# Erosion Resistant Construction of Overflow Sections by means of Geosynthetic Concrete Mattresses

**Markus Wilke[1]**

**Benjamin Krueger[1]**

**Markus Schuell[2]**

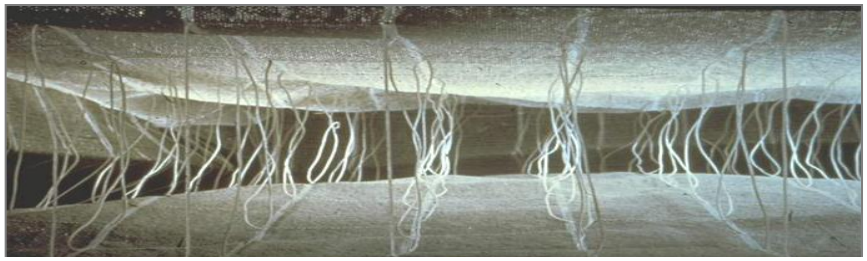
**Peter Tschernutter[2]**

[1] HUESKER Synthetic GmbH

[2] Technical University Vienna

# What are concrete mattresses?

„Geotextile lost formwork“



+

Flowable concrete/mortar
Min. consistency class ≥ F5
Preferable F6 or SCC

# System explanation

## Installation process

# System explanation


Overflow section after completion of concreting


After greening and two vegetation periods

# Experimental procedure

**Experimental studies at the Technical University Vienna with two types of concrete mattresses**

- **Recently concrete mattresses are not mentioned in literature as revetment for overflow sections → Approval of applicability**
- **Verification/check of the maximum permissible flow velocities for concrete mattresses given in recent literature**

