

Grouting & Cut-off Wall

Lower Carno Dam Remediation, South Wales

United Kingdom



Grout cut-off wall and grouting of grout/rock interface



Introduction

In the picturesque surroundings of Ebbw Vale, South Wales, Bachy Soletanche Limited has conducted essential remedial works at the Lower Carno Dam. Built in 1911, the dam has suffered with a number of leakages and complications eventually leading to the adjacent reservoir being emptied in 2005. In order to refill the reservoir, Bachy Soletanche installed a slurry wall and comprehensive rock injection grouting to reinforce the dam in this two phase project. It was only after the reservoir was emptied that the client's engineers, Black and Veatch could possibly determine a permanent solution to the long term problems. Employed by Dwr Cymru Welsh Water, the firm conducted a study to identify the possible mechanisms for the leakages. Then after carrying out an intrusive investigation, Black and Veatch developed an appropriate design for the remedial works in conjunction with Bachy Soletanche.

*Cut off wall installation by KS Grab and Cement Bentonite Plant
All photographs courtesy of Dwr Cymru Welsh Water & Black & Veatch*

CLIENT:	Dwr Cymru Welsh Water
CLIENT'S ENGINEER	Black & Veatch
GEOTECHNICAL CONTRACTOR:	Bachy Soletanche
DURATION OF WORKS:	5 months

Works Quantities

180m long, 800mm wide slurry cut-off wall up to 42m deep by KS hydraulic grab, through existing clay core, to a verticality tolerance of 1:100.

On-site batching of up to 175m³ of slurry per day and grouts.

More than 100no. boreholes to grout the slurry wall/ rock (coal measures) interface, up to 52m deep.

Radial grouting around scour culvert, working within a confined space.



The first phase involved installing the slurry cut off wall constructed from the crest of the dam using a diaphragm wall grab technique to prohibit the migration of water when the reservoir is refilled. Bachy Soletanche used a KS hydraulic grab which maintains verticality to 1:100 or better through on-board software which detects any deviation during the cut-off wall excavation.



KS Grab digging Cut-off wall

The slurry cut off wall itself was constructed in panels along the length of the dam, directly through the existing clay core. During the excavation, a cement bentonite slurry mix is pumped into the panel, keeping the excavated trench stable. The completed dam slurry wall is 180m long by 800mm wide and up to 42.7m in depth.

With such a high impounded water level behind the dam when in use, it was also crucial to conduct grouting to further prevent any potential leakages in a number of key areas.



Drilling of grout curtain

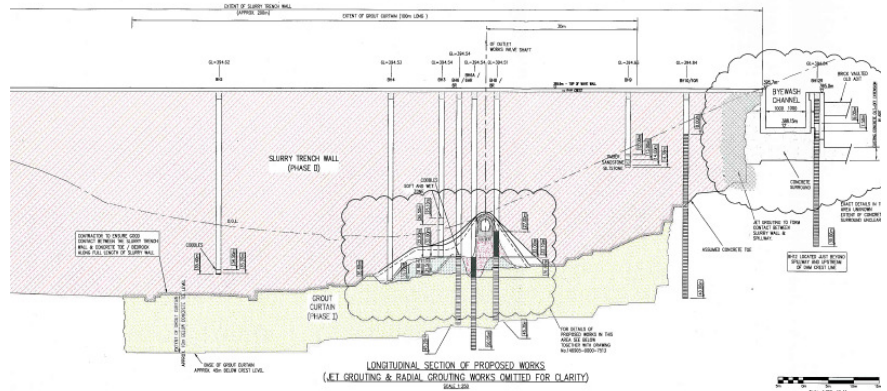
Phase 2 involved 2 rigs installing a grout curtain between the bottom of the cut-off wall and 10m into the rock (coal measures), using a high pressure “Wassara” hammer, directly below the concrete foundation of the dam and reaching as far as 55m below the crest. The grout pipes were installed through the newly constructed cut-off wall to seal top of the bedrock, in 3 stages using Tube-a-Manchette grout pipes.

With the project being in a rural location and with the dam being 97 years olds, the site team faced some environmental challenges, with the nearby River Ebbw is in close proximity, careful planning had to take place to avoid contaminating the river with the grout or bentonite fluid used on site.

The design process also had to be flexible because the ‘as built’ construction records from 1911 were poor. So to provide the most accurate solution as possible a 3D CAD model of the dam and surrounding ground was produced and proved extremely beneficial to the project.



On-site Slurry Mixing Plant



Scheme Drawing courtesy of Black & Veatch

A computer controlled pressure-system was employed to reduce the risk of fracturing the rock. More grouting took place within the 1.7m diameter (confined space) scour culvert. and grout was injected to strengthen and seal the surrounding soils.

The reservoir was then later refilled in order to increase the quantity of water available for the local towns and future developments and also to bring the rural beauty spot back to its former glory.