

GROUND IMPROVEMENT

A ROCKY ROAD

A new trunk road flanked by the mountains of Snowdonia is designed to improve safety, but it has been a less than smooth ride for engineers. Alexandra Wynne heads to Wales to take a look.



Engineers are using a reinforced soil system in North Wales to protect listed structures and overcome the challenge of diverting traffic away from improvements along the A470 trunk road.

The Welsh Assembly Government (WAG) awarded Alfred McAlpine a £10M design and build contract to improve the 4km stretch of road that runs between Blaenau Ffestiniog and Cancoed in the Snowdonia National Park.

"We are mostly widening along the existing road," says McAlpine project manager Tony Lewis.

The original design used Bailey Bridges to carry the diversion over two listed bridges. But these are costly to hire and would have meant installing another set of traffic lights, the number of which are restricted on the works.

The project's rural location has added its own pressure. "It's an important road because it's really

the only route serving this area," says Lewis. "Our main challenge is to make sure it's kept open during the scheme."

The 200m diversion is being built to divert traffic away from a triple-arch bridge that will be demolished and rebuilt during the work.

The team has had to overcome obstacles including two listed bridges over a river and an old mine wagon track bed. Additional complications are a nearby railway, a listed weighbridge and power house for the nearby slate mine, and an old dry stone wall.

WAG's heritage organisation, Cadw, has representatives on site to monitor the work and ensure that all listed structures are protected.

Instead of using Bailey Bridges, consultant Gifford, working on the £300,000 contract, came up with a design that involves raising existing ground for the diversion. It has used slate fill, interspersed with geogrids,

built up in layers on top of horizontal sheet piles to traverse the troublesome listed bridges.

The two Grade-II listed bridges will lie under the diversion – one crossing the River Barlwyd and the other the mining track bed. To cross these – and at the same time protect them from the development – site workers have installed temporary concrete abutments before laying on top the PU32 steel sheet piles laterally between them.

The sheet piles form a base for the soil-reinforcement structure. As an extra precaution, site workers have installed steel props between and around the edges of the bridges for extra support.

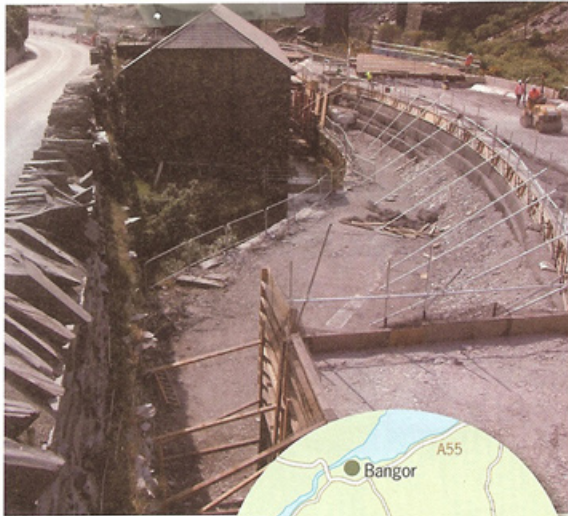
While this might seem a convoluted method compared with the use of Bailey Bridges, the designer's site representative Kevin Long feels that the most difficult area of the road improvement works has now become its most interesting aspect.

Along most of the diversion, site workers are using Huesker Fortrac 55/30 and 35/30 geogrids to form a wraparound reinforced soil structure.

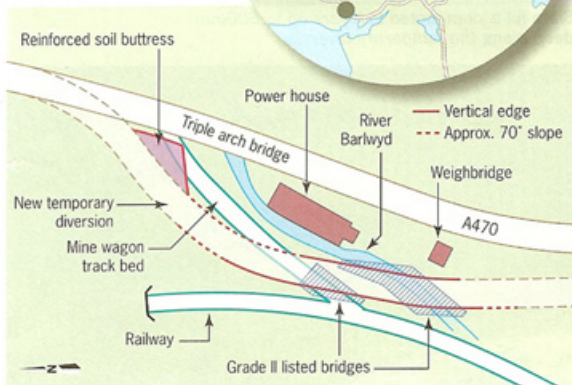
Temporary wooden shutters support the edge of the new embankment. Site workers lay a length of geogrid – the stronger 55/30 grids are used at lower levels – horizontally where ground is being raised and drape it over the front of the shutters. Locally won class IA slate fill is compacted in layers up to 600mm thick on top of the grid before the front is brought back into the area being compacted.

The maximum height of the reinforced soil structure at any point along the diversion is 8m.

The depth of the layer of fill and strength of the geogrid varies along this stretch. "We came up with a schedule to show what geogrids would be needed at every 5m along the reinforced soil section," says



The diversion includes a reinforced soil buttress (in the foreground) to support a wall where the new road joins the old one



Huesker applications engineer Peter Assinder. He explains that this is particularly important because in places the road gradient rises sharply and is restricted on one side by the railway and on the other by the edge of one of the listed bridges.

Each compacted lift is stepped back from the one below it to create a face that is about 70° from the horizontal in places. Where reinforced soil is near to the restricted areas there is no gradual incline calling for the face to be vertical to save space.

The railway – connecting Blaenau Ffestiniog with Llandudno – runs close to the west side of the site. Network Rail representatives reviewed the work and included provisions to monitor the track to ensure that it does not move at any point.

Long says throughout the project the team have been mindful that the diversion is temporary. All this work will be removed when the new road is completed and the

listed structures must be left intact and unharmed. To make it easier to remove the concrete abutments each section is separated from the next by a membrane, meaning it can be removed piece by piece.

