“Effective operations in ports”

SP2 – Ports & Environment
Cathodic protection
HAVRE PORT

Etat des poutres transversales

Conditions de travail difficiles

Le HAVRE Port’s Authority
INVENTORY

- 20 kilometers of breakwaters
- 30 kilometers of quay wall
- dolphins, dry docks, warfs,...

-between 5 and more than 150 years old
QUAY WALL

- DIFFERENTS DESIGNS

  - CONCRETE (caissoons, diaphragm walls, …)
  - STEEL (piles and sheet piles)
  - WOOD (PILES) AND MASONRY
  - ROCKS (for breakwaters)
Specificity of maritime structure

- Longer lifetime than human life
  - Great changes in the environment during the life of the structure
- Use of huge area
  - Maritime structures are great (quays, breakwaters), quite impossible to be destroyed and the area is quite definitively occupied
- It is necessary to take into account the future evolution in the design of the structure
- It is necessary to maintain the structure and to adapt the construction to the needs

Importance of maintenance and protection of the structures
maintenance of maritime structure

**SLOW**
- Ageing of the materials
  - Corrosion
  - Drive of the materials
  - Physic or chemical dissolutions
  - Compressing, displacements

**BRUTAL**
- Damages
- Storms, meteorological events

**PREDICTABLE ACTIONS**

**UNPREDICTABLE ACTIONS**
Corrosion

Steel for reinforced concrete  Coating of concrete
(5 or 7 cm)

Quality of the concrete
(density, rate Water/Cement)

Piles  exceedent thickness (1/10 per year)

Sheet piles  protection (paint, cathodic protection)
Protection of steel structures

In Le Havre, the tide is more than 8 meters high

Various protections

- over the level of high tide: paint ACQPA IM2
  (condition of sea water)
- under the level of high tide: cathodic protection
  sacrificial anodes
  outside source of current
- after correctives action for existing structures:
  seeling of holes by welding-on plates
Cathodic protection

Lowering the electro chemical potential of the work under -790 mV: two ways

Creation of electro chemical potential between the steel and a more electronegative metal (Al ou Zn)

Use of outside source of power.

Cost of energy

Parasite current with negatives effect on other structures

Require electrical continuity

In Port of Le HAVRE: sacrificial anodes in Aluminium
Sacrificial anodes

5 to 6 Kg / m²
potential lowered to - 850 mV
length of anode life of 15 years
survey with checking of potential (1 year, 5 years, 10 years, 15 years)
Sacrificial anodes

2790 meters of quay wall under protection between 1996 and 2009 (piles, sheet piles and dolphins)

400 t of anodes
Cathodic protection for Damaged concrete beams

Situation: corroded cage and damaged concrete

- Destruction of damaged concrete
- Change of corroded pieces of steel cage
- Reconstruction of the bottom part of the beams with specific concrete
Reinforced cage with sacrificial anodes