

STRUCTURAL HEALTH MONITORING SYSTEM GEVELCO QUAY-WALL, ROTTERDAM.

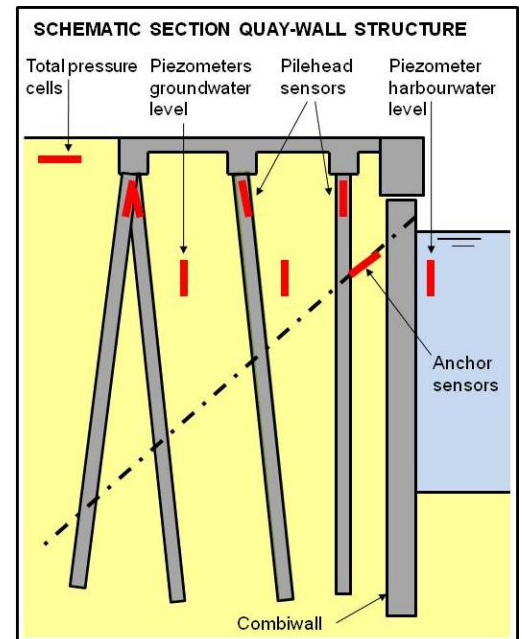
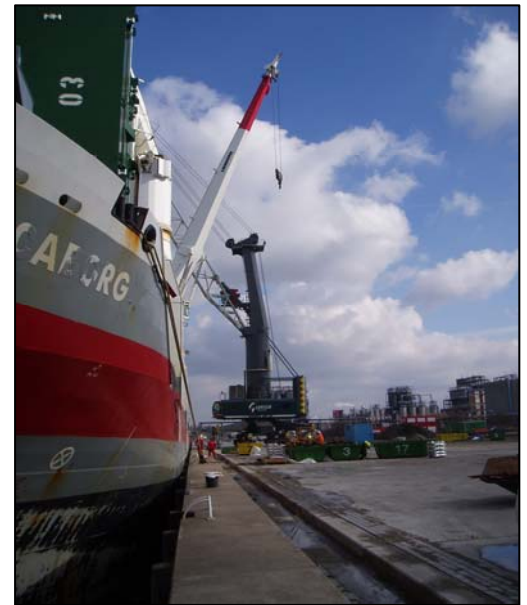
THE PROJECT

The project comprised the extension to the existing AWT (All Weather Terminal) and deep sea quay of Broekman Distriport along the Britannia harbour in the port of Rotterdam. The length of the new quay-wall section is 120m.

THE MONITORING SYSTEM

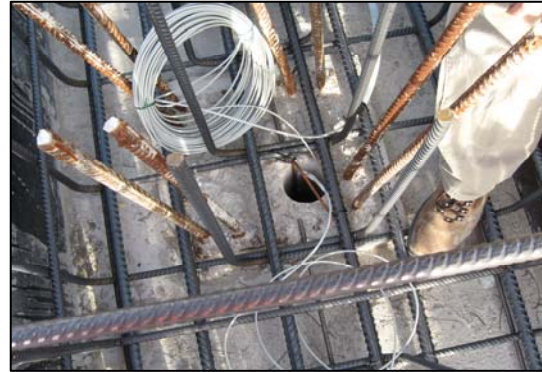
Inventec was commissioned by the Port of Rotterdam Authority to engineer, supply and install a fully operational monitoring system that includes:

- Anchorforce sensors.** Fiber optic strain sensors were installed in the hollow core of a substantial number of grout anchors. The purpose of these anchors is to monitor the anchor forces throughout the full life span of the quay-wall structure. The sensors were installed already before the tensioning of the anchors, in order to determine the relation between strain and anchor force and, secondly, to measure possible subsequent relaxation of the anchor.
- Pilehead sensors.** These were installed in a number of the piles that support the quay-wall slab. When a ship is being unloaded the pile head will be compressed to a certain extent. The degree of compression is proportional to the magnitude of the load on the slab. The compression is measured by the fiber optic sensor with an extremely small resolution of only 0,2 microstrain. The relation compression versus load is obtained by measuring the pile head's compression while a known load is placed on the slab. After such in-situ calibration the sensors produce their readings directly in KPa superimposed load. The importance of these sensors is that Port of Rotterdam, being the owner of the terminal, at any moment in time can see whether the quay-wall structure might be loaded heavier than allowed by the design criteria.
- Monitoring the load on the area behind the quay-wall.** For this purpose a number of total pressure cells were installed below grade level. Even these are in fiber optic execution.
- The groundwater level** is being monitored by fiber optic piezometers installed in standpipes at a number of locations. In order to establish the relationship between the groundwater readings and the harbour water level, one piezometer has been mounted at the outside of the quay-wall.



Tensioning of a grout anchor

- The reading units** with associated instrumentation are installed in a central housing at the terminal. From here the measurement data are automatically transmitted to a remote webserver for processing and archiving. Authorised users can log-in on this server. Data acquisition is fully autonomous and takes place at pre-set time intervals that vary with the type and duty of the sensors. Alerts /alarms (3 levels) are raised automatically and transmitted via email and SMS. Inventec is responsible for the management and maintenance of the data infrastructure.



Installation of pilehead sensor

STRUCTURAL HEALTH MONITORING (SHM)

SHM is a concept that offers the capability to monitor the behaviour and structural health of a structure over its full life span. The sensors are fully integrated and have a life expectancy that is equal to that of the structure itself. SHM can even play an important role in terms of liability. The cost of a comprehensive SHM system amounts to only a couple of percent of the capital investment in the structure itself. Obviously only very reliable and durable sensors qualify for this application. As specialists in SHM Inventec therefore only utilise sensing systems that are based on fiber optic and MEMS-chip technology.



Pilehead sensor

MEASURING WITH FIBER OPTIC TECHNOLOGY

In the selection of the instrumentation also on this project the outstanding properties of fiber optic technology were decisive:

- Unmatched reliability and accuracy
- Totally immune to electromagnetic induction
- No drift, not even over tens of years.
- Insensitive to corrosion, humidity, water and vibration
- Not influenced by variations in temperature
- Very small size
- Resists the most hostile environments
- Intrinsically safe, so ideally suited for use in hazardous areas.



Installation total pressure cells

