

Mejillones, CHILE

Breakwater and quay construction

The port of Mejillones is situated 1,440 km north of Chile's capital, Santiago, on the Pacific Ocean coastline, not far from the town of Antofagasta. The history of the town is directly linked to the mineral of sodium nitrate. In 1831 a small port for the shipment of nitrate was built in Mejillones.

In 1995, an earthquake seriously damaged the harbour installations of the town of Antofagasta, revealing the vulnerability of the exporters using this port. The local mineral industries were in need of an earthquake-proof harbour. Studies showed that the most efficient solution would be to build a new harbour 65 km north of Antofagasta, in the bay of Mejillones.



The masterplan of the "Complejo Portuario de Mejillones S.A." called for construction of joint terminals for different types of cargo in accordance with demand. Construction started in November 2001. Contractor Belfi S.A. completed the construction of Terminal 1 by October 2003. The total budget of the project is estimated at \$120 million. The annual amount of cargo handled by Puerto Angamos exceeds three million metric tons.

Terminal 1 is composed of different parts:

The breakwater was built using eight circular cells 24 m in diameter and 24 m in height. The 200-metre structure is made of high-tensile-steel sheet piles: AS 500 straight-web sections.



In accordance with the requirements of the mineral industry, the new port was designed considering seismic loads

The breakwater consists of sheet pile cells assembled with straight-web sections, whereas bending-moment-resisting sheet piles were used to build the terminal walls



The 31.1-metre sheet piles were provided in steel grade S 390 GP. Arcelor's straight-web sections have a width of 500 mm; there are currently five different thicknesses (9.5 mm to 12.7 mm) available. For the project in Mejillones, a steel thickness of 12 mm was chosen. The interlock of the AS 500-12.0 section is able to transmit tensile force of up to 5,000 kN/m.

A circular template was used for the installation of the cells. The sheet piles were driven from a jack-up barge. A total of 3,100 metric tons of AS 500 sections were used for the construction of the port's breakwater. The straight-web sections and the junction sections were fabricated in Luxembourg and delivered to the jobsite in Chile ready for installation.

The construction of Puerto Angamos was a first for templates of such size Chile. The contractor used a 200-ton crane on a jack-up platform and a two-level template of roughly 120 t to build each cell composed of 152 AS 500 sheet piles. All the cells were constructed using the same template.

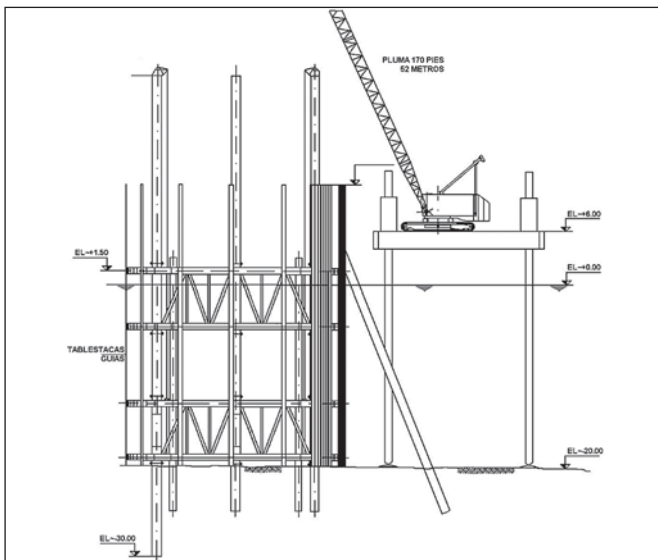
Quays 1 and 2 are deck-on-pile structures. They are designed for ships up to 50,000 DWT and a length of 225 m. The deck foundation consists of 296 vertical and battered steel piles.



