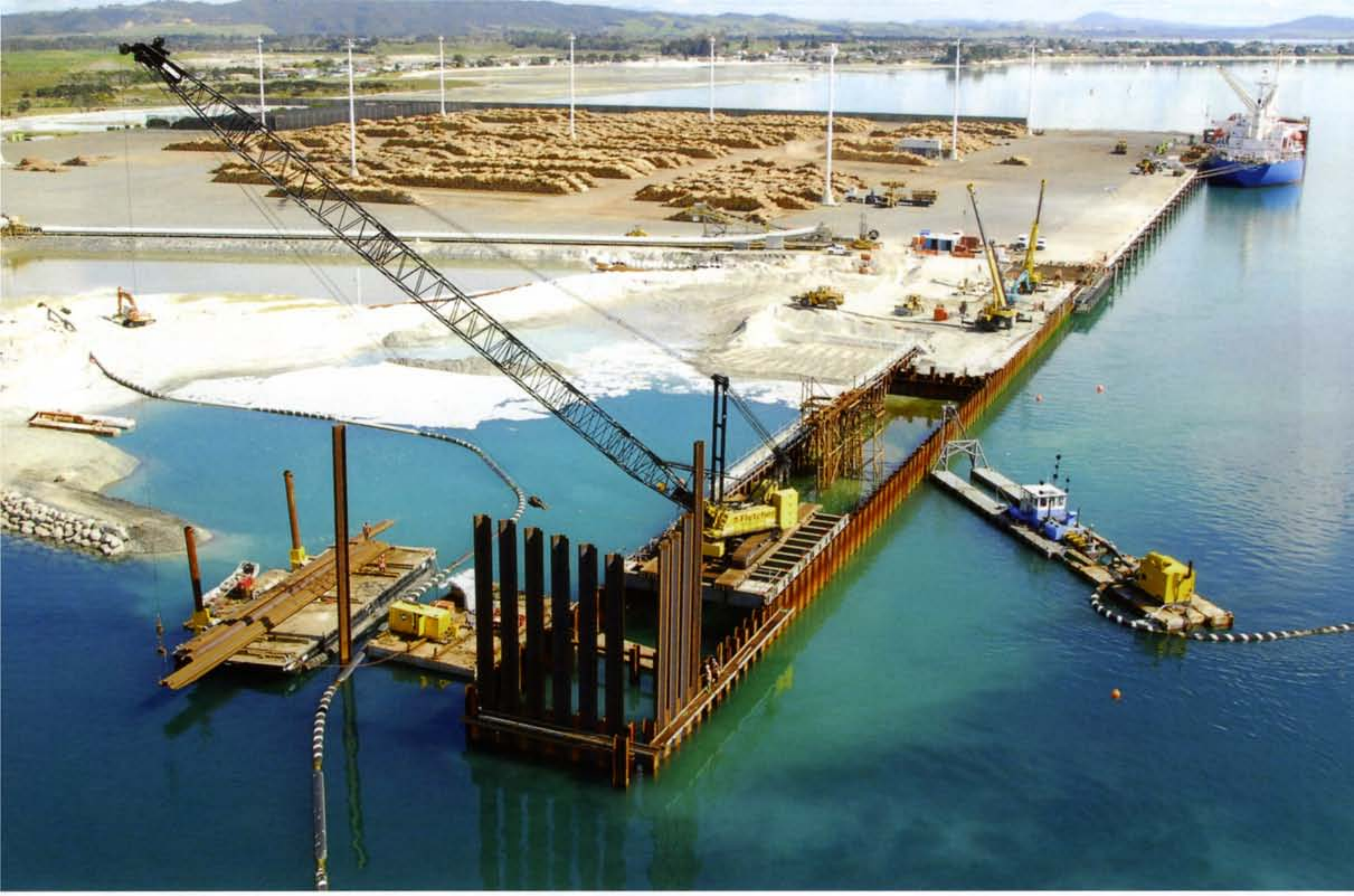

PILING

# ON THE WHARF FRONT

A new piled wharf front is being built on New Zealand's North island to increase the area available for an industrial port. Wade To reports.

A new 200m by 13m piled box has been built to act as a retaining wall for reclamation as well as providing an additional 30,000m$^2$ of land for the wharf at Marsden Point. It is New Zealand's deepest natural port dealing primarily in bulk commodities such as timber, veneer and fertiliser.

