



**GOEDEHOOP  
COLLIERIES  
BLOCK 7  
PROJECT**

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South Africa

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## Background

South Africa has a long history when it comes to mining. It is an industry that forms the backbone of the South African economy. The client of this project has been a key catalyst to help create a stronger, safer, healthier, and more sustainable South Africa since 1917.

One of the key requirements in mining is to ensure adequate ventilation of a mine, provisions are made for suitable airways for the air to flow down the mine to the working areas. The primary ventilation system consists of an intake (downcasts) through which the fresh air passes to the mine workings, and an exhaust (or upcasts) where the air passes after having been ventilated. Any interference with the ventilation system would have an impact on operations and safety.

The Goedehoop Colliery Block 7 mine ventilation downcast shaft is approximately 60m deep and was constructed in the 1980's. The shaft consists of a segmented ring liner arrangement with an interlocking joint connection between the different shaft segments. The shaft had experienced the ingress of water over the last 35 years with a notable increase in the last couple of years through the joint interface, posing potential unsafe conditions, flooding and deterioration to the existing concrete shaft liner.

The excessive leaks were being pumped out on a daily basis as part of a routine operation which was required for the normal running of the mine.

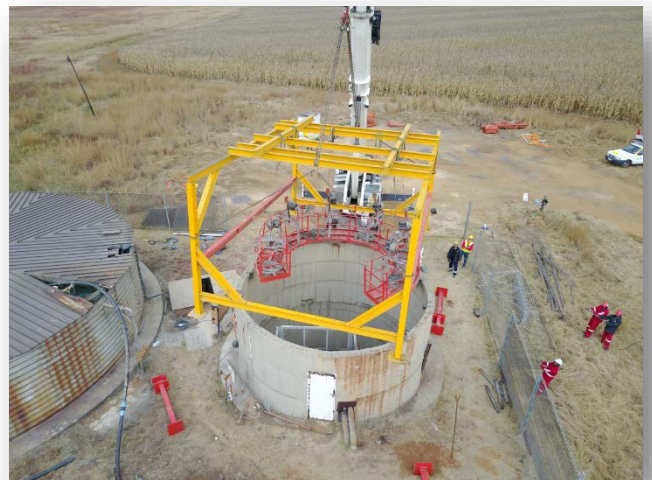
Over the years the underground water levels increased exacerbating the potential for significant leakages and flooding of the mining levels.

Early in 2017, the underground build-up of water broke through the concrete ventilation shaft, allowing excessive water penetration into the mine, threatening the safety of the miners.

A solution to the excessive water penetration into the shaft (approximately 7000 litres per minute) was required, failing which the possibility of closing the affected shafts was inevitable.



*View from the top of the shaft during the site inspection. The extreme water ingress points are evident all the way down the ventilation shaft. The base of the ventilation shaft was filled with water for 35 years.*



*Access to the shaft was a huge safety and logistical concern. The access specialists were able to supply a custom built cradle to lower workers into the shaft. This cradle was anchored to the sides of the shaft to ensure that there was no movement during the high pressure cleaning and sandblasting.*



The ingress pressure of the water was immense, shooting water torrents approximately 300 mm wide across the 7m diameter shaft.

There were numerous water ingress points along the full depth of the shaft, with the primary water ingress area, located between 19 and 25 m below ground level.

Being a ventilation shaft, there was no access to these areas, which therefore required the manufacture and installation of elaborate custom-made access equipment for both personnel and equipment.

