced soil structures will connect two further slip roads to the roundabout as the T5 construction progresses.

The next phase of reinforced soil work for the roundabout is due to start later this year.