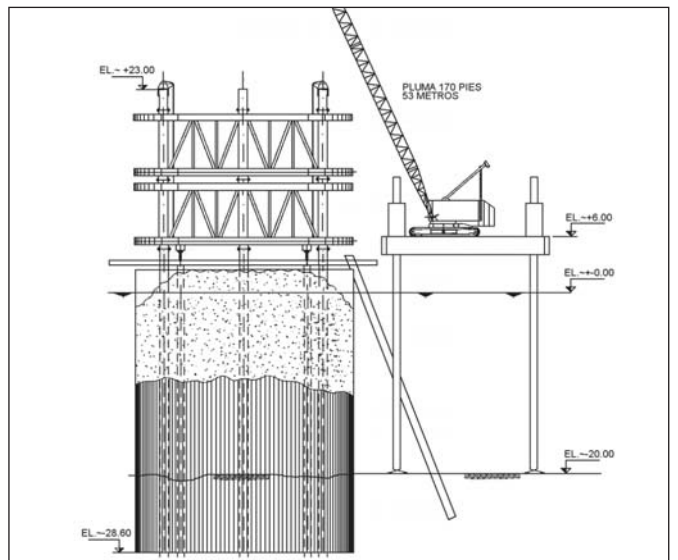
The breakwater is composed of eight cells with a diameter of 24 m



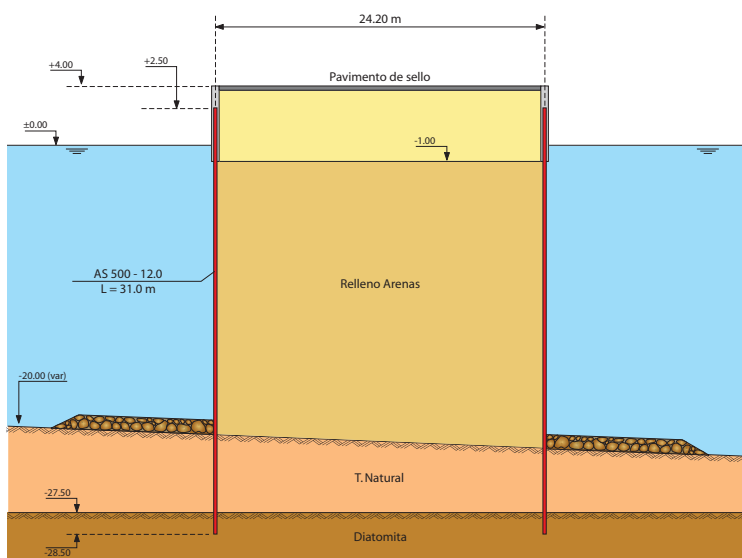
The straight-web sections were installed with the help of a template to form the breakwater cells



