Technische Universität Braunschweig

Leichtweiß-Institute for Hydraulic Engineering and Water Resources
Department of Hydromechanics and Coastal Engineering

Wind park alpha ventus, North Sea, Germany
(DLR, DOTI/J.Oelker/2010)

Granular Filter Design for Scour Protection at Offshore Structures

David Schürenkamp, Matthias Bleck & Hocine Oumeraci | 30th August 2012 | Advanced Filter Design

6th International Conference on Scour and Erosion

Contents

- Introduction
- Boundary Conditions
- Filter Design
- Conclusions and Outlook


DLR, DOTI/J.Oelker/2010


http://blog.ewea.org


Oumeraci et al. (2007)

Contents


DLR, DOTI/J.Oelker/2010


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Oumeraci et al. (2007)

Introduction

- Scour protection around a monopile
- Filter design for offshore environment
  - Geometrically closed filter
  - Geometrically open filter
- Recommendations for the filter design
  - Economical
  - Technical

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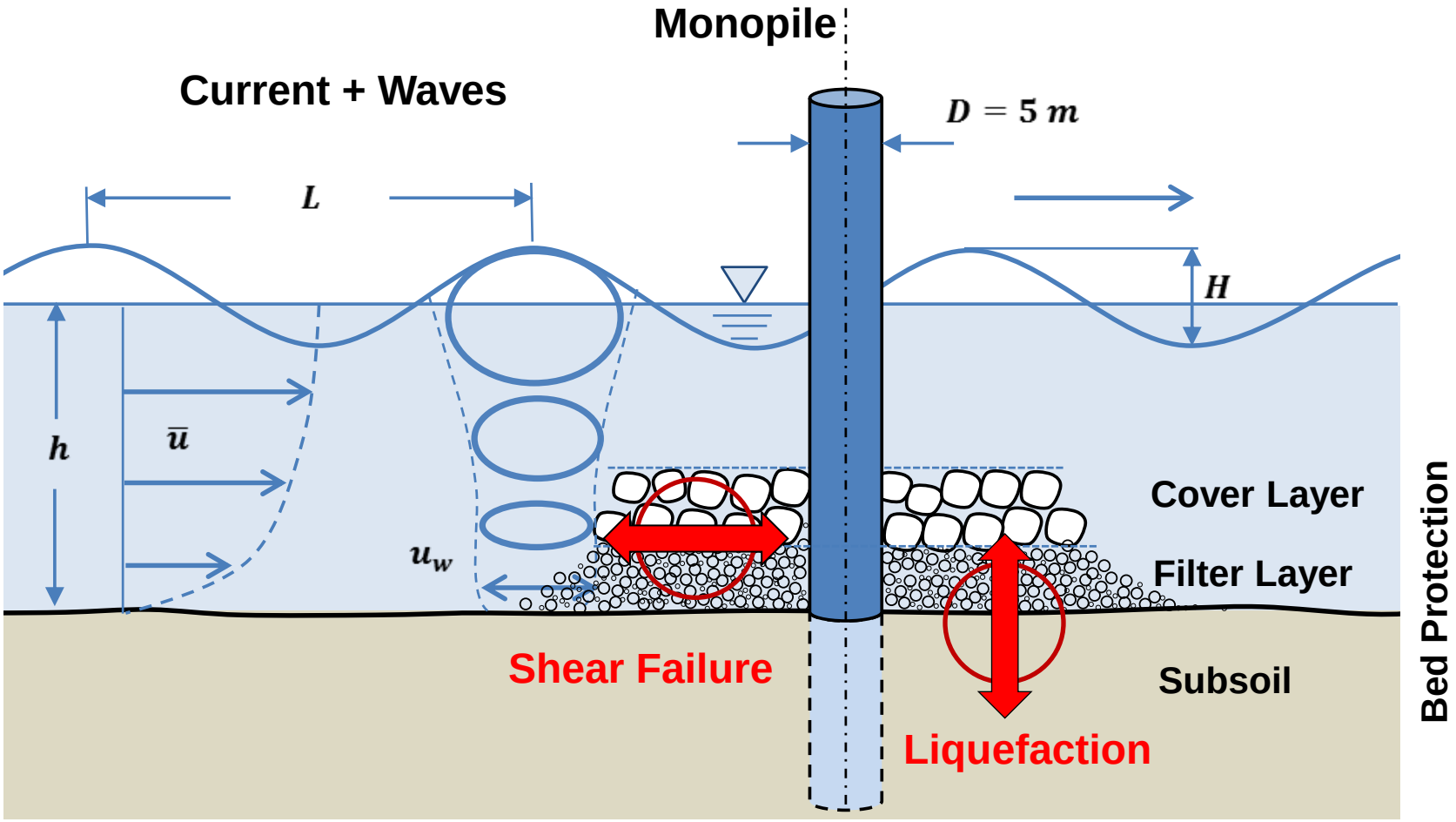
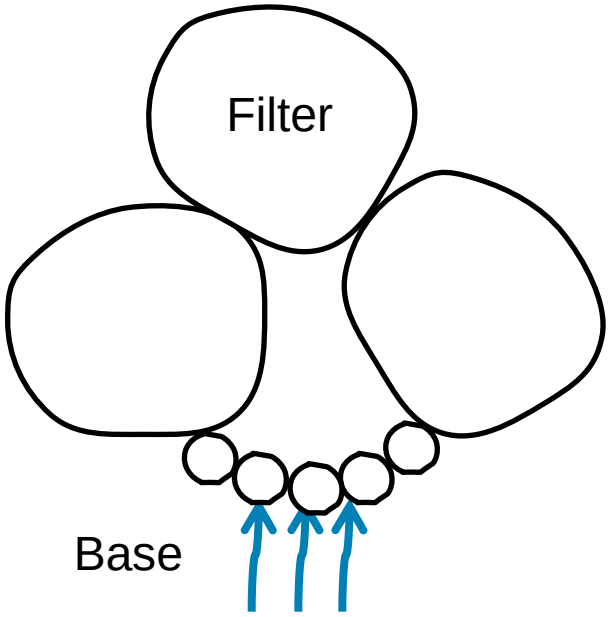
Boundary Conditions



