Nederlandse Geotextiel Organisatie – IGS Netherlands

Geosynthetic solutions in impressive projects

- <u>TOPICS</u>
- **2nd Niger Bridge Project in Nigeria by:**
    - *Max Nods (GeSySo, Netherlands)*
    - *Jeroen Dijkstra (Cofra, Netherlands)*
- **Two non-conventional piled embankments in Brazil by:**
    - *Werner Bilfinger (Vecttor, Brazil)*
- **Coastal protection with geotextile sand containers in Lubmin in Germany by:**
    - *Janne Kristin Pries (Naue, Germany)*

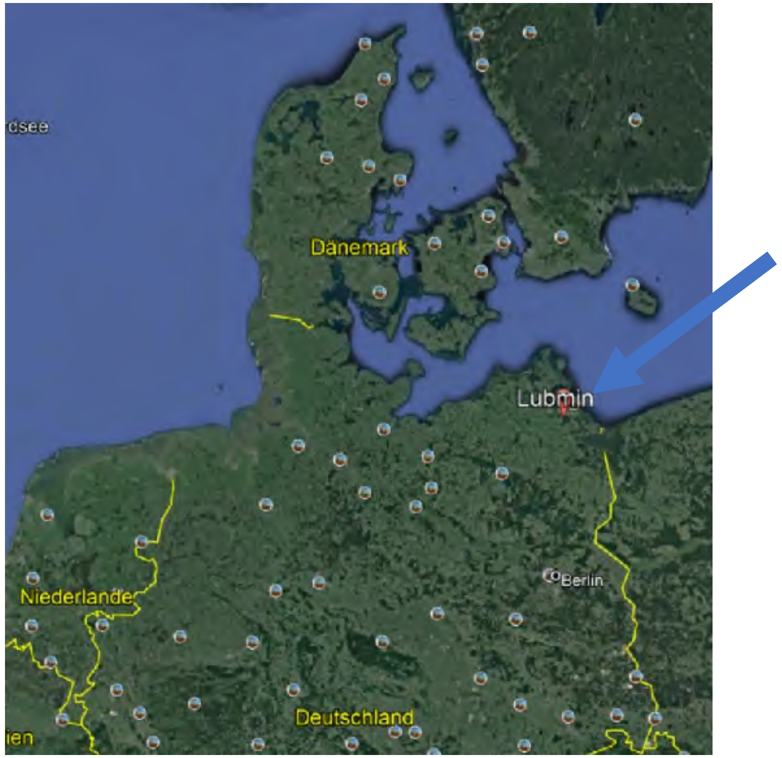
International Geosynthetics Society

NGO IGS Netherlands

Nederlandse Geotextiel Organisatie – IGS Netherlands

Coastal protection with geotextile sand containers at Lubmin in Germany

Baltic Coast in Lubmin



Source: Google Earth

Coastal protection with geotextile sand containers at Lubmin in Germany

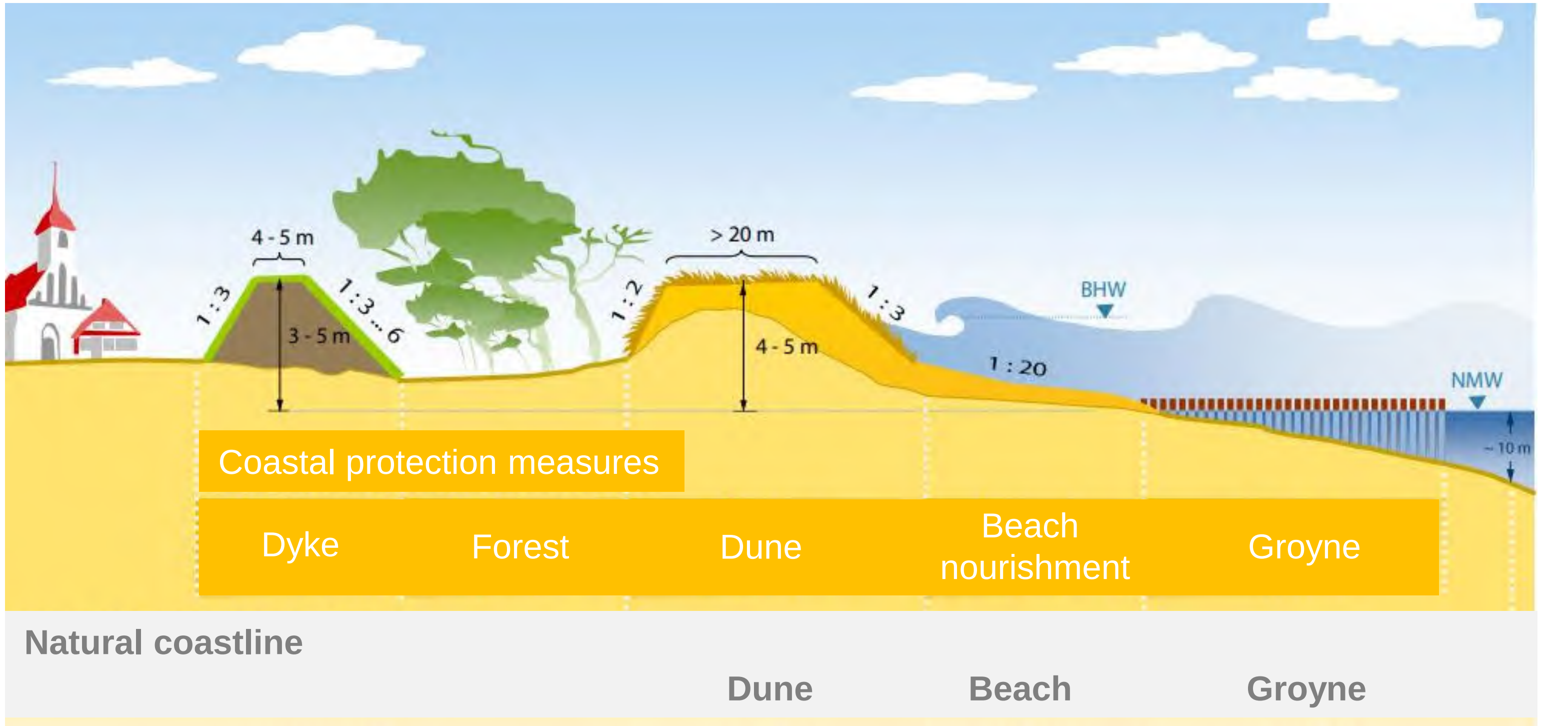
Baltic Coast in Lubmin

