Port of Brisbane: 32 million cubic metres — How's That?

Three decades from now, in the year 2030 or 2035, way out in Moreton Bay where fish are swimming today, the last concrete will be poured for a container hardstand. Or the last bolt will be pinned into a steel shed, or the last asphalt will be compacted for a service road.

On that day, when the Future Port Expansion Project becomes the completed port of Brisbane expansion, someone should unveil a plaque. Almost certainly, they won't, but it's a pity. The fact is, a very talented team came together in 2003 and 2004 and ingeniously tackled some major construction challenges to make all this possible.

There are some remarkable complexities to this project. They've been solved in ways we take for granted these days. Sure, the job could have been built twenty, thirty years ago. But one thing's for certain—it would have taken far longer, and cost far more.

The FPE Seawall Alliance

The objective of alliance arrangements, to bring to bear specialist disciplines in a cooperative problem-solving venue, is very nicely demonstrated at the Brisbane 'future port expansion' project.

The Port of Brisbane Corporation is using an alliance approach to complete construction of the FPE Seawall. Under project manager Greg Fokes, Leighton Contractors is involved for its construction management skills and Coffey Geosciences for its geotechnical expertise—the sea bottom is a variety of marine sediments of different bearing capacities. WBM Oceanics contribute skills in the design of wall structures to withstand variable weather, wave and current conditions and Parsons Brinckerhoff is the engineering design specialist. Team members from the Port of Brisbane Corporation are also part of the project and provide guidance in design and construction processes.

Ultimate Positioning is not part of the alliance, but in the spirit of teamwork at Fisherman Islands, has contributed strongly by quickly getting dynamically revised designs from the FPE group to where they're needed—the cabs of the excavators placing rock in the wall.

The Challenge

Very soon, two arms of a massive 1.2 million tonne rock bund will come together east of the existing port, enclosing 230 hectares of seabed roughly 1.8 kilometres long by 1.5 kilometres wide. In the fullness of time—and that means up to twenty five years—this area will be filled with material dredged from the river and shipping channel, creating a very substantial enlargement of the existing port complex.

In another story we'll deal with the overall project. In this article we want to focus on the particular complexities of the southern rock wall.

The challenge here has been to deal with soft seabed conditions that affect about a kilometre of the wall. To reduce the massive volume of rock otherwise required for a secure footing, the design solution has been to install a broad 'pancake' of white sand underlying and extending beyond each side of the wall—a support structure to distribute its weight where weak foundation strength exists.

The sand cushion is laid atop a membrane of high-strength geotextile. A lower-strength filtration geotextile sits on top of the sand, directly under the rock, to protect the pancake from erosion.

A Need for Continual Review

Rock can, and is being, accurately placed underwater by excavators equipped with Trimble's SiteVision GPS system. A difficulty is that the sand layer can't be placed as accurately as rock, since currents and wave action affect the output from the sand pumping system. And defects in the sand pancake could well jeopardise the integrity of the wall above it.

This is where the Alliance system has come up with the goods. The first issue is to establish - immediately after sections have been placed—the precise configuration of the sand layer, and

how closely it corresponds with the design. The Port of Brisbane's multi beam echo sounder, one of only a few in the country, is a very satisfactory high-tech answer to that particular challenge.

Emitting an array of beams to cover 120 degrees from near-surface to directly under the Sharkcat that carries it, this builds a detailed 3D 'picture' of the sea bed in a digital format suitable for import into the project design software. Not just under the boat, but off to the side where the wall foundation is being constructed. (These remarkable devices can 'look' from a passing boat up under wharves at the piles that support them, giving early warning of potential failure).

Interactive Re-design Process

In relation to cross-sections every five metres along the axis of the extending wall, an interactive process takes place between Alliance partners upon examination of the seabed 'pictures'. Coffeys assess any geotechnical issues that emerge—perhaps more sand needs to be pumped. Alternatively, WBM Oceanics may propose changes to the size, quality or volume of rock to be placed in that particular section. Solutions are developed, and in conjunction with Parsons Brinckerhoff the wall is virtually re-designed on the fly.

The revised data is passed to Mick McMillan, Chief Surveyor for the FPE Seawall Alliance. Using various systems developed by Trimble for other applications, but assembled specifically for the Seawall project, Mick is able to upload the revised design files by wireless link directly to the excavators at work on the wall.

We remarked to Mick that this must surely have been one of the most interesting projects he'd tackled in his long and illustrious career. He agreed—"These days the new technology makes it far more interesting to come to work." PK

Top: Mick McMillan, chief surveyor on the FPE Seawall project, uplifts from his office laptop a batch of revised design files, directly into the computers of SiteVision-equipped excavators placing rock. Due to the effect of currents and wave action on the underlying sand 'pancake' supporting the wall, designs are constantly re-worked. File uplift uses wireless technology developed by Trimble, applied by Ultimate Positioning.