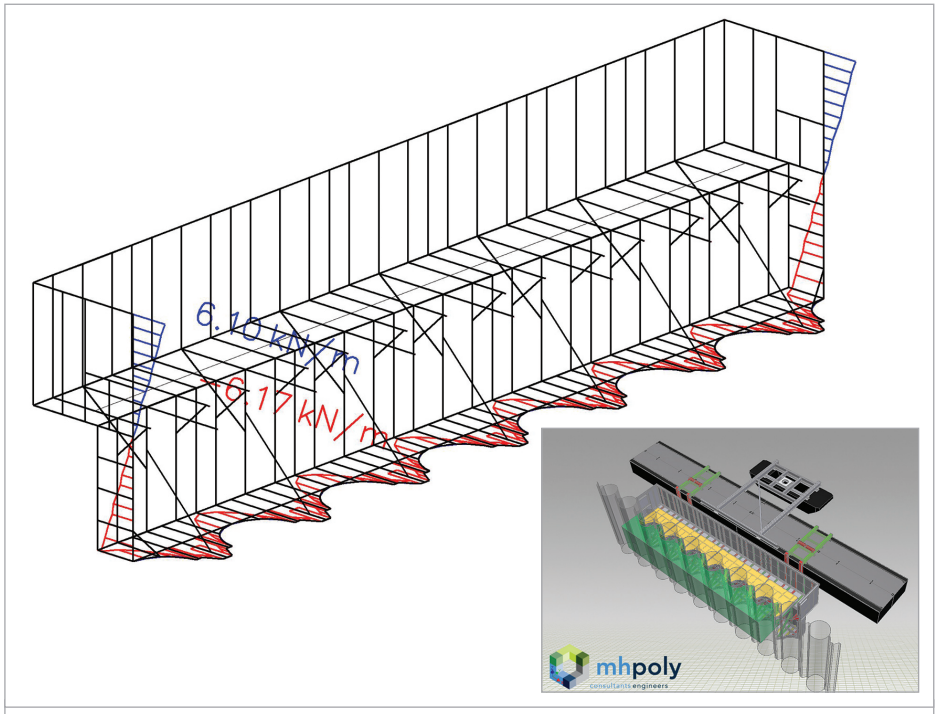
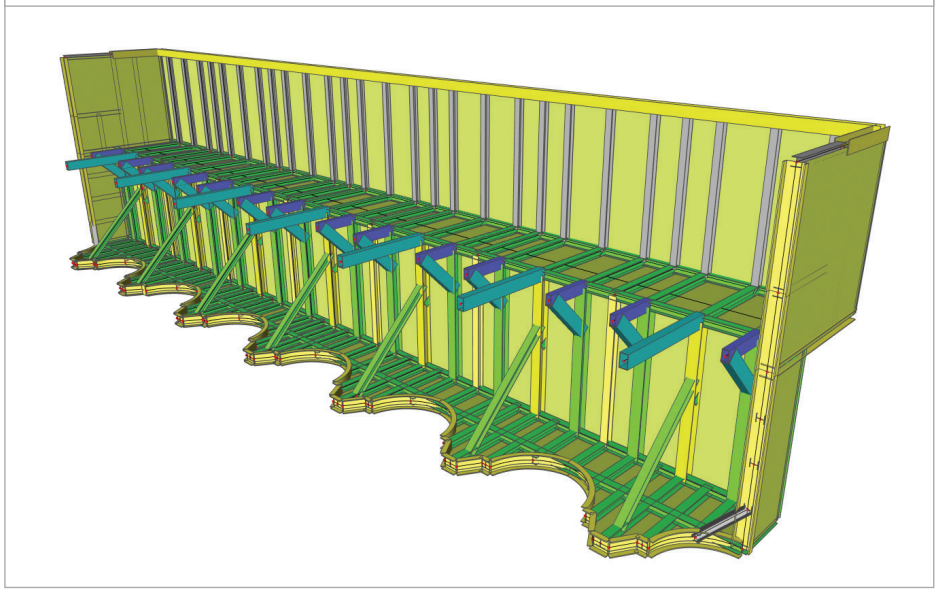
Aqua Shell - Antwerpen, Belgium





Software: Scia Engineer

The capping beam system special technique for the construction of quay wall capping beams

A recurrent problem in building quay walls in offshore conditions is the construction of the concrete capping beam. These capping beams usually reach below the water surface and hence must be cast below the water level. An unconventional shuttering technique is applied in the construction of a quay wall in the Port of Antwerp.