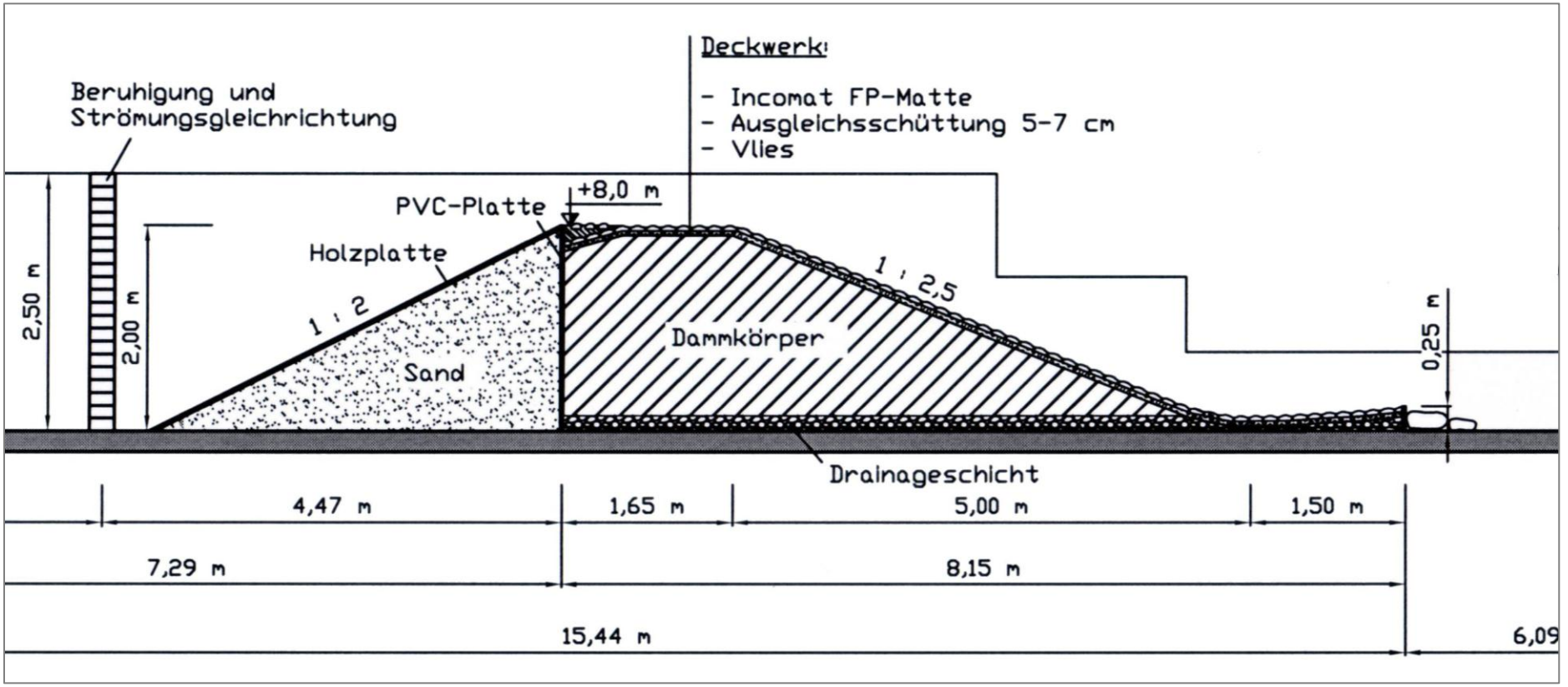
Filterpoint (FP) mat

Crib mat

# Experimental procedure

## Experimental set-up

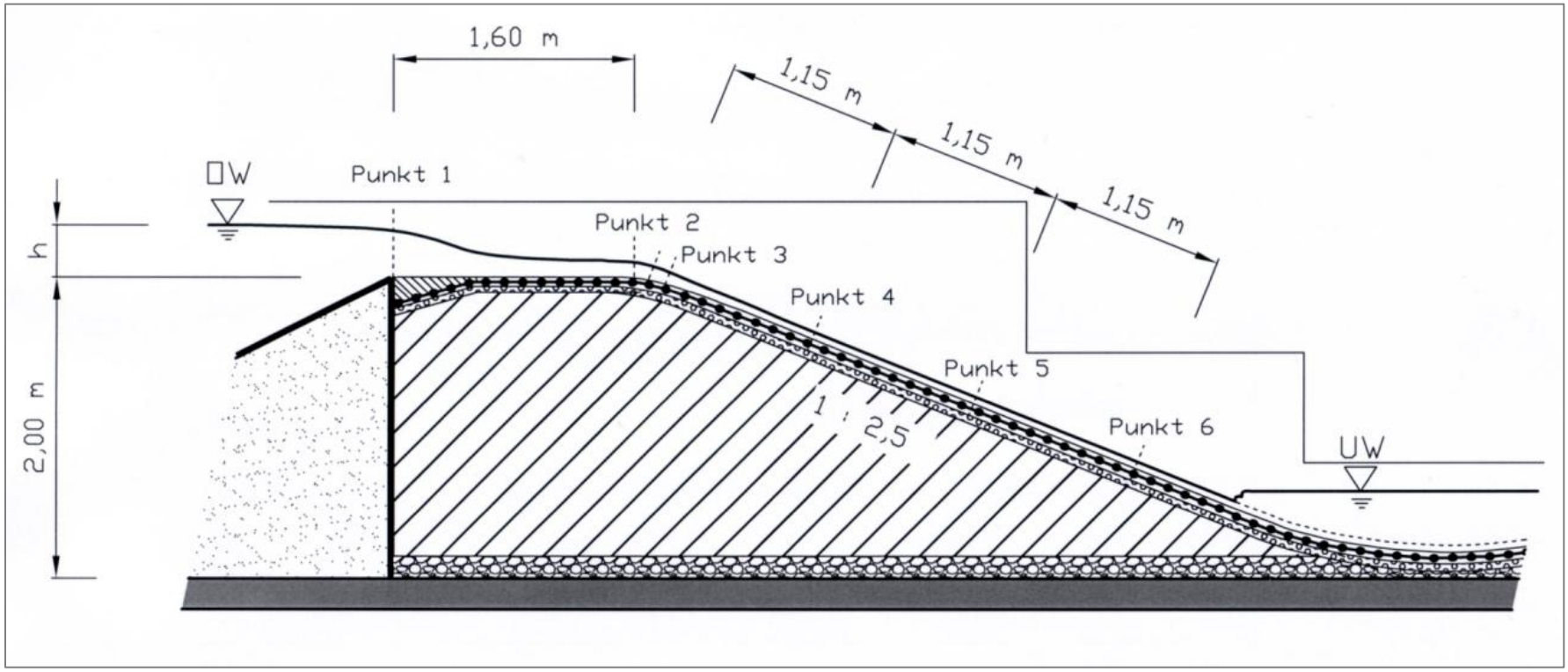
- Physical model with the scale of 1:4
- Froude‘s model law
- Slope inclination 1:2,5
- Specific discharge 0,5…2,5 m³/(s*m)



# Experimental procedure

## Location of the measuring points

- Flow velocity
- Water depths



# Experimental procedure

| q | Duration [h] | |
|---|---|---|
| [m³/(s*m)] | Filterpoint-mat | Crib-mat |
| 0.50 | 10 | 14 |
| 1.00 | 14 | 15 |
| 1.50 | 11 | 15 |
| 2.00 | 17 | 72 |
| 2.25 | 0.5 | 0.5 |
| 2.50 | 0.5 | 0.5 |

