

World Tunnelling



Europe

Big plans under London clay

Drill & blast

Basalt bedrock on Vancouver Island

Shotcrete

Clear communication in Hong Kong

PROJECT REVIEW

The nozzlemen and the noise

A noisy and cramped tunnelling environment on a current metro-extension project necessitated careful co-ordination during shotcrete works

Contractors began work on contract 901, the Admiralty Integrated Station and Shatin to Central Link Enabling works in May 2011, as part of the South Island Line (East) (SIL(E)) project, an under-construction extension of the Hong Kong MTR metro system.

The SIL(E) Project comprises a medium-capacity railway approximately 7km long with stations at Admiralty, Ocean Park, Wong Chuk Hang, Lei Tung and South Horizons. The stations include both underground and elevated structures.

The Admiralty integrated station provides a convenient interchange between SIL(E), the existing Tsuen Wan Line (TWL), the existing Island Line (ISL) and the future Shatin to Central Link (SCL).

The 901 contract is split into three sections: existing station works; tunnels and caverns; and the new station box.

It includes the underpinning of the Island Line platform along a 60m section with the progressive installation of temporary and permanent underpinning columns that extend up to 23m beneath the existing tunnel structure.

The works comprise an extension to the existing Admiralty station to accommodate an interchange concourse, circulation areas and plant rooms for SIL(E) and SCL, station cavern, SCL platform tunnels, as well as associated external works.

The extension is located under Harcourt Garden and is surrounded by the existing Admiralty station, two existing finger platform structures (ISL and TWL) and the existing underground Admiralty car park.

Four new platforms will be constructed below and adjacent to the existing Admiralty station, two for SIL(E) and two for the future SCL.

The station box itself covers an area of approximately 4,200m² and has been excavated down approximately 40m on average. It has been excavated and constructed using top-down techniques to offer the best possible programme advantages.

Excavation methods included drill and blast, mechanical breaking using large excavators and heavy-duty breakers and by drill and split.



Overhead view of the Admiralty station site

Shotcrete application

Shotcrete works started at the end of 2012, and have been undertaken to all exposed faces in the construction shaft, all tunnels and the cavern structure.

The shotcrete was applied with and without fibre, to supplement the systematic and feature bolting as part of the temporary support system and to provide a safe area for the workers to operate in. ▶

“In the station box the shotcreting has been limited to vertical walls, usually applied without fibres but with temporary rock support provided predominantly by rock dowels”

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14 Best practice: shotcrete

► In the station box the shotcreting has been limited to vertical walls, usually applied without fibres but with temporary rock support provided predominantly by rock dowels.

The rock has been generally massive, meaning that the temporary rock support requirement has largely been limited to spot bolting with the shotcreting providing a face for the permanent walls to be cast against.

There have, however, been several geological features and adits/tunnels coming off the box where the shotcrete has provided a crucial role in the support systems used, enabling safe progression of the works. This has been particularly evident in the excavation of the underpinning.

Careful planning on site

One of the biggest challenges in the station box was the sheer volume of equipment and works being carried out close together in such a confined area.

The work needed to be very carefully planned and implemented safely to meet the demands and achieve the milestones determined by the schedule.

Extremely high safety standards were imposed to ensure that the work could be

carried out without affecting the other adjacent works.

Another challenge during shotcreting was communication. Due to the amount of equipment been used at any given time, verbal communication was virtually impossible so it was extremely important that the team involved with the process were trained and aware of what was going on at all times.

Also engineers had to ensure that they had visual contact between the pump man and the nozzleman at all times.

The final challenge was the site logistics, as all the works carried out in the station box required the use of cranes for lifting materials in and out of the work area.

It was critical that everything was planned and scheduled well in advance to ensure the availability of the cranes to meet the very demanding works schedule.

Putting things in place

As the manager of T&M Specialists and an experienced sprayed concrete operator for 15 years, the author knows that there are many things contractors and operators can do to ensure best practice



but first and foremost is training and good supervision.

Operators need to have at the very minimum basic knowledge and understanding of shotcrete. The biggest problems during shotcrete come from the quality of the shotcrete mix itself.

It is extremely important that the pump man/operator can look at the mix and determine whether it is ok to use or not. Normally, onsite contractors have quality-control personnel, who will carry out acceptance tests of the shotcrete on delivery.

However, just because the mix is accepted does not exclude the pump man/operators from doing a final check before using it.

Another important thing that comes from good training is troubleshooting a problem if one does occur. In dealing with pressurised hoses it is important that anybody involved with the shotcrete is fully aware so that nobody puts themselves or anybody around them in harm's way.



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By hardware or by hand

Equipment used on this contract was all supplied by Normet Equipment. In the tunnels two diesel-driven Alpha 20 compact robotic sprayers were utilised and shotcrete was delivered to the machines via two Normet Tornado transmixers.

In the station box, due to the many changes in ground level, all of the spraying was done by hand using a Centurion pump in conjunction with either the Normet Concrete Remixer Cassettes or a skip held up by one of the cranes used for lifting materials in and out of the station box.

Shotcrete was supplied by Alliance, and the number of nozzle men varied between five and 10 for both station box and tunnel works.



The cavernous Admiralty station box hosts a gathering of the staff involved in its excavation and construction

In line with training and experience comes the knowledge of good application techniques, which include thorough surface preparation, spray patterns, distance from nozzle to spraying surface, always spraying at the correct angles, and never over-applying, which may result in fall-outs. However, if a fall-out does occur, the operator needs to know how to rectify it.

Finally, a thorough understanding of the equipment is needed to ensure that things run smoothly, which includes preparing equipment (pre-starts) before shotcrete and cleaning equipment after shotcrete.

Priority number one

Of course, the main thing to avoid on such a contract has to be any incidents or accidents. This has been the number one priority on the contract.

On this particular contract the team had extremely stringent levels of safety management, which filtered down through the ranks through supervisor meetings held by the senior construction manager, then daily briefings and toolbox talks on a day-to-day basis that the supervisors would conduct with their teams.

The contract team took numerous opportunities to promote safety through quarterly safety weeks and safety days and encouraged the workers to respond and implement their ideas.

All shotcrete works on the South Island Line (East) project are due to be completed during the first quarter of 2016.♥

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This article was written by Louis Fraser, the manager and owner of T&M Specialists



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Contact

Messe Berlin GmbH
Messedamm 22 · 14055 Berlin
Germany
T +49 30 3038 2376
F +49 30 3038 2190
innotrans@messe-berlin.de

 **Messe Berlin**