As well as protecting the Network Rail line, workers have had to be careful not to dislodge the local slate tip – a mountain that towers over the west and north side of the diversion. There were concerns that possible vibrations could move the slate and cause an avalanche. To counter this, instead of using a vibratory roller, a dead roller is being used to compact the fill.

Additional reassurance was needed for the stability of the site where the diversion ties back in with the old road at the north end. The designer had to come up with a plan to support a dry stone retaining wall in case the weight of the temporary road adjoining it caused it to move.

Once again, site workers used the



Ground improvement along the A470 using slate fill

GROUND IMPROVEMENT

geogrids and slate fill in a wedge-shaped area between the old and new road.

The two straight edges of the reinforced soil buttress are 15m and 10m long and Fortrac grids are rolled horizontally back from each of these edges. The process is repeated until the backfill reaches a height of 8m. Because workers are installing the grids from two directions, they are placed at alternating levels to ensure there is no interference.

A major part of the route lies in the Snowdonia National Park, which meant that as well as widening the road for traffic and improving its horizontal and vertical alignment, the scheme had to allow more room for pedestrians and cyclists.

"The old road just isn't wide enough," says Lewis. "In places the old road narrows to 5.1m and there are points where heavy goods vehicles travelling towards each other are unable to pass. Even the temporary section improves on the existing road because we're providing a pedestrian walkway that doesn't already exist."

Along the less complicated stretch of road away from the diversion, site workers are carrying out ground improvement using a simple dig and replace method.

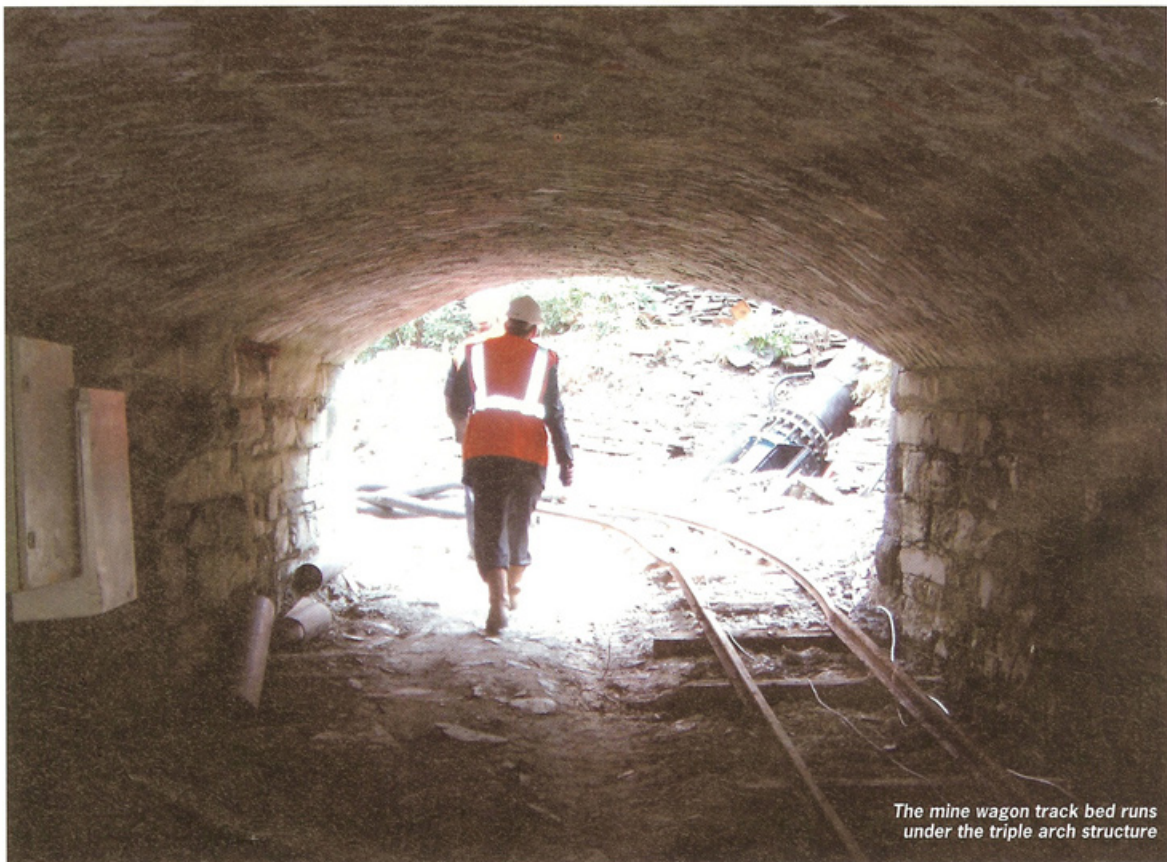
The ground profile comprises up to 5m of peat, underlain by clay and occasional outcrops of granite. Once the peat is stripped off, class 1A and 1C slate fill is being used to form a structural embankment and widen the road to a standard 7.6m. To improve the aesthetics, site workers place the peat back on the road embankments.

Following the earthworks, the team will demolish and rebuild the triple-arch bridge, doing all they can to ensure it resembles its predecessor. However, in its new incarnation the bridge will be built from concrete instead of stone and the old stone face will be replicated by slate and detailed masonry work.

Work began on site in November and the diversion route is due to be opened by the end of this month, after which, demolition and rebuilding of the triple-arch bridge can begin.



Slate fill is compacted in layers up to 600mm deep along the temporary diversion



The mine wagon track bed runs under the triple arch structure