GRIFFITHS

civil engineering and construction

Geotechnical Division Case Study
Blaenau Ffestiniog Tunnel

Rockfall protection system installed inside the longest unlined rail tunnel in the UK

The site is located along the Llandudno Junction to Blaenau Ffestiniog Railway line railway line (LJT1), specifically within the two-mile lone Blaenau Ffestiniog Tunnel. The tunnel has been cut through slate bedrock and was the longest unlined tunnel in Europe for a time and remains the longest unlined rail tunnel in the UK. Due to the unlined nature and age of the tunnel, rockfalls can occur regularly, affecting the reliability and safe performance of the railway.

The worksite area was located approximately in the centre of the tunnel, over 2 miles from the closest pedestrian access point and 4 miles from the closet plant access point.

The project consisted of the installation of 600 stainless steel rock bolts, 2.5m in length and 1500m^2 of high tensile stainless steel rockfall netting. The programme of works was condensed around a 21-day blockade (full railway closure), with a week either side to allow for site mobilisation and demobilisation. During the blockade, the site was operational 24 hours a day, 7 days a week.

Not only was the project logistically challenging in terms of access and the constraints associated with a single railway line to work from, but special consideration was also required due to the nature of the tunnel working environment and its potential to adversely affect the workforce.

Due to the confined nature of a tunnel, plant emissions were a concern. In order to overcome this, Griffiths utilised a low emission fuel for its plant called Ecopar, which produced considerably less carbon dioxide and nitrogen oxides. This was coupled with two large fans to ensure a fresh supply of air at all times. Potential dust produced by drilling was eliminated by the use of inline misting units. Continuous air and particulate monitoring was completed throughout to verify a safe working atmosphere for the workforce. Two kilometres of electric lighting powered by solar panels located in the compound was run through the tunnel to provide illumination for the worksite but also in the event of evacuation being required.

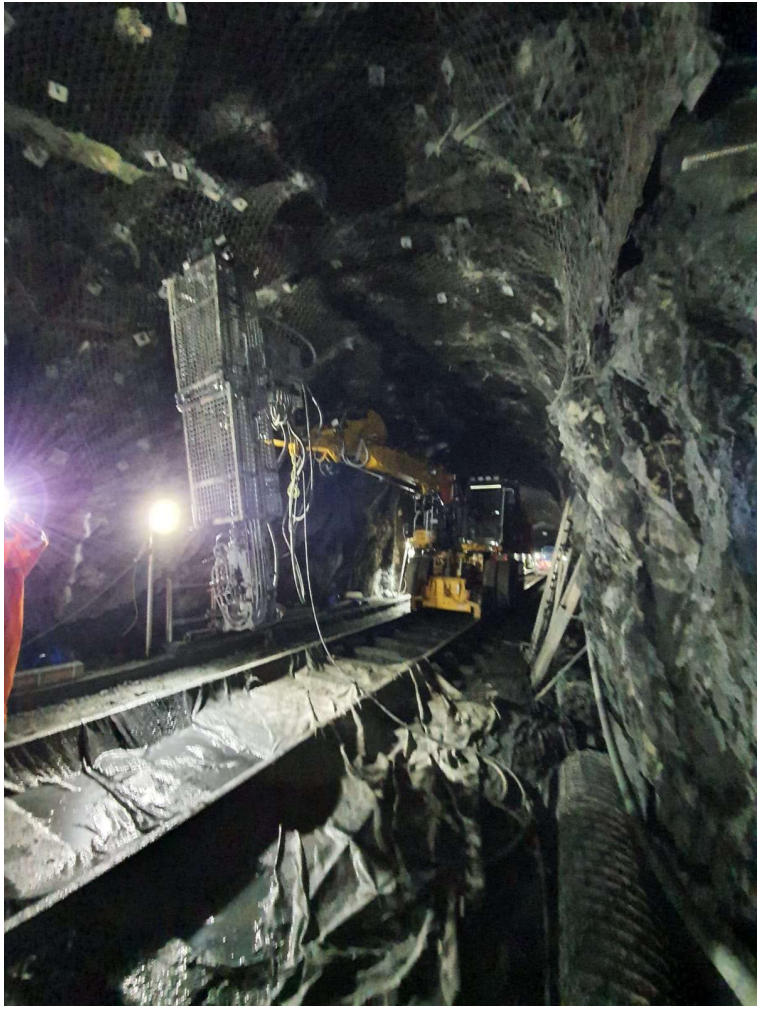
Pictured above: Rock bolt installation in roof of tunnel with demarcated exclusion zones.

