

# Submerged geomembrane systems innovative polder-constructions in limited space



Sheetpile polderconstruction Assen Peelo-zuid – The Netherlands

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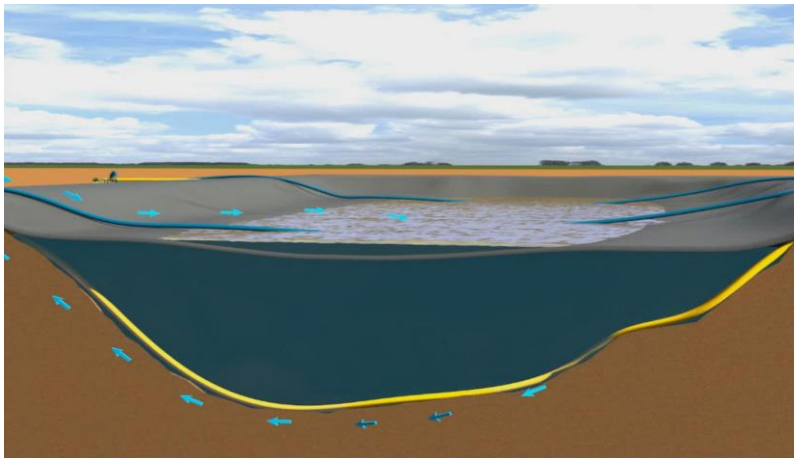


Rijkswaterstaat  
Ministerie van Infrastructuur en Milieu

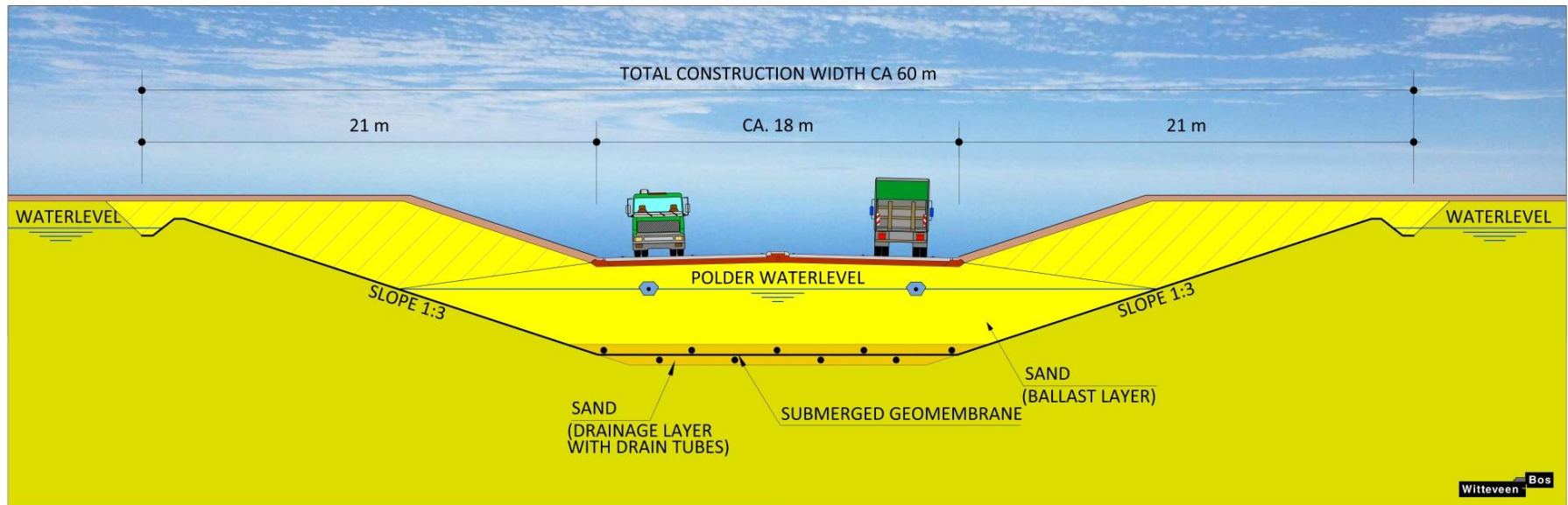
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# Submerging: how does it work?