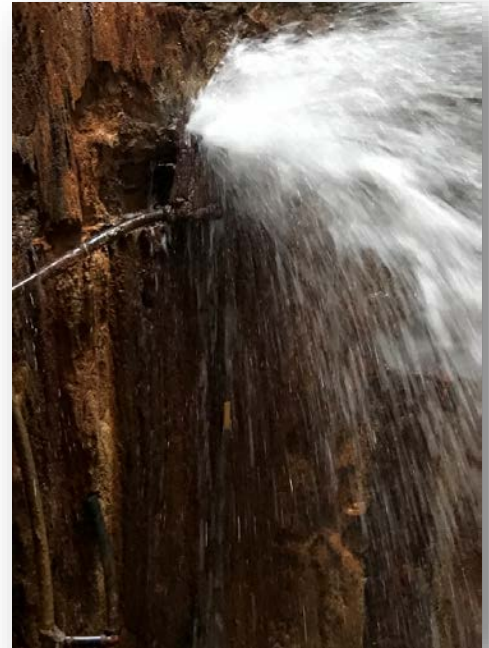
A solution to the ingress of water from the positive to negative path (from outside the shaft into the shaft opening) was required. In addition, there was no access to the positive side - being underground.

Even after extensive panel tests by various contractors, none were able to apply a product that could withstand the immense negative pressure exerted by the water in the mine shaft.

After an in-depth site evaluation, it was noted that the mine was under approximately 20 meters of water and the repair of a water penetration point at this level posed many difficulties and risks.

Numerous tests were carried out to ascertain the best procedures to access the mine, to investigate the concrete damage below water level, to confirm structural integrity as well as safety.

The scope of work focused on the main water ingress points which were in urgent need of concrete repair and jointing detail as well as surface waterproofing applications.



*Major water penetration points were blasting masses of water 300 mm wide right across the 7 m diameter of the shaft. The extreme pressure of the water was causing damage to the structure of the shaft as well as making the repair a very dangerous project*

## The Solution

It was critical that the entire structure be correctly rejuvenated, repaired and waterproofed using Crystalline Technology, which has a proven success record in similar case studies worldwide for the past 40 years.

The very first obstacle to overcome was that of access down the 7 m diameter shaft riddled with leaks. After numerous discussions and on-site tests, the appointed access company, devised a cradle system to safely lower workers into the shaft. The cradle also needed to be stabilized against the sides of the shaft to reduce movement for the work at hand.

The inspection and preparation of the site was imperative for this project. A borehole had to be sunk to the depth of the major water ingress and camera equipment sunk into the borehole to accurately investigate the ingress from the positive side. A scan of the concrete in the affected areas by GPRS equipment was conducted to ensure the safety and integrity of the structure was still intact.

With information gathered by visuals, a swelling waterstop had to be introduced to the positive side to reduce the water flow to a manageable condition.



*Swelling waterstop being tested with shaft waters VS tap water.*



*The waterproofing specialists also tested the swelling waterstop on the ingress points to ensure that the waterstop would swell to its maximum capacity to alleviate water pressure to continue with the crystalline leak repair system..*



In order to prepare the site for the application of crystalline waterproofing products, the damaged sections of concrete had to be cleaned and prepared using a dustless sandblasting and ultra-high pressure cleaning. Concrete cutting machines and chisels were used to chip chases along the entire length of all water ingress points, construction joints and cracks.

Running water was stopping by the use of a rapid-setting hydraulic cement and a swelling waterstop.

Chased cold joints were filled with a repair grout (specially mixed dry-mix).

Waterproofing crystalline surface-applied cementitious concrete compounds were applied to the surface in a slurry form in accordance with manufacturer's specification.

The application over the entire surface of the concrete structure resulted in the growth of crystals throughout the concrete mass preventing any further water or air ingress into the concrete, thus transforming the concrete itself into a waterproof barrier.

The growth of these crystals into the concrete and subsequent waterproofing of the concrete will retard any further deterioration of the concrete structure from water ingress and will therefore substantially lengthen the lifespan of this structure.

The overall result is a safe, dry and useable structure.



*Using a rapid-setting hydraulic cement and a swelling waterstop, the waterproofing specialists were able to successfully contain the flow of water to a single access point, thus making the water more manageable.*



*View from the bottom of the shaft once the project was complete*

**Other related images:**

Image A:



Image B:



*After the water was fully contained using a rapid-setting hydraulic cement and a swelling waterstop, the surface area was correctly prepared and applied with a crystalline repair grout (image A) and crystalline surface applied waterproofing (image B).*



*The base of the shaft had not been seen or dry for over 35 years. This was the first time that workers were able to stand at the base of the shaft.*