

# Rehabilitation in Singapore – going the extra several thousand miles in search of the right solution



by Angus W. Stocking, L.S.



Toh Ben Seng Contractors Pte Ltd, based in the Republic of Singapore, had just landed a huge contract for sanitary sewer rehabilitation in Singapore, more than 55 km of line – that was the good news. The bad news? The project included hundreds of manholes, the schedule was tight, and manholes were not, at the time, one of Toh Ben Seng's specialties.

**INFRASTRUCTURE IN SINGAPORE** is held to high standards, and even though the manholes in question were just 10 to 40 years old, they would all require relining.

Toh Ben Seng project manager Raymond Pang said "The oldest were brick lined and in pretty bad shape.

"Walls were corroded, some of the benching and grout was gone, there was infiltration, and there were cavities that needed filling. The newest were of precast concrete and were not so bad, just a bit of peeling – but they had to be restored as well."

Further complicating matters was the Republic's tight control of materials and processes used for infrastructure

work – everything must be certified and approved. While investigating solutions, Toh Ben Seng learned about PERMACAST CR-9000, a corrosion resistant mortar of fully fused, calcium aluminate cement that is designed to resist biogenic corrosion.

"It's one of the products approved in Singapore, it's recommended by the UK-based WRc Group (a privately owned group of companies providing research and consultancy on water supply and waste treatment) and we read about it in their manuals, we decided to give it a try," said Mr Pang.

In addition to corrosion resistance, PERMACAST mortars are exceptionally dense and strong, so they are ideal for rehabilitation, however they require skilled

application. Typical shotcrete applicators are not suitable for manholes, because high pressure in the tight space leads to 'rebound', meaning that concrete sloughs off, leaving a patchy, uneven surface.

PERMACAST licensed applicators in the United States typically use the SpinCaster, from AP/M Permaform, to apply the mortar to manholes – the SpinCaster is a pump connected to a mortar-emitting nozzle that is winched in and out of manholes. It is bi-directional, meaning that the nozzle spins alternately, clockwise and counter-clockwise. Since half the thickness is applied in each direction (and while being raised and lowered), the PERMACAST is sprayed evenly and does not 'cast shadows' in raised parts of the rehabilitated surface, such as protruding bricks.

Pressure is modulated just enough to eliminate rebound, but kept high enough to compact the mortar with centrifugal force and ensure tight adhesion. Spinning in both directions also applies a smooth coat and eliminates trowel work.

The application labour is also straightforward, and only requires a two-man



Vehicle set up of PERMACAST system.



Winch hoisting the spin caster.

crew – one to mix mortar and tend the pump, and one to operate the winch and spinning nozzle at the ‘business end’. Coats applied are very thin, but applied quickly. This allows precisely engineered thicknesses of new material, depending on the condition of the substrate, but still lets crews move quickly and repair several manholes a day. There is one more advantage to SpinCaster use – since the nozzle is lowered from the surface, and since hand trowelling is usually eliminated, employees rarely have to enter hazardous confined sewer spaces.

So far, so good: Mr Pang felt that he had found the right material to apply, and the right application method, but he didn't know anyone else in Singapore that was using PERMACAST or the SpinCaster. In fact, Toh Ben Seng would be the first licensee in the world's largest city-state, even though AP/M PERMAFORM has licensed contractors in many other countries outside of North America. So Mr Pang and two other Toh Ben Seng employees flew to AP/M Permaform headquarters in Johnston, Iowa for training.

“Training was excellent. We were given thorough classroom instruction, and then we were taken to actual job sites, which I really appreciated. It let us see how the products were used onsite, and what actual conditions were like. I thought it was much better than classroom training alone,” said Mr Pang.

### Getting to work

Back in Singapore, Toh Ben Seng took delivery of the mortar and two SpinCasters and got to work immediately – the research and training phase of the project had put them behind schedule. Fortunately, Mr Pang found that his crews were able to move quickly.

“In a good week a team with a SpinCaster was able to rehab up to 30 manholes per week,” said Mr Pang.

The older brick manholes required patching, filling and other repair work, but Mr Pang found that PERMACAST alone was sufficient repair for the newer manholes, which were peeling and spalling, but still essentially intact.

Once Toh Ben Seng got started, they were more than able to make up for lost

time. “In fact,” said Mr Pang, “not only were we able to get back on schedule after the late start, we were able to finish before the end date.”

In the initial project, Toh Ben Seng rehabilitated a total of 350 manholes. The job was judged to be such a success that more equipment was acquired to outfit a total of four crews and take on more projects, and the company has since completed another project that included rehabilitation of an additional 300 manholes.

“We've inspected some of our earliest rehabilitated manholes, which are now about half a year old and we find that they're holding up very well.”

The flight from Singapore to the United States is more than 15 hours, which seems like a long way to go in search of a manhole rehabilitation solution. But for Toh Ben Seng the effort was worth it and they've been increasing their investment in this solution.

“PERMACAST is a great product, and the SpinCaster has worked really well for us we'll be using them together for a long time,” said Mr Pang. 📍