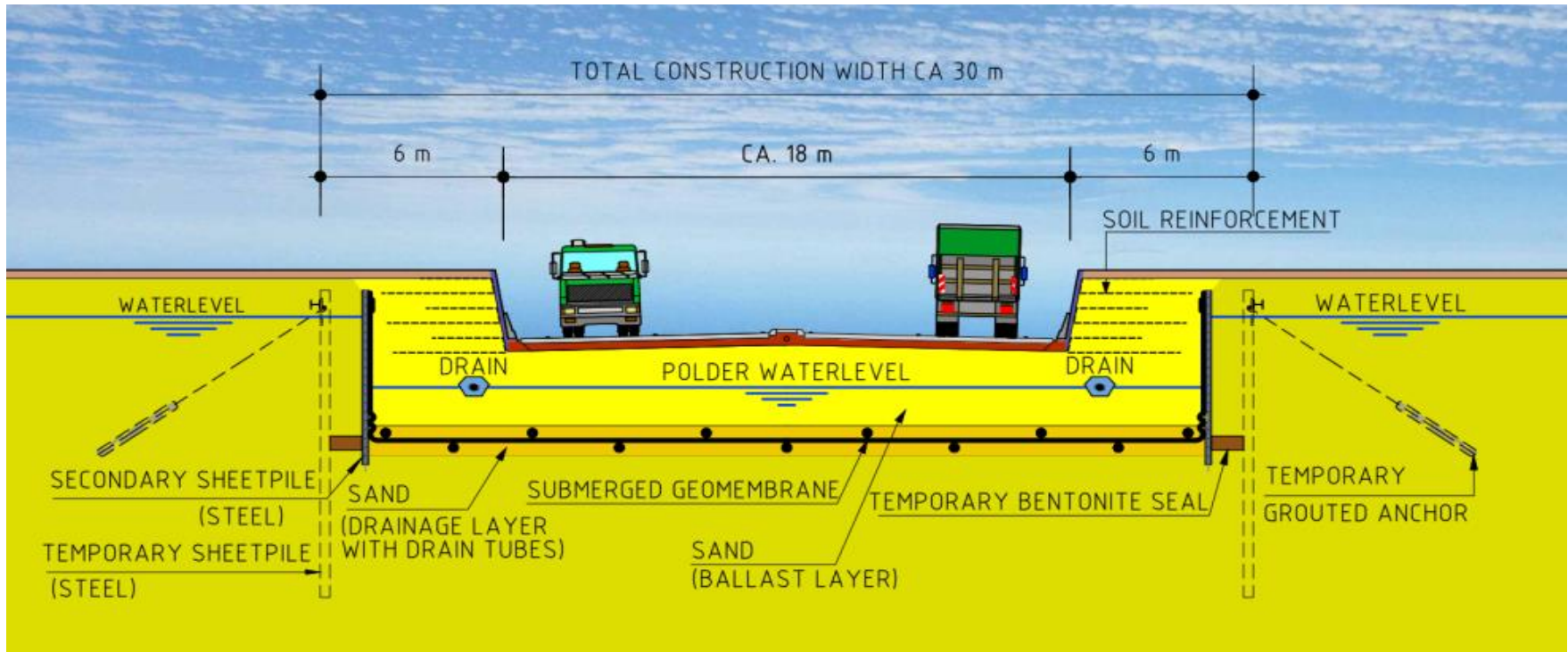
# Submerged geomembranes with natural slopes



## Important and limiting factors

- Spatial use can be extremely large (100-400 meter width)
- Soil conditions (sand, cohesive soil layers, gravel, boulders, etc.)
- Hydrological conditions (groundwater tables, confined water pressures)
- Slope inclinations and stability (excavation in wet conditions)
- Purchase building area (property lines), presence of buildings, etc.