The quay wall is situated alongside the Westquay of the Canaldock B2. The design and engineering of the aqua-shell is done by MH Poly Consultants & Engineers. The construction is entrusted to Van Laere General Contracting n.v.

Construction of the Quay Wall

The new quay wall has the length of approx. 860 m and is built up from sections of 20.10 m each. Each section consists of a combi-wall with 6 tubular piles, sheet piles in between, and a capping beam 4.36 m wide and 3.52 m high. This construction is then anchored by means of 31 m-long MV-tension piles.

Some indicators for the construction:

- 267 steel tubular piles, diameter 2,032 mm, thickness 22 mm, length 26.8 m.
- 262 MV-piles HP360x174 (HISTAR 460), length 31 m.
- 268 double sheetpiles AZ26 (S355GP), length 20.8 m.
- 4,000 m^3 colloidal concrete and 18,000 m^3 reinforced concrete.
- 1,500 tonnes rebar steel and 13,000 m^2 formwork.

During the tendering phase, the contractor was required to submit a clear step-by-step plan including drawings and descriptions, showing how he intended to build the capping of the quay wall considering the preconditions, such as the water. The quality of this plan also counted for the final assessment of the tender subscriptions. Van Laere n.v. was the only company tendering with this exceptional technique based on a steel, watertight limpet structure which is mounted on to the combi-wall (front wall with tubular piles) and subsequently pumped out completely.

Basics of the Aqua-Shell

After building the front wall and the tension piles, a partial backfill up to the level of +3.40 (TAW) will be carried out behind the combi-wall at shore side. This level coincides with the bottom of the concrete capping beam. A caisson (steel limpet construction) is subsequently placed against the combi-wall alongside the dock side. The particularity of this method is that the concrete capping beam is cast from atop the water in a watertight caisson that is mounted to the combi-wall. Furthermore, this caisson can support the full weight of the cast concrete and thus simultaneously serves as bottom formwork. The concrete sections will be placed in alternating order, skipping a section each time. Next, using an adapted caisson, the remaining intermediate sections are completed. In view of the tight time schedule, two caissons will be made which can be used simultaneously.

The Aqua-Shell will be shifted to the next section by means of a single floating pontoon (catamaran type). An ingenious forklift system holds the limpet construction in the pontoon, which can thus float to the next position and also ensures attachment of the caisson to the combi-wall. After temporary attachment to the front wall, large pumps lower the water level inside the caisson as fast as possible, so that the rubber profiles around it are compressed and ensure a safe and watertight connection.
The design of the rubber profile was one of the challenges during this project: The caisson had to be watertight at all times considering a drive tolerance of 80 mm on the steel tubular piles.
The upward forces on the Aqua-Shell due to the water pressure are passed on the quay wall by use of a specially designed connection which can be re-used during the project.

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MH Poly Consultants & Engineers BV is an independent, multidisciplinary and reliable consultancy with over 25 years of experience.
We are mainly active in the field of environment, infrastructure, civil and mechanical engineering. The way we work: professional, creative and practical; the result comes first.

Main activities
Civil Engineering & Infrastructure: Design and engineering of civil structures such as harbours, quays, jetties, habitats for diving activities, slipways, etc.
Industry & Structural Design: Design and engineering for industrial plants, factories, piping, processes, etc.
Environmental & Planning: The execution and expertises of environmental studies, for roads, tunnels, and industrial areas.

Project information

Owner	Van Laere nv
Architect	MH Poly Consultants & Engineers bv
General Contractor	Van Laere nv
Engineering Office	MH Poly Consultants & Engineers bv
Location	Antwerpen, Belgium
Construction Period	06/2009 to 11/2009

Short description | **Aqua Shell**

The Aqua-Shell is used to create a dry environment to pour the capping beam of a quay wall.
After the Aqua-Shell is placed against the quay wall it is pumped dry so it will pressed up against the quay wall just by the use of water pressure on the outside of the Aqua-Shell.
The upward forces on the Aqua-Shell due to the water pressure are passed on the quay wall by use of a specially designed connection which can be re-used during the project.
The rubber profile for the watertight sealing was tested in a compression test and modelled as non-linear spring supports in Scia Engineer.
Furthermore, the Aqua-Shell was optimised in Scia Engineer for weight reduction of the steel structure.
To make the Aqua-Shell transportable by road it can be dismounted into two parts.