Source: Google Earth

Baltic Coast in Lubmin

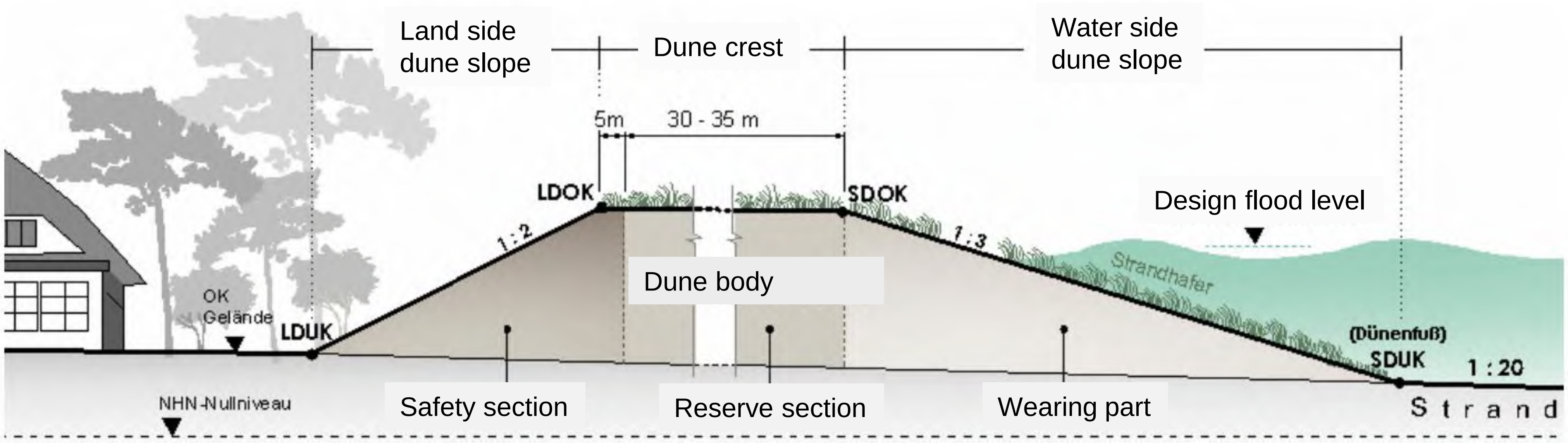
Source: Google Earth

Cross-section of a traditional protection system



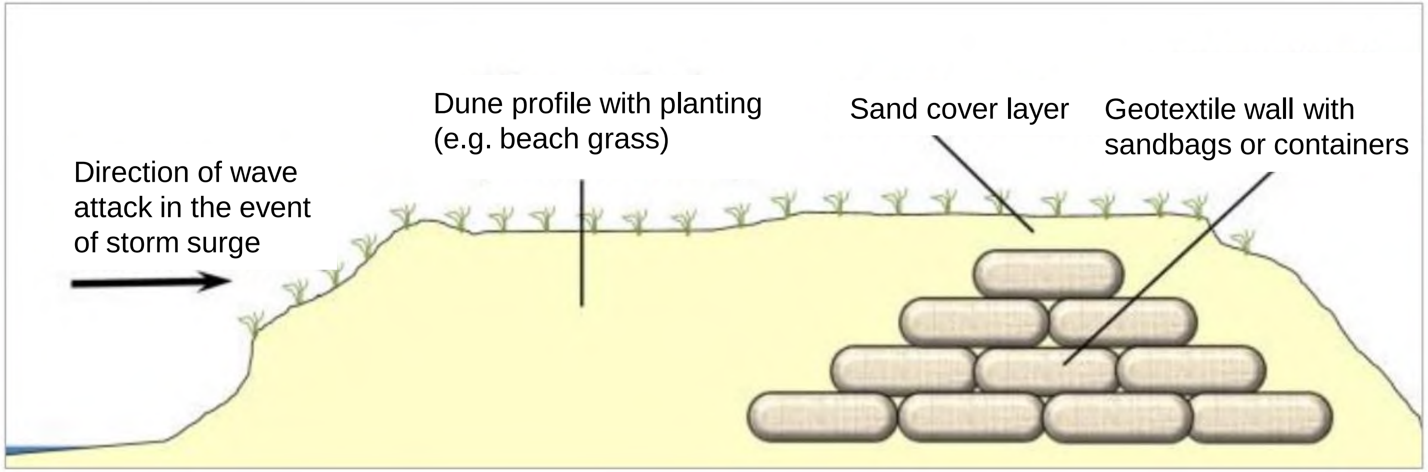
Source: Regelwerk Küstenschutz Mecklenburg-Vorpommern, Übersichtsheft

Cross section of a coastal protection dune



Source: Regelwerk Küstenschutz Mecklenburg-Vorpommern, Übersichtsheft

Dune including a geotextile wall



Source: Regelwerk Küstenschutz Mecklenburg-Vorpommern, Entwurfs- und Ausführungsgrundsätze

Coastal protection Ludmin, Mecklenburg-Vorpommern, Germany

Solution with Secutex® Soft Rock - Geotextile Sand Container as beach wall protection structure

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Geotextile scour protection GSC

Our philosophy

As small as possible and as big as necessary!

Flexible system:

High adaptability to deformations.