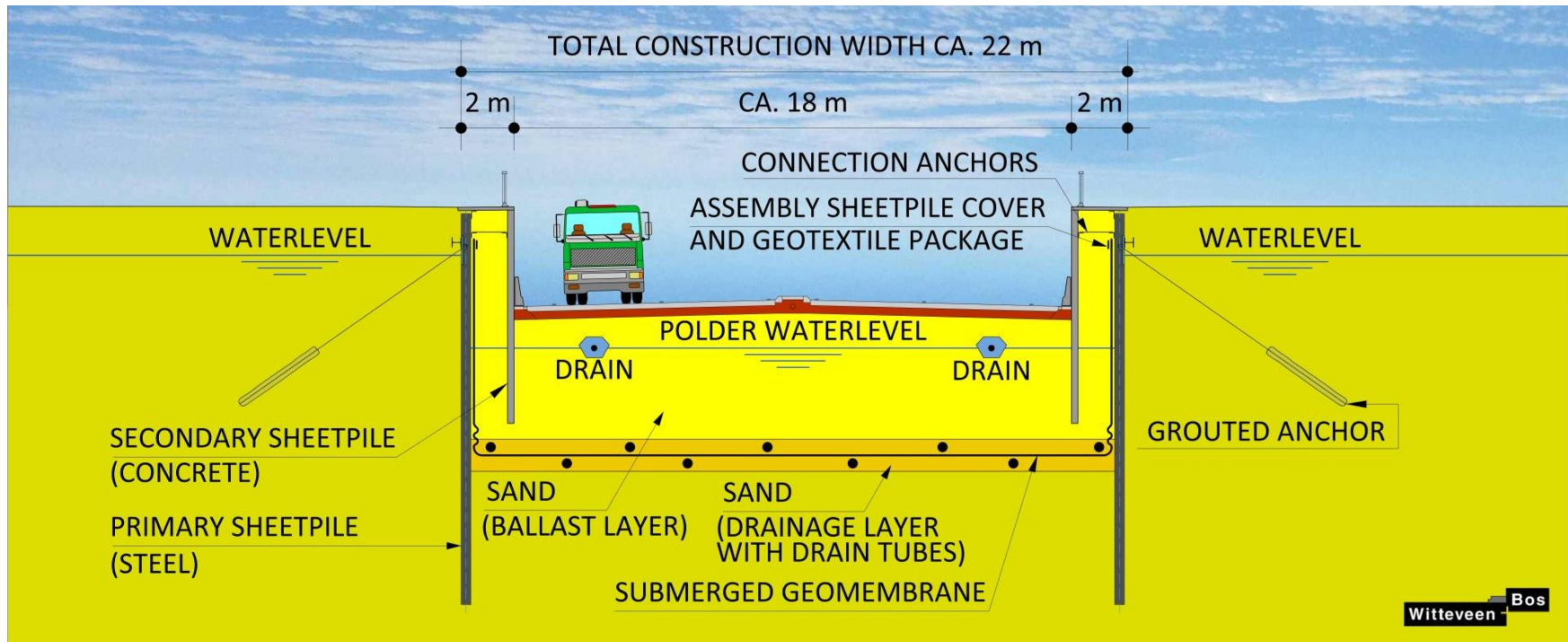
# Geomembrane U-polder



- Primary sheetpile: building pit, geotechnical stability, anchors
- Secondary wall: formwork vertical submerged geomembrane
- Structural connections walls in between
- Limiting width: about factor 2

**Temporary  
Lost  
Temporary**

# Geomembrane sheet pile polder



- Primary sheet piles: building pit, geotechnical stability, anchors, vertical submerged geomembrane
- Secondary wall: wall facing and stability geomembrane
- Structural connections walls in between
- Limiting width: maximum, about factor 2-3

