

STRUCTURAL HEALTH MONITORING SYSTEM

BRAMMENTERMINAL, ROTTERDAM

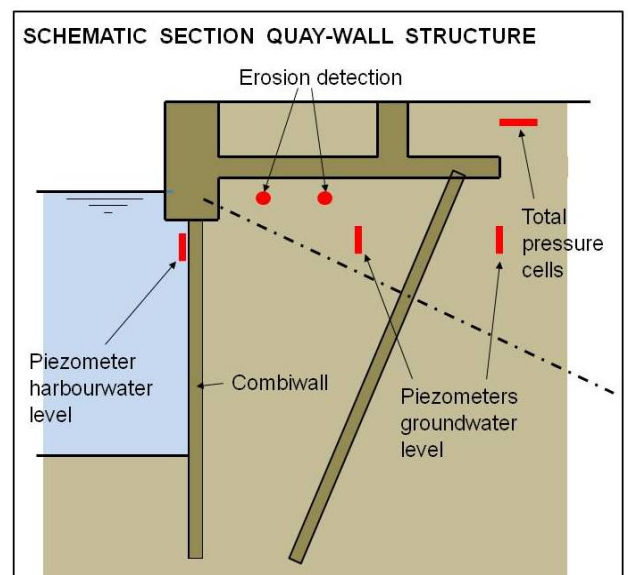
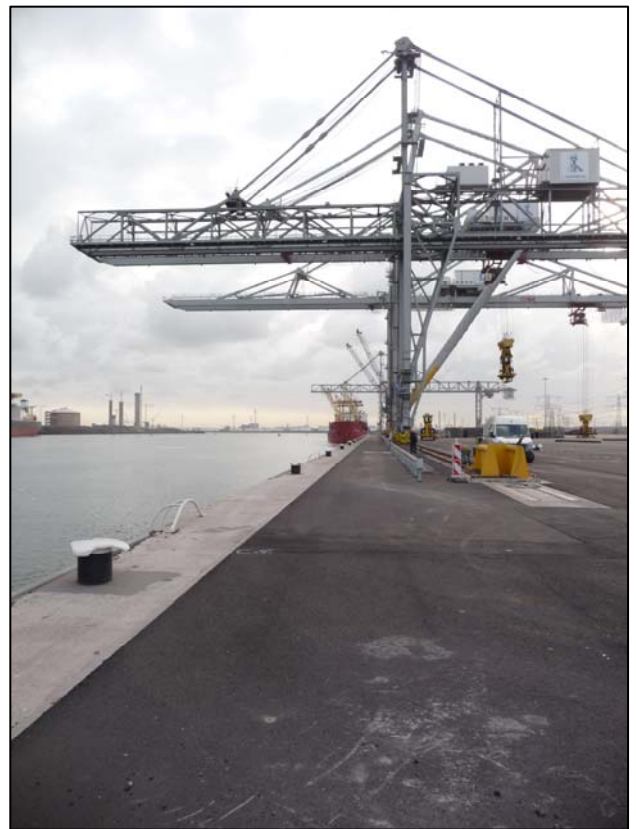
THE BRAMMENTERMINAL

A “bram” is a plate of steel from the first production stage of iron ore. Brams form the raw material for various grades of steel that are produced in the second production line such as sheet steel, pipes and steel for the automotive industry. The current development is that countries rich of iron ore, such as Brazil, no longer export the iron ore but process it domestically into brams that subsequently are exported. The subject terminal has been designed to receive, store and transfer these brams. Hence the name Brammenterterminal. It is located in the Mississippi harbor at the Maasvlakte near Rotterdam. The quay-wall has a length of approximately 500m.

THE MONITORING SYSTEM

Inventec was commissioned by Ballast-Nedam Group to engineer, supply and install a fully operational monitoring system that includes:

- Detection of soil erosion** behind the combiwall. Two special fiber optic cables were installed in the soil below the superstructure of the quay-wall over the full 500m length of the terminal. A reading unit continuously launches a high frequency light pulse of one specific wavelength through the fibers and analyses the backscattered light. Analysis of the backscattered spectrum produces the distributed deformation over the full length of the quay-wall. Whenever the deformation at any one point along the fiber reaches a pre-set value, an alarm is raised immediately. The location of the event is indicated with an accuracy of 1 meter.
- Monitoring the load on the area behind the quay-wall** enables the owner of the terminal, Port of Rotterdam, to see at any moment in time whether the quay-wall structure might be loaded heavier than allowed by the design criteria. For this purpose a number of fiber optic total pressure cells were installed below grade level. These continuously measure the load in real-time.
- 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 groundwater and harbour water level one piezometer has been mounted at the outside of the quay-wall.

- **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 web server for processing and archiving. Authorized users can log-in on this server. Data acquisition 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 erosion detection cables

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.

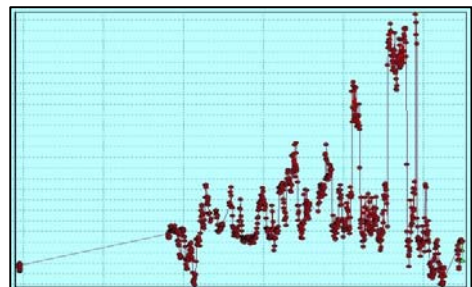
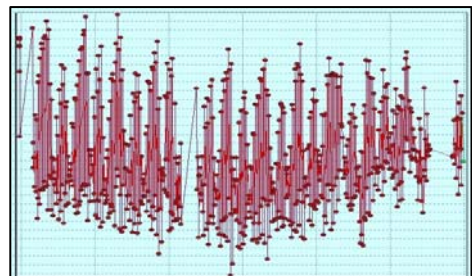


Installation of a total pressure cell

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.



Central housing of reading units