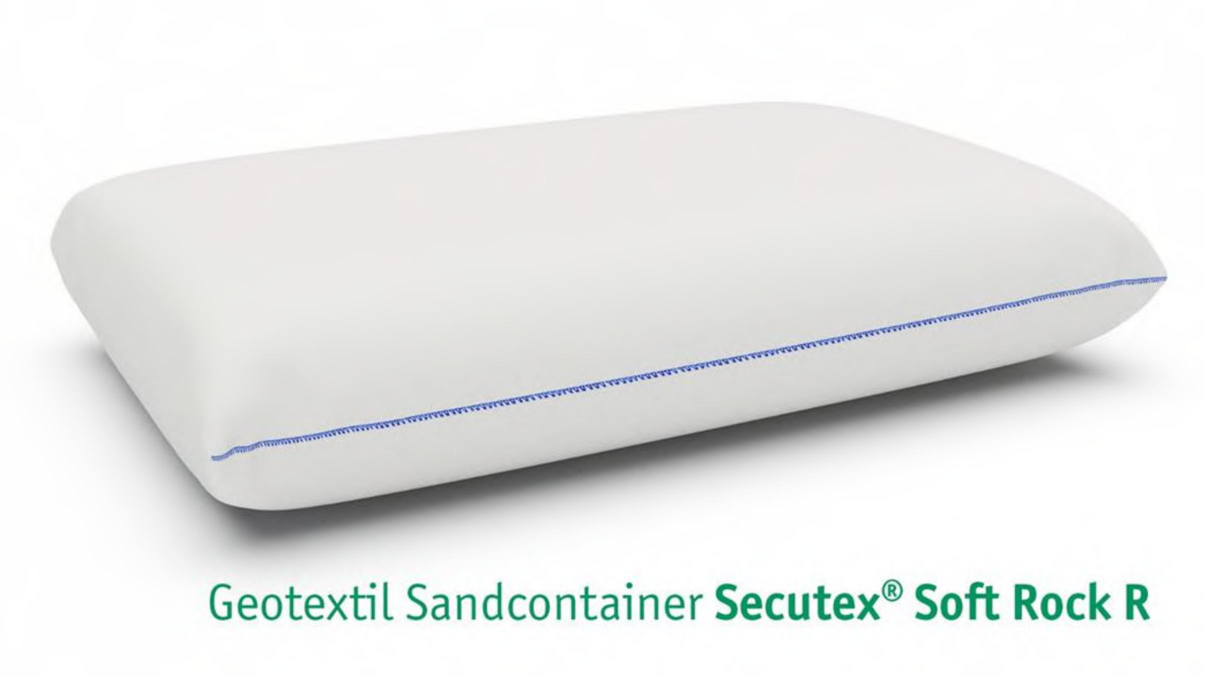
Requirement: Deformation capability

→reached by needle punched nonwoven geotextiles and highly stretchable seams

Geotextile Sand Container (GSC)

Secutex® Soft Rock

Geotextile containers made of single-layered robust and abrasion resistant needle-punched nonwoven, closed along three sides. One side is open, for filling the geotextile container with sand. The open side can be closed optionally with a hand-held sewing machine or with the use of a new tool-free closing technology which is attached to the product.



Geotextile Sand Container (GSC)