**Permanent  
Permanent  
Permanent**

# Comparison construction methods

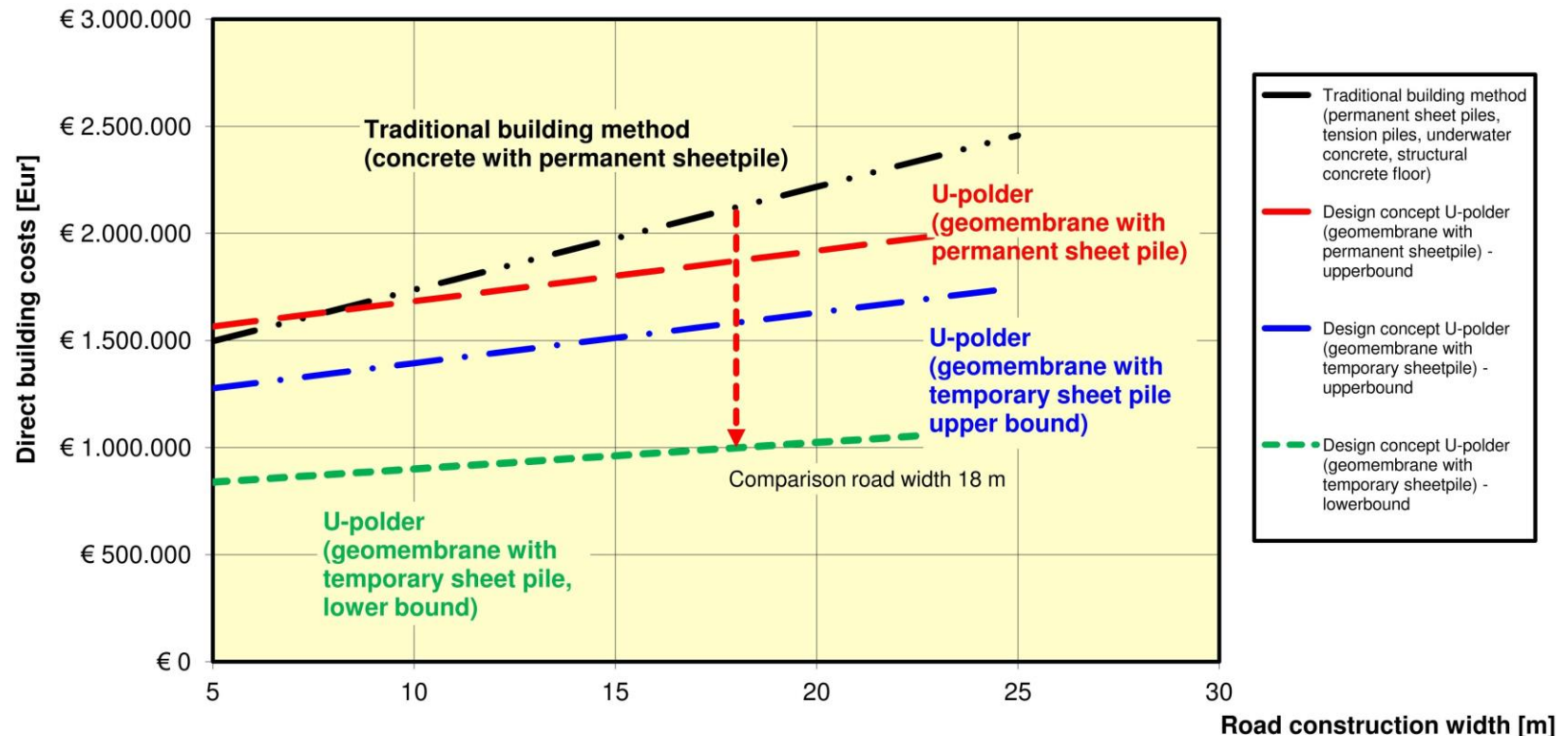
Construction method	Limited width	Experience	Sustainable building (CO2)	Costs
1. Concrete (traditional)	+++	+++	-	-
2. Natural polder (soil layers)	+	+/-	+++	+++
3. Geomembrane open excavation	0	++	+++	+++
4. Geomembrane U-polder	++	+	++	++
5. Geomembrane Sheet pile polder	+++	+	++	+

- Desired visual design of ramps ‘Green slopes’
- Spatial use at building location
- Soil conditions / reuse of excavated material
- Presence of environmental pollutions
- Risk control at design, construction and maintenance
- Direct en indirect building costs



**Choosing the optimum construction method**

# Relation building costs - road width



## References calculation global building costs:

- Building costs per 100 m<sup>1</sup> underground construction length
- Building method with natural (green) slopes 1 to 2 inside underground construction
- Underground passway at 4 minus ground and groundwater level
- Width total construction = road width + ca. 16 m
- Costs excl. VAT and contractor surcharges, price level 2014 (estimate band width +/- 30%)
- U-polder options varying temporary / permanent sheet piles, re-use of excavated soil, leakage control, QA and 20% risk surcharge

# Geomembrane sheet pile polder



Installation with winches  
to each side building pit,  
submerging geomembrane



# Final situation sheet pile polder



Reference: Meester / Gerritsen, Folieconstructies met damwand-polder en U-polder te Assen, Land+Water, mei 2009