A barge-mounted crane lifted the sheet piles into the template



Removal of the template and filling of the cells

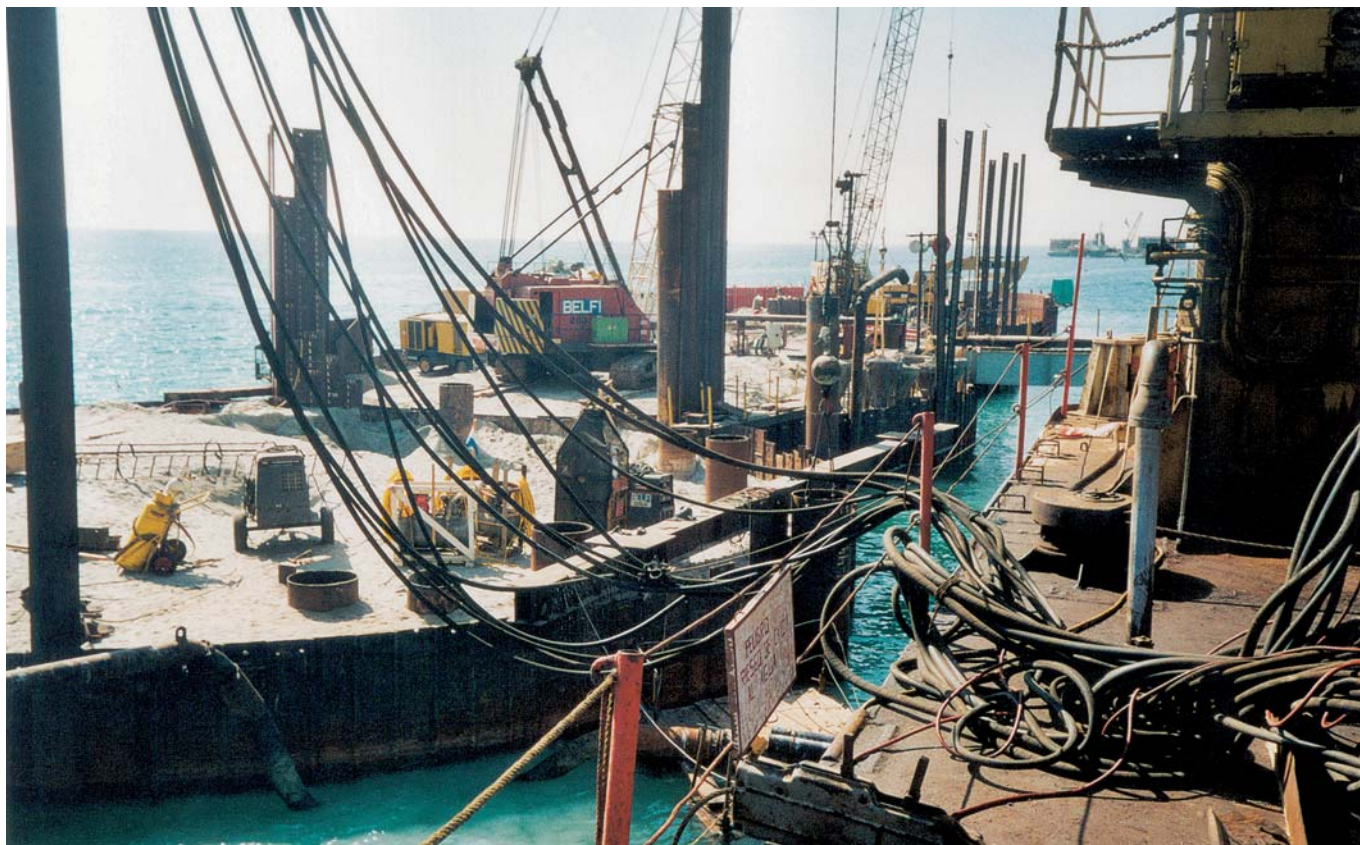


The self-stable cells protect the quay area from waves

The 620-metre wall of Quay 3 was built using bending-moment-resisting sheet piles. A high-strength HZ/AZ combined wall was installed in Puerto Angamos. The quay wall consists of HZ king piles that carry the main loads and AZ sheet piles that act as infill elements also called intermediary sheet piles. The HZ piles were anchored using steel tie rods provided by Anker Schroeder from Germany.

The chosen sheet pile system varies with the rising water depth. The 115-mm-diameter tie rods were supplied in three parts due to their considerable overall length. The individual pieces were joined together by two turnbuckles providing a flexible, moment-free system.

A special template fitting all HZ beams was built to facilitate the installation. Special care had to be taken over the



The filled cells are capable of supporting the construction plant

design of this template because it was to fit HZ beams with heights of 575 mm, 775 mm and 975 mm.

Contractor Belfi S.A. used a 100-ton crane to install the steel sheet piles. The crane was mounted with a vibratory

hammer for driving of both the straight-web sections and the combined wall. The HZ/AZ system was vibratory-driven until refusal. The vibratory hammer was then replaced by Delmag D-22 and D-30 impact hammers for driving the final metres.



