Concrete Mattresses for Lining and Sealing of Canals

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Agenda

- What are concrete mattresses?
- Design of concrete mattresses
- Benefits of concrete mattresses
- Installation follow up of concrete mattresses
- Case studies
- One more thing...
What are concrete mattresses?

Concrete mattresses consist out of two basic components:

- Geotextile formwork
- Highly fluid concrete

What are concrete mattresses?

General types of mattresses:

- State-of-the-art cover lining and erosion control with concrete mattresses.
- Permeable cushion mattress with built-in hinge zones, designed for high hydraulic loads and settlement-prone bases.
- The permeable concrete mat for use on stable subsoil and lower hydraulic loads.
- The plantable concrete mat for erosion protection, ideally suited for shore protection above the permanent water level or for standing water bodies.

- Impermeable
- Permeable

* Thickness controlled by
  - Binder length
  - Size and distance of filterpoints

* Shrinkage depends on the type chosen
  - Vertical binders
    - Up to 4% areal shrinkage
  - Cross binders or filterpoints
    - Up to 30% areal shrinkage
**Design of concrete mattresses**

- Type according to application
  - Sealing
  - Erosion protection
- Thickness according to flow- or wave load
  - Different approaches available like
    - Pilarczyk
    - Hawkswood
    - Own lab tests and experience
    - ...

**Benefits of concrete mattresses**

- Flexible system, which adapts to the underground
- Proven sealing system
  - Canals
  - Ditches
  - Ponds
  - ...
- High hydraulic resistance
- Mannings n of uniform section mattress: 0,015
- High mechanical resistance
  - Anchor fall resistance (thickness >= 20 cm)
- Installation on steep slopes possible
- Underwater installation common practice
- Robust and long lasting
- Installation speed: up to 2000 m²/d

Inlet with a maximum inclination of 1:1.5 and an approx. length of 160 m for a max. discharge of 5 m³/s
### Benefits of concrete mattresses

- Non-Coherent
- Coherent

#### How it should be done:
1. Preparation/leveling of the subsoil
2. Lay out of the pre-fabricated panels
3. Filling of the mattress with highly fluid concrete/mortar

#### Also possible...

- Installation follow up of concrete mattresses
Case studies

Canal Imperial de Aragones, Spain (1973) - Sealing of an irrigation canal

Condition in 2000

Condition in 2011

Banter See, Wilhelmshaven, Germany (1977) - Erosion protection of a lake bank

Condition in 2008

Condition in 2008
Case studies

Canal de Jonage, France (1994)

During installation

After completion

Design:

- $v = 0.5$ to $2.0$ m/s
- $h = 5.4$ to $7.0$ m
- Slope 1:3
Case studies

Canal de Jonage, France (1994)

Condition in 1998

Condition in 2016

Case studies

Morrovalle, hydroelectric power plant canal, Italy (2011) - Sealing

Design

Excavated canal
Case studies

Morrovalle, hydroelectric power plant canal, Italy (2011) - Sealing

Lay-out and anchorage of the mat

Concreting works in progress

Case studies

Morrovalle, hydroelectric power plant canal, Italy (2011) - Sealing

After completion

Situation in July 2021 (source: google street view)
Case studies

Munich, rehabilitation of the Mittlere Isarkanal, Germany (2013) - Sealing

Location of the Mittlere-Isarkanal (Source: wikipedia)

Areal view of the emptied channel of a previous rehabilitated section (Source: wikipedia)

Cross section; h = 5 m to 7 m

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Case studies

Munich, rehabilitation of the Mittlere Isarkanal, Germany (2013) - Sealing

Schematic installation process (longitudinal section)

Schematic installation process (cross sectional cut)
Case studies

Munich, rehabilitation of the Mittlere Isarkanal, Germany (2013) - Sealing

Installation pontoon with “Bierzelt”

Filling of the bed section on the ramp

Case studies

Munich, rehabilitation of the Mittlere Isarkanal, Germany (2013) - Sealing

Filling of the slope elements

Rehabilitated section
Case studies

Berlin, Drainage ditch for WWTP, Germany (2018) - Sealing

Cross section

Subsoil preparation

Final bedding layer

Empty fabric formwork installed
Case studies

Berlin, Drainage ditch for WWTP, Germany (2018) - Sealing

Covering transition zone

After completion

One more thing...

Concrete mattresses as pipe cover

Installation of pipe cover

Installation of ballasted syphon
Thank you for your attention