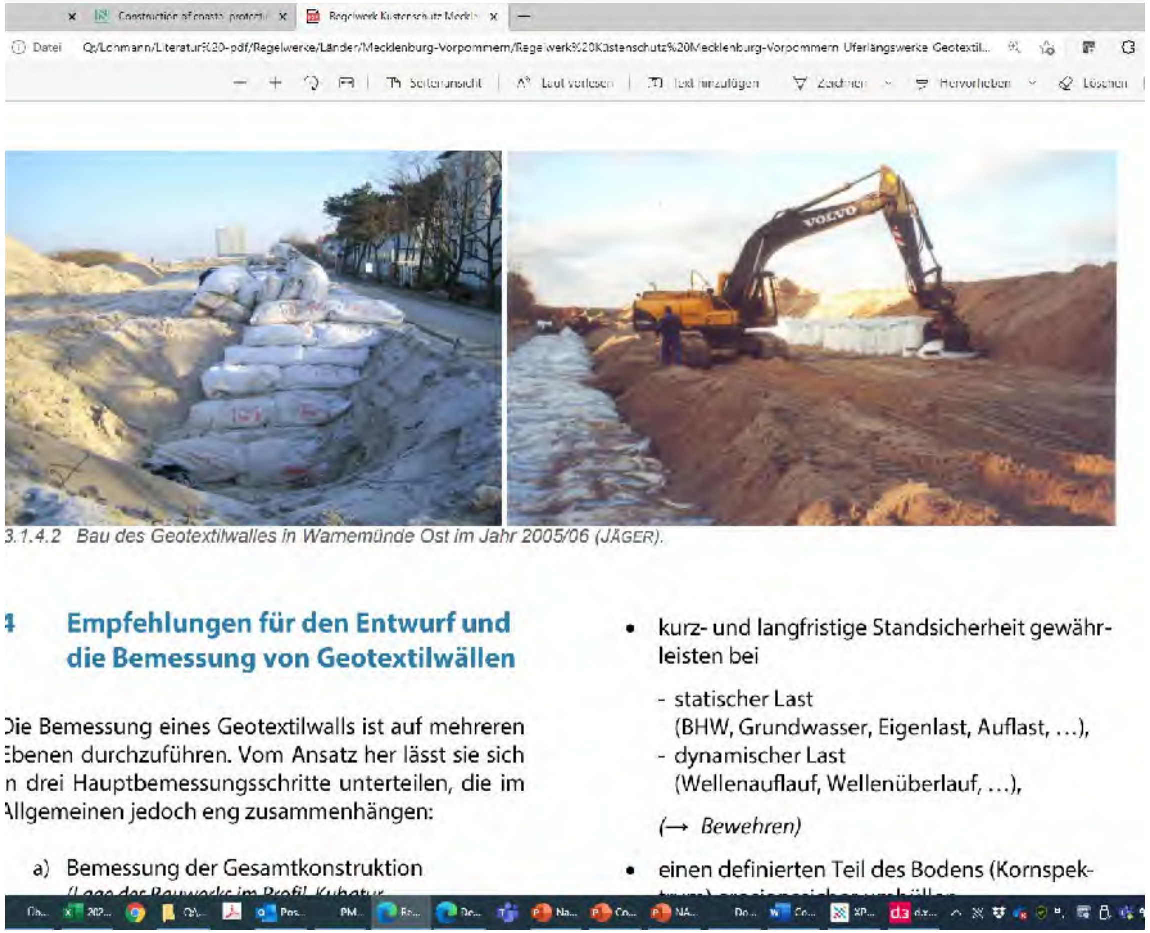
Secutex® Green Soft Rock

Geotextile container made of robust, abrasion resistant, needle-punched and biodegradable filter nonwoven for the filling with sand or other mineral material. The geotextile container is closed along three sides. One site is left open, for filling the geotextile container with sand. The open side can be closed with a hand-held sewing machine.

Design

The design of coastal protection systems must be carried out on several levels. It can be divided into three main design parts, which are generally closely related:

- Dimensioning of the overall construction
- Dimensioning of the geotextile sand containers and
- Dimensioning of the geotextile materials used.



3.1.4.2 Bau des Geotextilwalles in Warnemünde Ost im Jahr 2005/06 (JÄGER).

4 Empfehlungen für den Entwurf und die Bemessung von Geotextilwällen

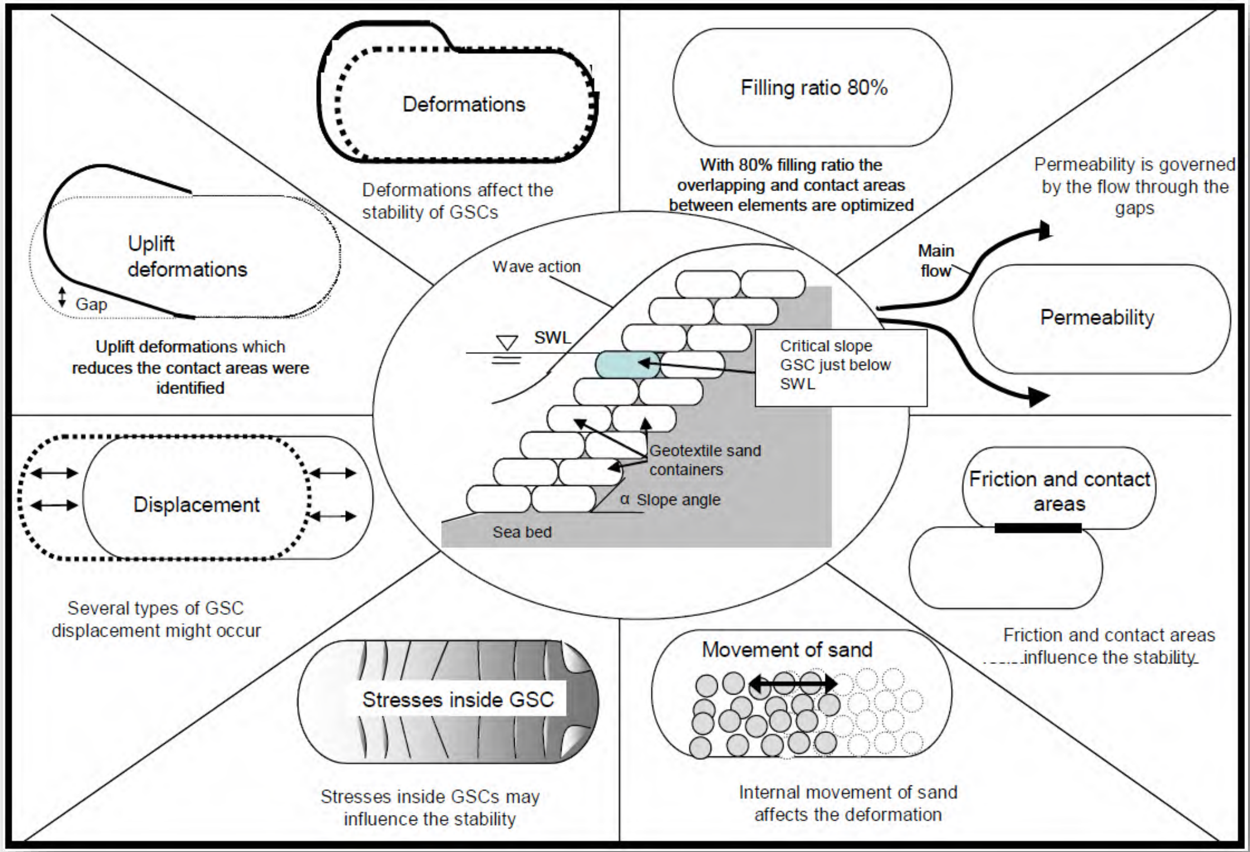
ie Bemessung eines Geotextilwalls ist auf mehreren benen durchzuführen. Vom Ansatz her lässt sie sich n drei Hauptbemessungsschritte unterteilen, die im llgemeinen jedoch eng zusammenhängen:

