Rapid revision

Use of geotechnical software enabled significant time and cost savings to be delivered on a major slope stabilisation scheme on the A1(M). **Claire Smith** *reports.*

Workers from Can Geotechnical get to grips with the rock cutting on the A1(M) at West Cornforth

Imagine the scene: you've got the design agreed with the client and a contractor poised to start on site but there's a new product or technique available that could save both time and money. Do you postpone work on site to check what savings the new approach could offer or push ahead with the original plan to avoid standing time and delays from redesigning the work?

For many schemes this is a stark reality but for stabilisation work on a rock cutting on the A1(M) at West Cornforth, designer CH2M had the best of both worlds. Use of specialist design software allowed the benefits of an alternative design to be quickly weighed up on the scheme to cut costs by a third and time on site by three weeks.

CH2M was working for A-One+ on Highways England's managing agent contract 14 and had specialist contractor Can Geotechnical about to move onto site when protection system specialist Geobrugg launched a new product.

"We had already assessed Geobrugg's 2mm and 3mm Tecco mesh for the project but, just before we started on site, the company added a 4mm product to its range," says CH2M senior geotechnical engineer and Area 12 and 14 geotechnical maintenance liaison engineer Chris Jackson. "Geobrugg suggested that we use the new product at the West Cornforth site. It was a little over the top in terms of the capacity needed for the cutting but we looked at the benefits."

Jackson had used Geobrugg Ruvolum software to assess the design using the 2mm and 3mm products, so changing the parameters to consider the benefits of the 4mm mesh was straightforward. Ruvolum is a slope stabilisation dimensioning program that allows scheme designers to assess forces affecting anchor points in relation to geotechnical parameters and verify performance of the system as a whole.

"We re-did the modelling and that suggested that we could significantly reduce the number of soil nails," he explains. "This not only had potential cost savings but also meant that the time on site would be reduced, which is important when you consider that the work was to be undertaken from the hard shoulder with live traffic on the dual carriageway."

Long-term fix

CH2M had been monitoring the rock slopes in the cutting since minor spalling started and it was several years before plans for stabilisation were drawn up.

"The cutting is through magnesium limestone and was built in the mid-

1970s," says Jackson. "It is about 500m long, so you have 1km of lane length through the cutting. The faces are up to 5m high and stand subvertical at between 75° to 80°."

No stabilisation or protection was placed on the rock faces at the time of construction and, as a result of weathering, spalling had started to occur with blocks of up to 150mm reaching the hard shoulder.

"The rock falls did not reach the running lanes so traffic management was put in place on the hard shoulder but that is not ideal. Highways England wanted a quick solution but one that would provide a long-term fix," says Jackson.

After almost four decades since the cutting was constructed, the slopes – especially the crest – had become well vegetated and wildflower grassland had become established. "The area was not protected as such but the species of flowers meant that the area was of local environmental significance and therefore sensitive, so the solution we developed had to try to minimise disturbance of the vegetation," adds Jackson.

The initial proposal was to use active mesh on parts of the slope and localised rock catchment fences in other areas. "There is an opposing pair of faults that runs through the cutting that has created a brecciated zone with the potential for larger block failure – up to 700mm or 800mm – which is why we proposed a high energy catchment fence in this area," explains Jackson. "Highways England wanted to minimise the ongoing maintenance and asked for an active system to be installed throughout the entire cutting to prevent failure, rather than catch failed material."

The result of a value engineering exercise was a bolted system. The design used Geobrugg 3mm Tecco mesh secured using 1,200 2m to 2.5m long Dywidag gewi bar soil nails that were to be installed at 15° below horizontal by Can's long reach wheeled excavators working from the hard shoulder.

Faster solution

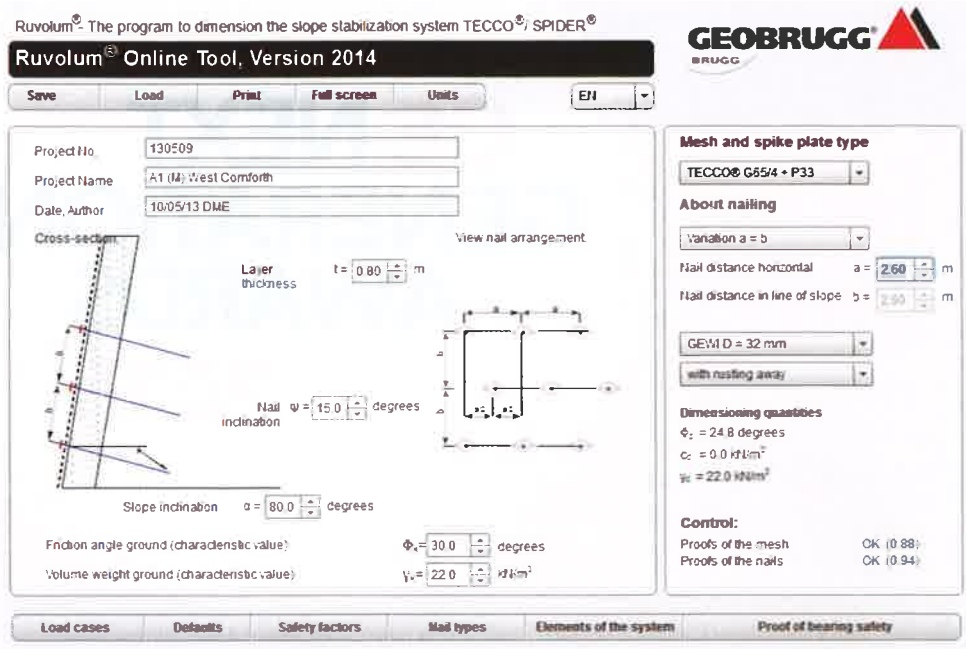
Re-designing the scheme using the 4mm mesh allowed Jackson to increase the soil nail spacing to a 2.5m grid and the number of soil nails was reduced to 550, which was where the time and cost savings were secured. "The 4mm mesh was slightly heavier so it was slower to install and the work had to be carefully sequenced, but overall it went well on site," he says.

The Ruvolum software proved its worth again once the work was underway. "In several places the rock was slightly harder than we had expected so the scaling work didn't achieve the profile we had designed for," adds Jackson. "However, we were able to use Ruvolum to check the design based on the new profile and adjust the soil nail positions accordingly to ensure the mesh still met the specification."

The software was also used to design a section of passive restraint using Greenex mesh to control a section of the cutting where weathering differences meant that the failure mechanism was different to elsewhere at the site. "The failure mechanism meant that there was a risk of 40mm to 50mm sized cubes of rock ravelling from the face and we needed an alternative design to control this," says Jackson.

According to Jackson, the speed at which the design could be reviewed and changed using Ruvolum meant that there were no delays on site and the work was completed in four weeks. "Other software would have got us to the same point but it might have taken longer," he says. "Time matters when you have traffic management booked and limited time allocated for the work."

In hindsight, Jackson says that greater ground investigation could have avoided the need to redesign the work once on site but the software helped the project team to overcome the challenges and work together on the solution.



Ruvolum software was used to create and re-evaluate the design

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