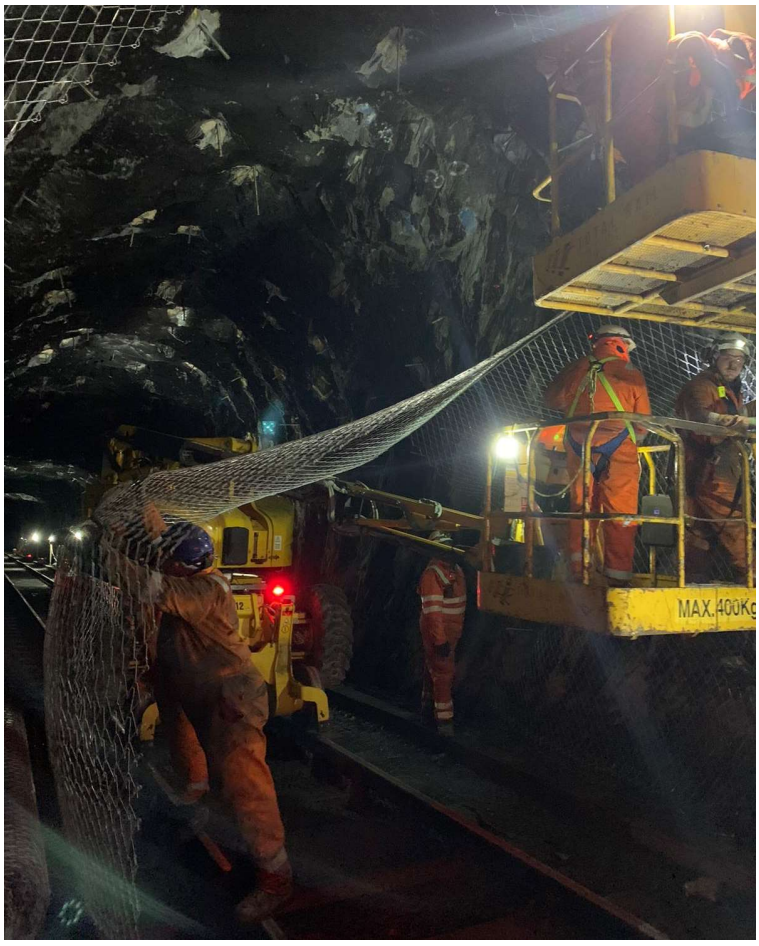
Stainless steel rock bolts were drilled on a staggered pattern at intervals of approximately 1.50m. The majority of the bolts consisted of 25mm bars installed 33mm diameter holes, with 30mm bars installed in 41mm diameter holes utilised to deal with specific features. The rock bolts were secured in place using a combination of slow and fast set resin grouts which allow bolts to be installed in the roof of the tunnel immediately, providing an instant grip on the bar after around 10 seconds.

The geology of the tunnel varies but for the most part consists of a slate bedrock. The portion of the tunnel being treated was located in an area of slate recorded as 'the bastard slates' on historical drawings. The slate is this area was particularly hard and was renowned for wearing out drill bits within a few hundred millimetres of drilling and traditionally taking around 1 hour to drill a two-metre bolt by traditional hand drilling / air leg methods used by comparable contractors who had previously worked in this area.

Griffiths utilised its smaller hydraulic drill rigs mounted to road rail vehicles with two slew rings which allowed to the drills to be rotated 360 degrees in two planes of direction and most importantly fit within the tunnel bore thus eliminating the need for hand drilling and slow labour-intensive techniques using hand assembled frames and scaffolds for drilling and moving locations. This reduced drill times to under 10 minutes and providing a huge advantage when moving between drill positions, taking minutes rather than hours.

In addition, Griffiths had bespoke drill steels manufactured to match the length of the drill hole removing the need to couple drill steels halfway through the drilling of each hole. This not only removed a task and the time associated with this process, more importantly it meant that the driller could stand well clear of the drilling activity and operate the drill remotely thus removing an interface with large machinery and potentially any falling debris resulting from the works.





Pictured above:
Fig 1) Drilling rock bolts using road rail vehicle (RRV) mounted with hydraulic drill.
Fig 2) Installing high tensile mesh to crown of tunnel from MEWPs.

Pictured above:
Completed high tensile mesh and rock bolts to crown of tunnel.

Project at a glance

Client: Network Rail
Location: Blaenau Ffestiniog, North Wales
Completed: December 2019
Value: £2.1M