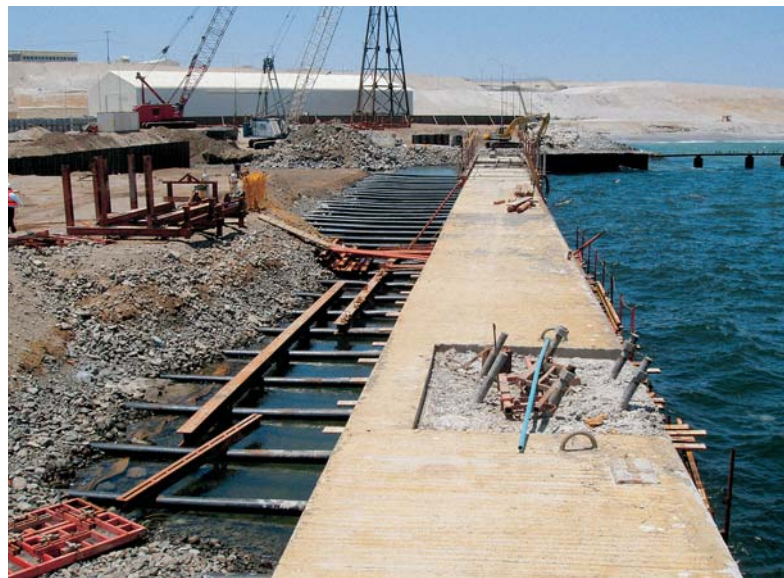
Sheet pile cells are usually filled with locally available sand