a) Bemessung der Gesamtkonstruktion

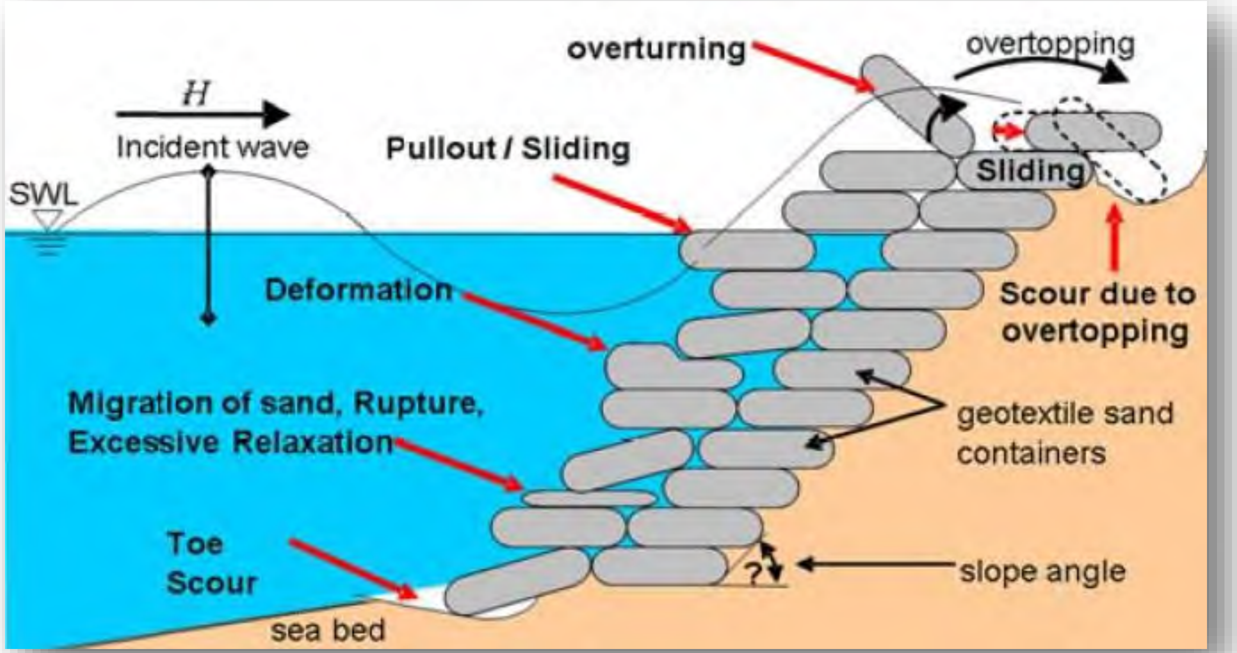
- kurz- und langfristige Standsicherheit gewährleisten bei
  - statischer Last (BHW, Grundwasser, Eigenlast, Auflast, ...),
  - dynamischer Last (Wellenauflauf, Wellenüberlauf, ...),