# Experimental procedure

## Overflow tests at the TU Vienna 2010

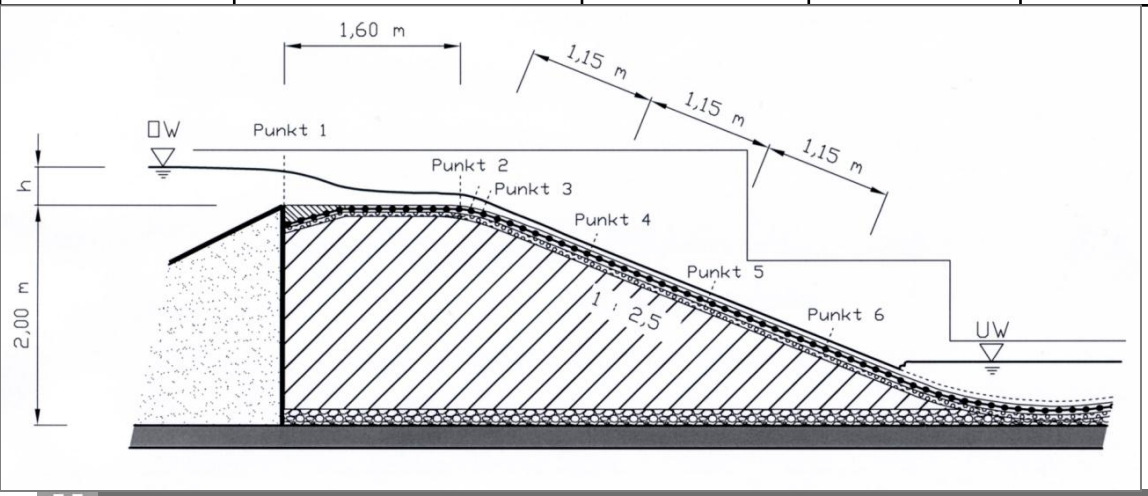
q = 0,25 m³/(s*m)

q = 0,50 m³/(s*m)

q = 2,50 m³/(s*m)

# Experimental procedure

| Type of mat | Specific discharge q [m³/(s*m)] | Measured maximal flow velocity [m/s] | | | | | |
|---|---|---|---|---|---|---|---|
| | | Point 1 | Point 2 | Point 3 | Point 4 | Point 5 | Point 6 |
| FP | 0.50 | 1.30 | 2.80 | 3.20 | 5.80 | 5.66 | 5.60 |
| | 1.00 | 1.70 | 3.64 | 4.32 | 6.80 | 7.80 | 7.80 |
| | 2.00 | 2.20 | 4.20 | 4.88 | 7.26 | 9.16 | 9.50 |
| Crib | 0.50 | 1.45 | 3.16 | 4.30 | 6.44 | 6.00 | 6.68 |
| | 1.00 | 1.84 | 3.62 | 4.52 | 6.44 | 7.58 | 8.14 |
| | 2.00 | 2.30 | 4.16 | 5.04 | 7.36 | 8.96 | 10.50 |



# Experimental procedure

## Summary of the test results

- **Structural design of the overflow section is essential**
  - **→ connection to the dam crest**
  - **→ stilling basin/toe design**
  - **→ lateral integration into the dam/structure**
  - **→ sufficient drainage layer below the concrete mattress**
  - **→ stable subsoil (well compacted)**

- **No indication for a failure – neither for the Crib nor for the FP mat**
  - **→ for great discharges (q=2,0m³/(s*m))**
  - **→ for a steep slope (1:2,5)**
  - **→ for hydraulic loads over a long period of time (72 h)**
  - **→ for higher hydraulic loads over a short period of time (q=2,25…2,5m³/(s*m))**

# Summary

| Revetment type | Max. slope [1:n] | $q_{max}$ [$m^3/(s*m)$] |
|---|---|---|
| Pitched stone[1)] | 6 | ≤ 1.0 |
| Rip-rap[1)] | 4 | ≤ 1.0 |
| Geosynthetic gabions[1)] | 4 | ≤ 1.0 |
| Mastix asphalt[1)] | 6 | ≤ 1.0 |
| Grass paver[1)] | 6 | ≤ 1.0 |
| Soil solidification[1)] | 4 | ≤ 1.0 |
| Filterpoint or Crib mat[2)] | 2.5 | > 2.0 |

[1)] According to [LfU BW - Überströmbare Dämme und Deichscharten]
[2)] Derived from the model tests at the TU Wien

Comparison of conventional revetment systems concerning discharge capacity and maximum permissible slope

# Conclusion

## Advantages of the concrete mattress system

- Very high resistance to increased hydraulic loads/discharges
  (→ greater in comparison to conventional systems)
- Optimization of the dam cubature
  (→ steeper slopes are permissible)
- Reduced layer thickness
- Very economical system
- With adequate preparation great daily installation rates
  (→ up to 1.500 m²/d)
- Subsequent protection of overflow sections is possible
  (→ no change of the main dam body required)
- Coherent revetment
- Very pleasant appearance/integration into the landscape due to subsequent grass cover


Thanks for your kind attention!
© www.wwa-ke.bayern.de