Sol Data

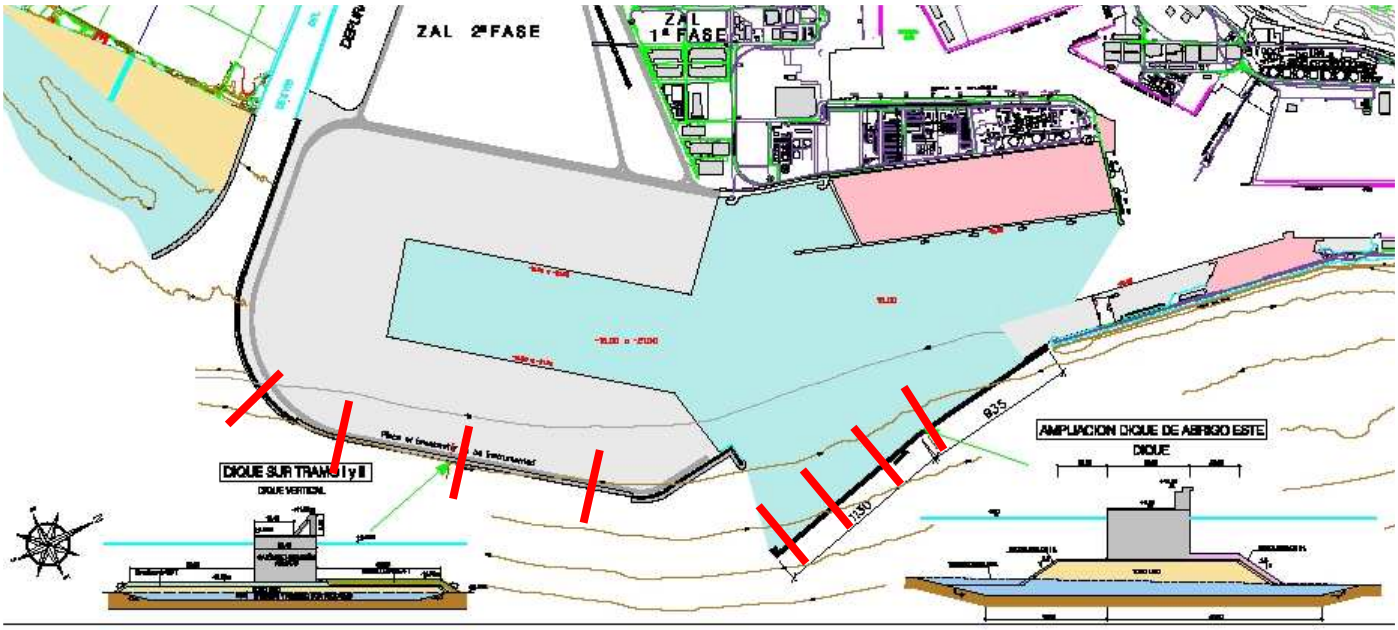
Harbours

Automatic Instrumentation, Remote surveillance, Alarms

EXTENSION OF HARBOUR

BARCELONA - SPAIN

Monitoring the substratum during construction of the port dykes



Plan view of the Barcelona port: Southern dyke on the left, Eastern dyke on the right. In red: instrumentation arrays

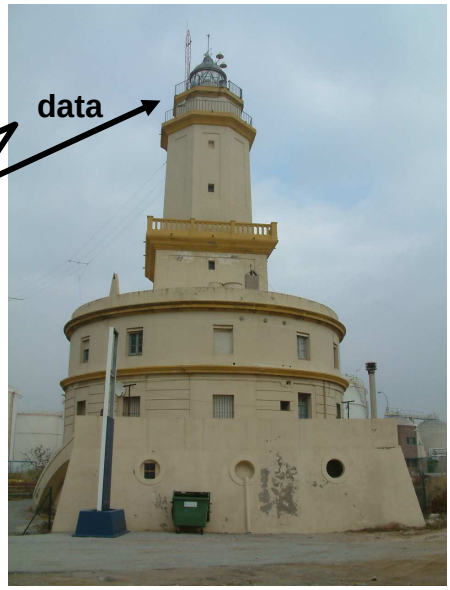
Since the nineties, the Barcelona Port has been the subject of an extensive re-organization operation. In 2001, the fourth expansion project was launched, allowing the present surface area of the port to be doubled, now covering 1,300 hectares. This project is in response to a predicted traffic increase.

The future port would be built within two dykes, 400 meters wide: the Southern dyke (4.9 km) and the Eastern dyke (2.2 km).

