GROUND ENGINEERING

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HIGHLAND SWING

Upgrading Scotland's notorious A82

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Site investigation and testing

LESSONS FROM PULPIT ROCK

The upgrade of one of Scotland's most demanding roads involved a multi-disciplinary site investigation and the use of a large helicopter, reports Neil Jaques.

The A82 is one of Scotland's most picturesque and significant roads. As the principal route from Glasgow to the western Highlands, it winds past such landmarks as Loch Lomond, Glencoe and Ben Nevis.

Unfortunately, it also has a reputation as one of Scotland's most dangerous transport arteries. Between January 2005 and 2007 there were 22 fatalities and more than 450 injuries between Tarbet, situated on the banks of Loch Lomond, and Inverness.

Such is the concern surrounding the road's condition that a high-profile campaign to upgrade the A82 has been running since 2006, with vociferous hauliers, emergency services, local businesses and locals urging the Scottish government to act.

Transport Scotland began to address the problem in February 2006 with the publication of the *A82 Tarbet to Fort William – Route Action Plan* and an announcement that £16M would be invested in several priority intervention sites over the next five years.

Among the first to be subjected to an overhaul is a notorious bottleneck a few miles north of Tarbet, slightly south of the village of Ardlui. Flanked by Loch Lomond on one side and a huge hill on the other, this stretch of road is a nightmare for drivers, particularly during the summer tourist season, managed only by a set of temporary traffic lights that have been in place for over two decades.

Just beyond the traffic lights, and lending the scene a vaguely ethereal dimension, is Pulpit Rock, a towering slab of stone. History states that in 1825 locals from Arrochar parish complained to their minister about the 12.9km walk to and from church.

They were told that if they created a pulpit he would come and preach to them. Wasting no time, a few enterprising individuals used dynamite to blast a vaguely pulpit-shaped hole into the rock face to allow the minister to keep his word.

The area is one of astonishing natural beauty, so it is in everyone's interest to make it as safe and as driver-friendly as possible.

"We are seeking to alleviate a key operational constraint identified in the *Route Action Plan*," says Transport Scotland project manager Angus Kennedy. "This is caused by queuing resulting from the stop-and-go effect at the long-term traffic lights."

The plan is to broaden the road to accommodate two lanes of traffic, which, Kennedy says, would see an improvement to journey times. To do this, Transport Scotland has two options: expand the breadth of the road to run over Loch Lomond via a retaining wall or create a stilted carriage way, or drill a tunnel into the hill.

Sensitive nature

To ascertain the best way forward, RSK Group's site investigation contracting arm Structural Soils was commissioned to undertake a £600,000 investigation in May. Although the number of boreholes required was no more than 17 in total, the site's restrictive and ecologically sensitive nature meant that it would be a considerable challenge to get the job done at all, let alone on time and to budget.

"The investigations we were asking them to carry out weren't particularly out of the ordinary, but the locations they were in were very out of the ordinary and that required all sorts of equipment and a lot of thinking," Kennedy says.

To assess the ground conditions in the loch, Structural Soils employed a jack-up barge to drill three rotary boreholes at 4m to 10m depths about 10m from the shoreline.

To get an overview of the road conditions, the team drilled five rotary boreholes at similar depths to those created in the loch using night closures. Those were the easy parts.

More demanding was getting the 3t Comacchio MC 305 drilling rigs and associated equipment to the top of the hill, which towers some 40m above road level. With its craggy,»

Piece by piece: the piling rig was dismantled into 1t pieces and airlifted to the top of the hill

steep inclines leaving little room for manoeuvre, Structural Soils had to proceed with caution and with more than a little ingenuity.

A plan was soon hatched to airlift the equipment by helicopter. However, this was problematic as the weight of the drilling rigs would necessitate the use of a large helicopter, the type of which is usually monopolised by the oil industry for work in the North Sea.

Undeterred by the lack of available resources, Structural Soils director John Lawrence contacted aerial surveillance and software provider, and fellow RSK Group member, RSK Orbital.

Although the company usually focuses on the pipeline industry, capturing aerial images for use in its own asset management software, it knew how to source a light helicopter and, crucially, had access to an exceptionally skilled pilot.

To make it work, the drilling rigs would have to be dismantled into component parts and airlifted from a patch of farmland 1.6km away. The method proved far more efficient than initially anticipated (although the area's fluctuating weather conditions resulted in numerous abortive attempts and occasional bouts of frustrated hair-pulling).

At the top: nine boreholes were drilled, one of which was angled at 30˚

The challenge was to keep everything moving and trying to adapt the planning on an hour-by-hour basis so we were where we needed to be at any given time.
Structural Soils on-site manager John Bassett

"Normally it would take a day and a half to put the kit back together, but with the precision flying and the helicopter doing it in component parts, we can actually put it back together in 20min," Lawrence explains.

The rigs, split into 1t sections, were flown along the loch to the top of the hill where engineers guided the pilot to gently slot the pieces into place before bolting everything together.

Once all the kit was mobilised, the team set to work drilling nine rotary boreholes (two of which were inclined at 30˚ angles) in the schist bedrock using 131mm barrels to accommodate down-hole geophysics equipment.

Electrical resistivity

A two-stage geophysics programme conducted by another RSK company, STATS, was integral to producing a comprehensive model of the principal subsurface geological features, the kind that would not have been possible using borehole data alone.

The first stage involved a geophysical survey that included electrical resistivity imaging, seismic refraction, surface wave ground stiffness and a microgravity survey.

Among other things, the process identified 12m of sand and gravel above the schist bedrock, which was mapped across the entire site to guide the Structural Soils drilling team "This could not have been determined by any other means," said STATS director and geophysics team leader George Tuckwell.

The second phase involved a cross-hole seismic tomography survey, which delivered important engineering parameters of the rock, such as Young's modulus, Poisson's ratio, shear modulus and bulk modulus. It also helped identify potential fracture zones and other weaknesses within the bedrock.

It was a constant battle to ensure that all the site investigation components ran on time and were adaptive to the quirks of the site and whims of the weather.

"It was a really demanding project for us because there were many different elements involved," says Structural Soils on-site manager John Bassett, who also had to co-ordinate a team of RSK Group ecologists and the transportation of core samples to in-house laboratories.

"The challenge was to keep everything moving and trying to adapt the planning on an hour-by-hour basis so we were where we needed to be at any given time."

Nevertheless, Structural Soils finished its on-site work on time at the end of July and is in the midst of undertaking laboratory testing and groundwater monitoring duties.

Once these are complete and transposed into a report, Transport Scotland will select the preferred road alignment option with a view of completing any works by 2011 to 2012, subject to the satisfactory completion of statutory processes.

"It's been a hell of a job to manage," says Lawrence. "But it has been extremely rewarding. It's great to be tested in extreme, difficult conditions and also to support such an important development."