# Project experiences



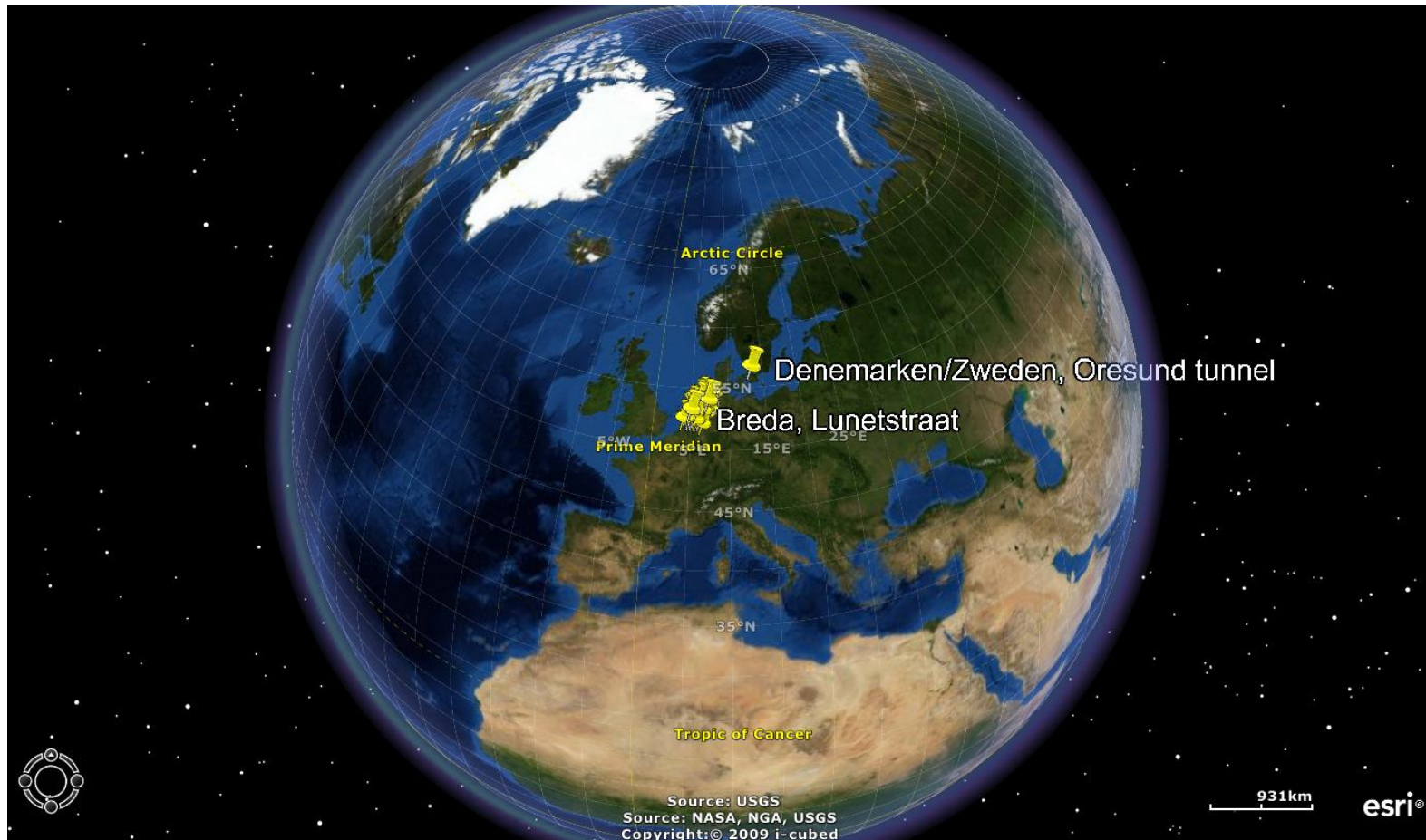
# Special detailing and experience...



# Projects in the Netherlands



# Where do you place your civil geomembrane construction?



A world to conquer... export the Dutch experience and approach?!

# Submerged geomembrane systems

## Innovative polder-constructions in limited space

### Conclusions

#### Minimize

- Building costs compared with traditional building
- Spatial use / construction width
- Building time: sealing by prefabrication
- Effects in surroundings: no groundwater dewatering

#### Special

- Design and construction is very specialized
- Integral approach necessary for risk control and success
- A lot of potential for applications abroad

# Thank you for your attention. Any questions?



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For further information see our paper congress proceedings, the article in the ICG-NGOspecial or contact the persons above!!