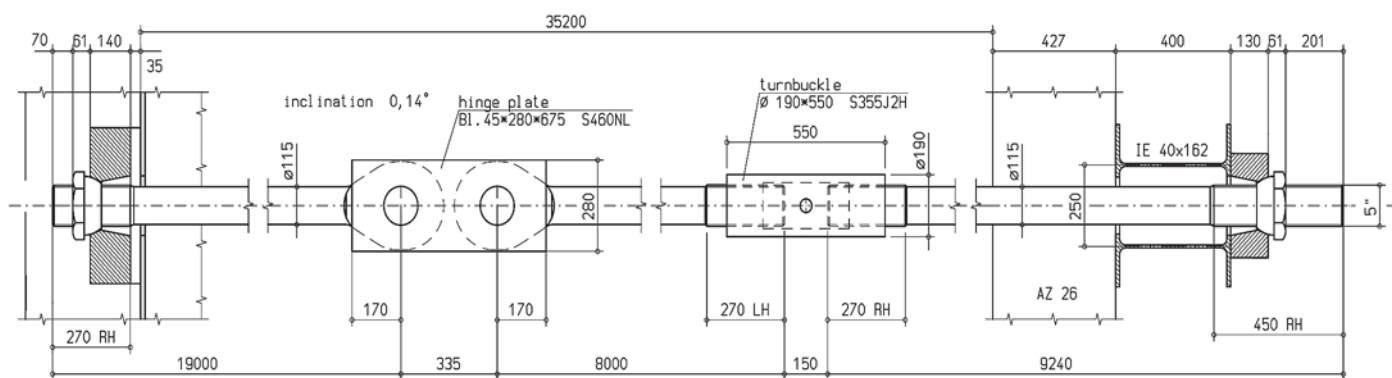
Concrete ring beams protect the cells



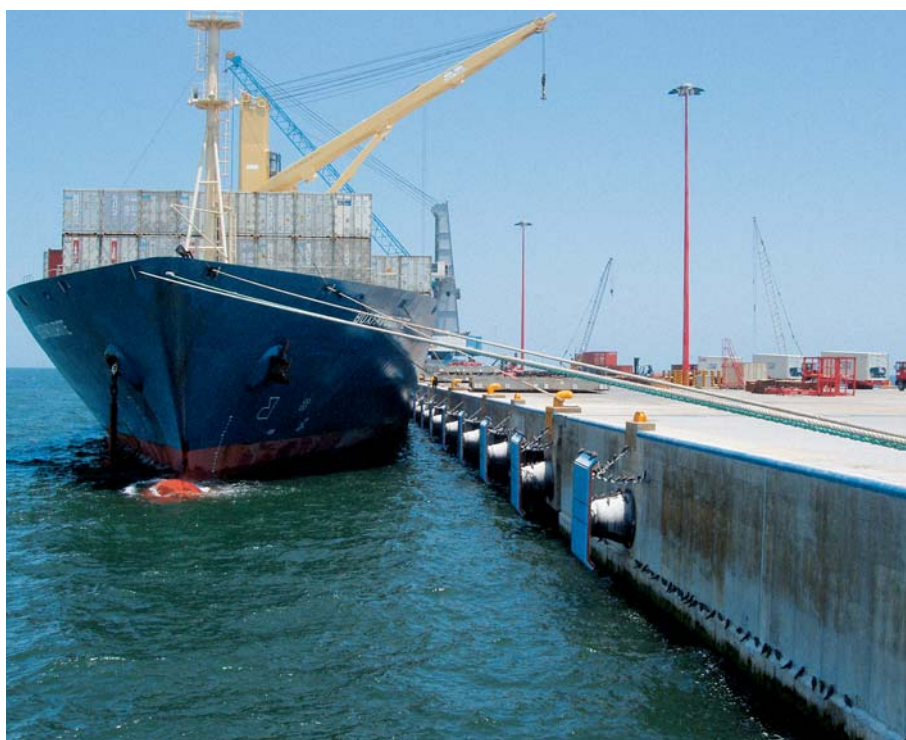
An anchored combined sheet pile wall was chosen as the optimum solution for the quay wall



A concrete capping beam supports fenders and bollards



The steel tie rod is in three parts to facilitate transportation



First vessel docking at the new port constructed in less than two years

Owner:

Complejo Portuario de Mejillones S.A.

Contractor & Engineering:

Belfi S.A.

Steel grade:

S 390 GP

Sheet piles:

• AS 500 – 12	3,100 t
• HZ 575 A – 14	100 t
• HZ 575 B – 24	480 t
• HZ 775 A – 24	1,500 t
• HZ 975 A – 24	1,700 t
• AZ 13	620 t
• AZ 26	700 t

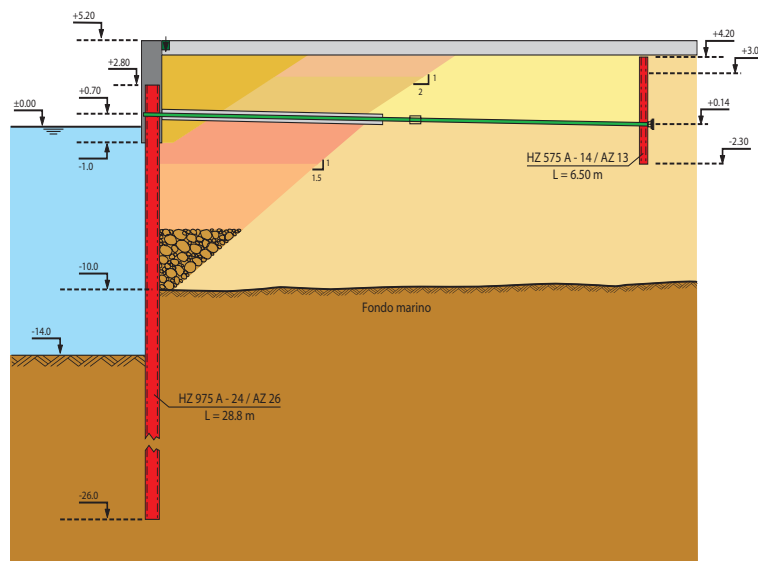
Total quantity of sheet piles:

8,200 metric tons



A jack-up barge and a template were used to install the HZ/AZ system

The main challenge for the contractor was the completion of the Puerto Angamos' quays in only 22 months. Eighteen cranes and two jack-up platforms were used simultaneously to stick to the tight time schedule. The workforce reached up to 1,400 employees at peak construction times.



Typical cross-section of the HZ/AZ system adapted to the varying water depth

The contractor implemented a quality assurance plan for the construction of this important project based on the NCh-ISO 9002 standard. More than 11,000 inspection reports confirmed the outstanding quality of the Puerto Angamos project. ■



Completed in record time, the port is mainly used by the mineral industry