The construction of the dykes is made on compressible soil. The Barcelona port authority wished to monitor the behavior of the substratum during the works.

Continuous observations of the deformation behavior in terms of vertical and horizontal movements had to be made, as well as the interstitial pressure, guaranteeing the stability at each phase of construction.

Buoy housing acquisition box



Lighthouse containing computers

OWNER :	AUTORIDAD PORTUARIA DE BARCELONA
CONSULTANT :	NORWEGIAN GEOTECHNICAL INSTITUTE UNIVERSIDAD POLITECNICA DE CATALUÑA (UPC)
PROJECT DURATION :	2003 – 2004

SCOPE OF WORKS :

- Marine works : Positioning by GPS, marine drilling of 184 sensors from a barge, installation of 8 buoys, undersea cabling,
- Installation of the automatic acquisition system and alarms,
- System maintenance

After an international open tender, the SolData-Balineau joint-venture was appointed to carry out the supply, installation and running of the real-time instrumentation.

- **Offshore conditions**

Innovative methods were used to install over 180 sensors, approximately 35 meters underground, out to sea and 25 meters below the surface.

Each component was precisely positioned using GPS and the instrumentation itself was subject to significant constraints linked to the marine corrosion, the movements of the dykes and the size of the deformations. Only the best instrument manufacturers were chosen and the different types of steel and materials were researched carefully. The cabling was also subjected to specific testing. Some sensors were doubled to take into account the possibility that a certain percentage will be lost during positioning or during the lifetime of the installation.

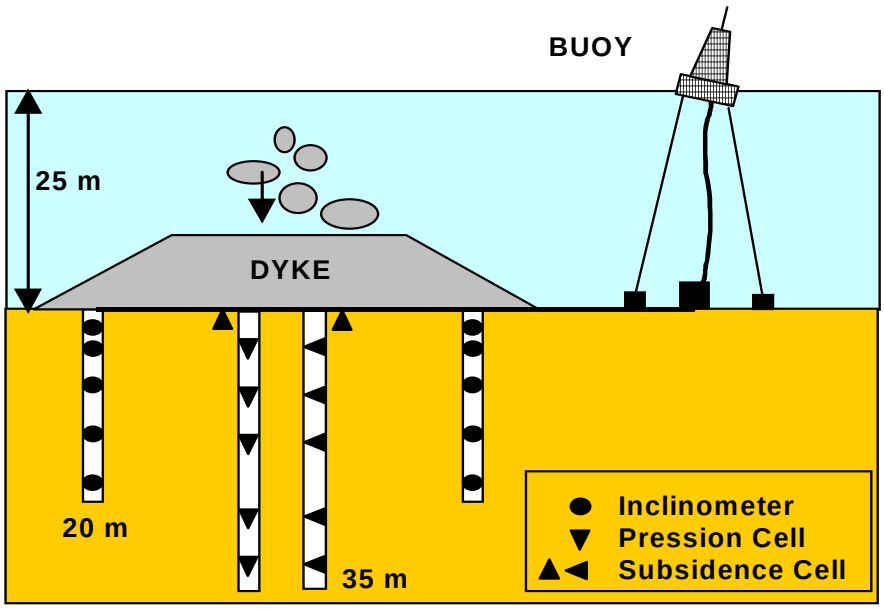
The buoys on the surface were equipped with solar panels and batteries that powered a light indicating their position during the night. The solar panels also power the sensors, the central numerical acquisition system and a digital radio.

- **In-depth data analysis**

On land, housed inside a lighthouse, a pilot computer acquires the data transmitted by radio. The secure dialogue protocols allow real-time retrieval of the information collected at sea. The data managed by the Geoscope software is available at all times even in the Port offices from where it is sent via the Internet to the University Polytechnic of Barcelona.

This data is studied daily by experts, allowing the positioning of materials in a manner that guarantees the stability of the construction at each stage.

Positioning of the instruments by barge mounted drilling rigs



Instrument arrays within a width of 300m, comprising:
- 2 chains of 5 vertical inclinometers (maxi 20m),
- 1 chain of 5 piezometers (maxi 35m),
- 1 chain of 5 settlement gauges in the substratum (maxi 35 m),
- 1 chain of 2 settlement gauges situated at the seabed,
- 1 reference gauge situated outside of the zone of influence,
A signaling buoy out on open sea (diameter 2.20 m, height 6.20 m) equipped with a system for acquisition system and data transfer and an independent solar-paneled power supply system.