

# Upholland tunnel shaft void filling



## Background

Geobear was recently contracted by Murphys to provide a void filling solution at Upholland tunnel in the North West of England. The requirement was to fill five redundant shafts that had provided steam ventilation, in order to manage the water drainage in the tunnel.

Upholland tunnel is sited on the Kirkby branch line, it stretches for 877 metres and is the highest point on the line between Kirkby and Wigan. The route is undergoing a major upgrade and filling the ventilation shafts within the tunnel is a crucial aspect of the works programme.

## Solution

This particular void filling operation had a number of challenges. The ventilation shafts were situated throughout the tunnel and ran vertically from the roof of the tunnel to the surface. The key challenge was having no access to the voids from above, so the filling operation had to be delivered within the tunnel, filling the void vertically from the base at each of the five locations.

In order to fill the voids Geobear worked with Murphys to develop a modified rail vehicle that could house the pressure pumps and material itself. This resulted in an isolated mobile void filling unit that could be positioned where required beneath the voids. A safety first programme was implemented where vehicle modifications were challenged to ensure compliance. This featured the inclusion of purpose built sidebars and harnesses to ensure all personnel were secure with the confines of the vehicle whilst both travelling through the tunnel and using the pumps.

The process for the work would involve transferring the modified rail vehicle on and off track during each possession and relocating into the tunnel. With five shafts to fill, the pre-programme identified the order of operations and a series of minor works included the base of the voids being secured and pre-drilled with 16mm holes.

The delivery of void fill material was through 12mm steel tubes. The pre-drilled holes in the base of the shafts allowed the technical teams to insert tubes of up to 12 metres in length into the void. Two tubes of differing lengths were inserted into each void, this would ensure

the full area was filled. For example, a tube six metres in length was installed vertically and used to pump in material which, by virtue of gravity, would fall to the base of the shaft. Once the 6m vertical space was filled, the teams would use a 12m tube and material would begin to fill from the previous 6m ceiling. Using multiple tubes would ensure the full area of the shaft was completely filled.

The engineering department identified Geobear 2640 as the suitable geopolymer material used for this project. The material is injected as a two component liquid which mixes on delivery to the fill area, the chemical reaction of the two components creates a geopolymer material with a slow controlled reaction profile creating a mechanically stable material once cured. >

Each Geobear material has different reaction profiles and mechanical characteristics, therefore the Geobear engineering department pre-select the material in accordance with the site specification and access variables. In this instance Geobear 2640 was selected as it's a lightweight material with high expansion properties and is capable of being pumped in excess of 30m from the point of injection.

Given the circumstances of the location, Geobear required a geopolymer with a reaction that would start within a few seconds, but stay within its liquid phase long enough to flow and ensure that void was completely filled as the material receded up the shaft.

Whilst the engineering team designed the Geobear works programme, where required, the experienced Geobear site technical teams in conjunction with the engineering department can also influence the behavioural properties of the material, by regulating pump outputs and the injection temperature of the materials.

Fifty kilograms of material injected as a liquid would equate to a cured volume of approximately one cubic metre, therefore for the volume of material for the complete works could be pre-calculated to provide a fixed price to the client.

Geobear could mobilise within one week to deliver this project which saw the voids successfully filled, on time and to the client's strict QA procedures.

Our lightweight geopolymer was the ideal solution for these difficult to access shafts. With the need for minimal plant and the versatility to adapt to client needs, Geobear is at the forefront of challenging void fill or track stabilisation projects.

This project was completed successfully and the operational processes now form the best practice for delivery for similar works.