Fletcher Construction began planning and design work in early 2005 and started building in July of the same year. The NZ $22M (€11.6M) design and build contract involved the design of the piled box, tied and filled with sand to form a mass gravity structure.

Three months of enabling works included the removal of an 18m deep rock armour bund that acted as the retaining structure for wharfs one and two, before the piling phase began. The company decided a full dig and replace operation down to virgin ground would allow it to achieve the strict tolerances required during follow-on works, even though access to tie rods was only required to -10m chart datum (CD).

The bund comprised 300mm sandstone capped with a 1.5m layer of rock armour. Using a Benoto technique, site workers excavated the armour stone between the piled footprint to reveal natural ground and replaced the void with uniformly graded sand.

The piled structure is a proprietary combi-wall system manufactured in Luxembourg by steel pile supplier, Arcelor. The wall comprises 244, HZ775A king piles with intermediate AZ26 sections on the front wall. The team installed a lighter AZ17 section for the rear wall that required a passive anchor system to cope with increased bending at working loads.

These 33m long king piles are the longest to be driven for a combi-wall in Oceania, according to Arcelor.

Pile depths are typically 15m into the ground that is dominated by a series of interbedded silty sands and sandy silts. Client Northpoint conducted a site investigation (SI) based on standard penetration test (SPT) N values, which typically had an increasing strength with depth profile.

One of the challenges of the project came from managing the risk of changes in the strength profile. The SI indicated that the SPT N value decreased dramatically part of the way along the wharf to about 1.5m above founding level and the slender piles rely mainly on shaft resistance.

Rig crews carried out initial pile investigations to find the most efficient driving method and to provide soil profile information.

Prior to using it on site, the performance of the Junttan 9A hammer was modelled using the analy-

***The NZ $22M (€11.6M) design and build contract to extend the wharf involved the design of the piled box, tied and filled with sand to form a mass gravity structure.***

sis programme, GRLWEAP. Site testing confirmed the findings of the WEAP analysis but the company decided to conduct an additional trial using a PTC 60 vibro-hammer manufactured by PTC in France. The aim of the test was to determine the pile driving analyser (PDA) capacity of the piles driven using vibro-hammer techniques alone.

Site workers did this testing in the same area as the impact hammer to minimise any variation in capacity that could be caused by ground variation. The results showed that the load of 2960kN for each pile could be achieved by vibro-driving them to depth. The vibro-hammer has the additional benefit of being quieter than the impact hammer, which the project team felt might reduce potential objections to the contract.

The consulting engineer had previous experience of the ground during the construction of wharfs one and two. Building on experience gained from that project, it was happy with a proposal to use temporary works piles used for locating the guide frame (used for installing the tie system connecting the front and rear walls), as test piles.

The temporary piles provided the consulting engineer with more PDA test piling than was needed in the contract requirements as well as greater confidence about the capacity of the piles, considering that pile sets were not being collected. Signal matching improved foundation verification using the software programme CAPWAP.

This method allowed a faster production rate and provided early warning of any changes in ground conditions because the temporary works piles were always installed ahead of the main works. The site team found this helped it to cope with ground changes without major disruptions to the contract programme.

The PTC HD60 vibro-hammer was mounted on a Kobelco CKE 2500, 250t crane. Both items were new purchases for the contractor, who was keen to reduce the chance of equipment failure. It also requested that the manufacturers replace the hydraulic oils with bio oils so that if a major hydraulic burst did occur, oil would degrade more quickly in the warm waters.

Piling was helped by the chief engineer's development of a method to advance the crawler crane over 17m of water.

This was done using a platform system with a sand fill and shallow steel bracing that removed the need for diver and welding work. The method meant the crawler frame could advance forward some 13m over a 10-hour shift and, by combining the temporary and permanent works, freed up pinch points in the deck building programme later on.

The driving philosophy behind the method hoped to reduce health and safety risks associated with diver-related work and construction of structural steel below water.

The project demanded fine tolerances for advancing the working platform when installing the tie system to connect the front and rear walls.

Plan positions of 50mm were achieved, improving on the 100mm allowed by the temporary and permanent works.

The tie method allowed divers to build on the success of the tolerances achieved by the piling team and allowed site workers to install 14 tie rods in a 10-hour shift.

The combination of this pile installation method and the development of a process to advance the crane over the newly formed structure meant a two-week saving on the piling programme of 43 weeks.

Follow-on works to build the concrete deck and install the passive anchor system at the back of the wall were completed to provide the client with a fully functioning wharf by the end of last year.