  (→ *Bewehren)*
- einen definierten Teil des Bodens (Kornspek-

Influence of the hydro-geotechnical processes for the stability of the GSCs

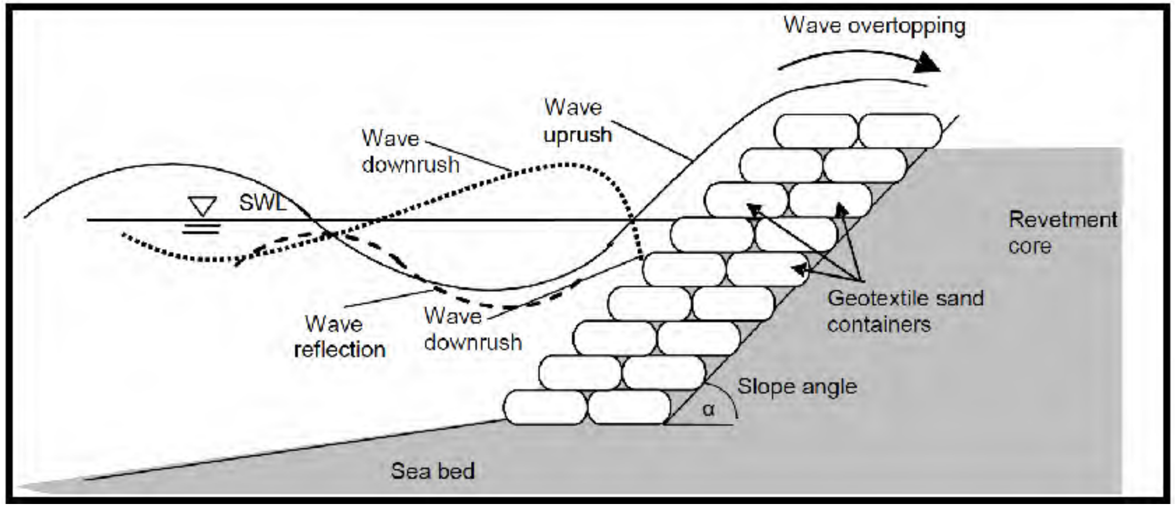


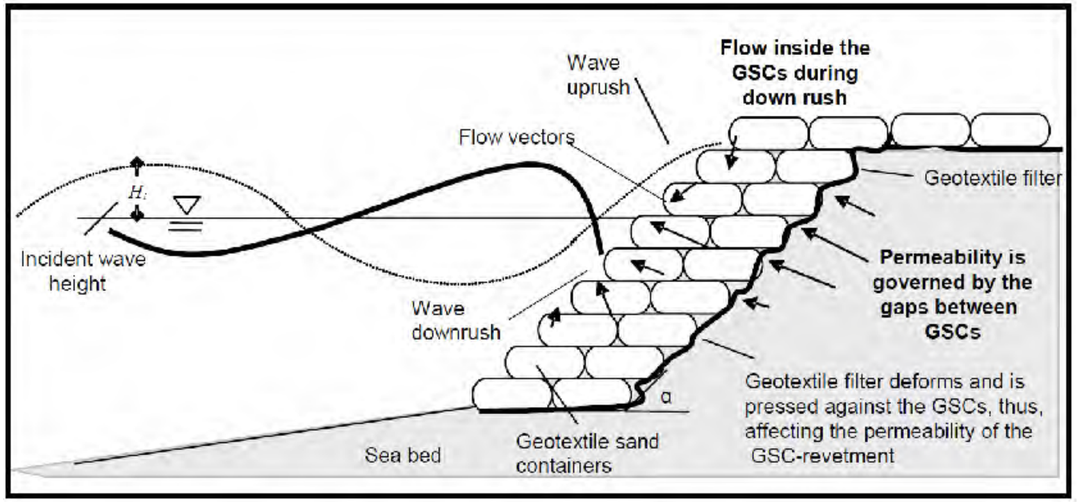
Failures



Source: Dissertation, Juan Recio

Loads on the crest and in the slope area





Source: Dissertation, Juan Recio

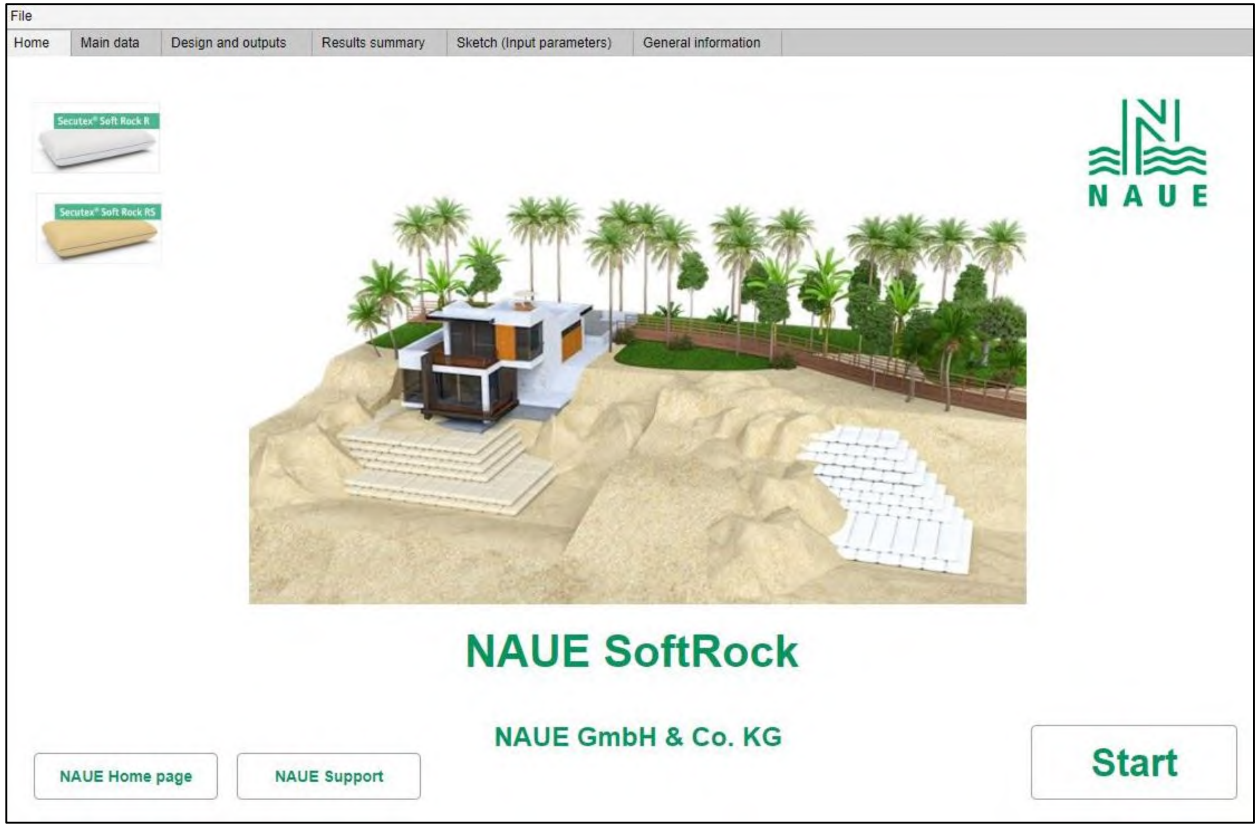
Design approaches

Parameter-oriented design approach according to Oumeraci and Hinz (2002)

Process-orientated design approach according to Oumeraci and Recio (2008)

	Sliding Stability	Overturning Stability
Parameter-oriented design approach:	$N_{s,slope} = \frac{H_s}{(\rho_E / \rho_W - 1) \cdot D} < \frac{2.75}{\sqrt{\xi_0}}$	$N_{s,crest} = \frac{H_s}{(\rho_E / \rho_W - 1) \cdot D} < 0.79 + 0.09 \frac{R_c}{H}$
Process-oriented Design approach:	Required container length $l_{c(sl)} \geq u^2 \frac{[0.5KS_{CD}C_D + 2.5KS_{CL}C_L\mu]}{\left[\mu KS_R \Delta g - KS_{CM}C_M \frac{\partial u}{\partial t}\right]}$ Required container mass $W_{GSC} \geq \rho_s \left(u^2 \frac{[0.5KS_{CD}C_D + 2.5KS_{CL}C_L\mu]}{\left[\mu \Delta KS_R g - KS_{CM}C_M \frac{\partial u}{\partial t}\right]} \right)^3 / 10$	Required container length $l_{c(ov)} \geq u^2 \frac{[0.05KO_{CD}C_D + 1.25KO_{CL}C_L]}{\left[0.5\Delta KO_R g - 0.1KO_{CM}C_M \frac{\partial u}{\partial t}\right]}$ Required container mass $W_{GSC} \geq \rho_s \left(u^2 \frac{[0.05KO_{CD}C_D + 1.25KO_{CL}C_L]}{\left[0.5\Delta KO_R g - 0.1KO_{CM}C_M \frac{\partial u}{\partial t}\right]} \right)^3 / 10$

Design Software Naue SoftRock



Design

According to the current state of knowledge the following requirements can be derived:

- Ensure short- and long-term stability under static load (dead load, ballast, groundwater, design flood, etc.)
- Ensure stability under dynamic load (wave run-up, wave overflow, etc.)
- Ensure erosion stable encapsulation of the fill material in the geotextile sand container (define soil retention, check filter effectiveness of the geotextile)
- Ensure sufficient resistance to impact loads (dropping elements, flotsam)
- Ensure sufficient resistance to abrasion
- Meet the other hydraulic requirements and allow the flow of precipitation water through the structure without damage,
- Consider chemical and biological influences and UV radiation.

Conclusion

The residents in Lubmin are satisfied with the coastal protection solution and are pleased with the improved safety.

Second Niger Bridge
Scour protection with geotextile sandcontainers