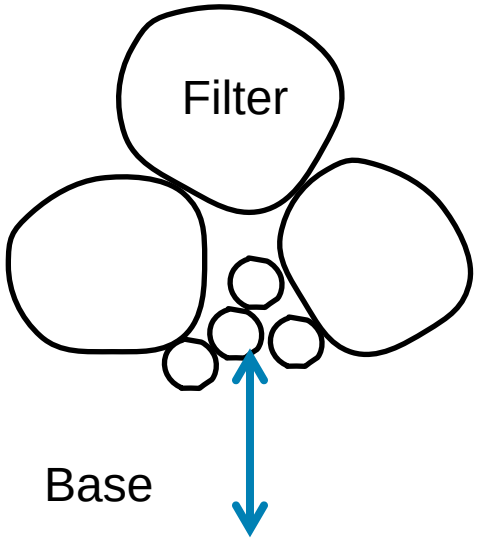
Boundary Conditions

a) Arching



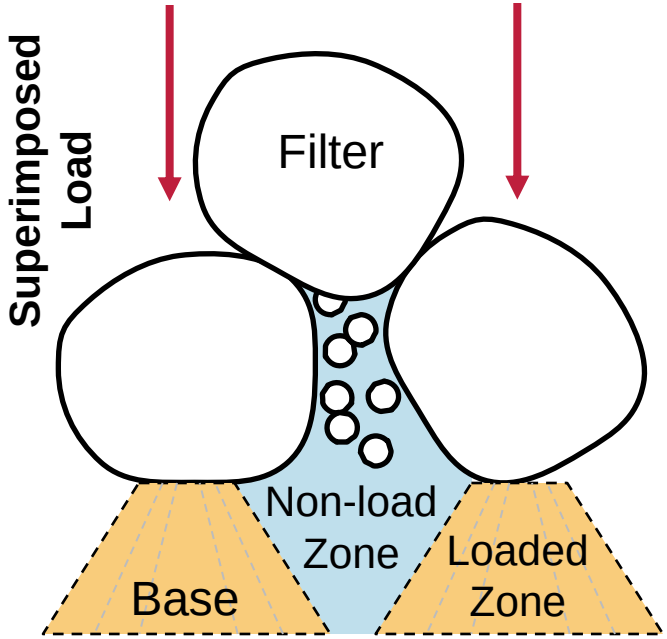
Unidirectional Flow

b) Geometrically Closed



Oscillatory Flow

c) Local Liquefaction



modified from de Graauw et al. (1983)

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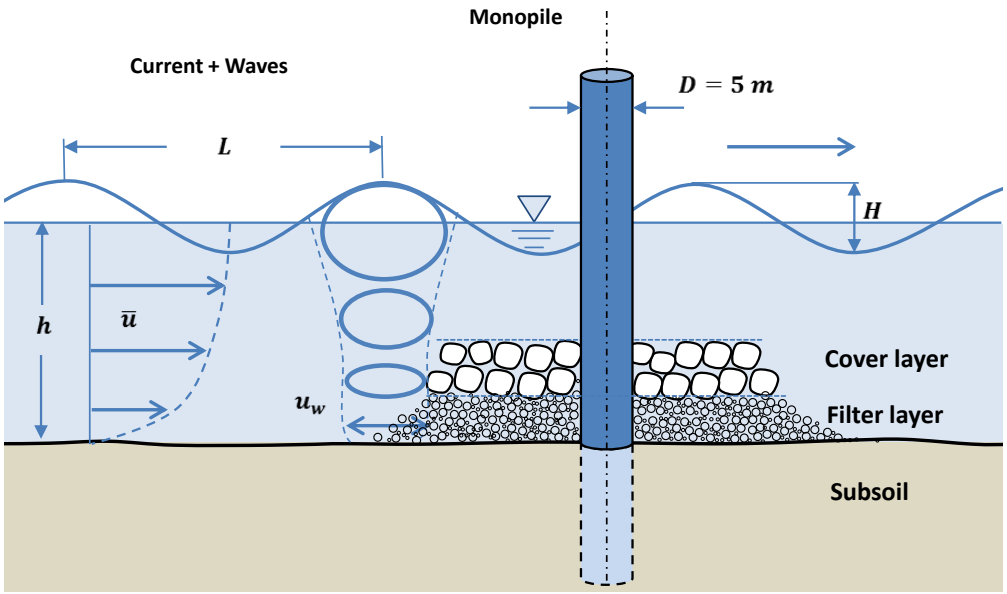
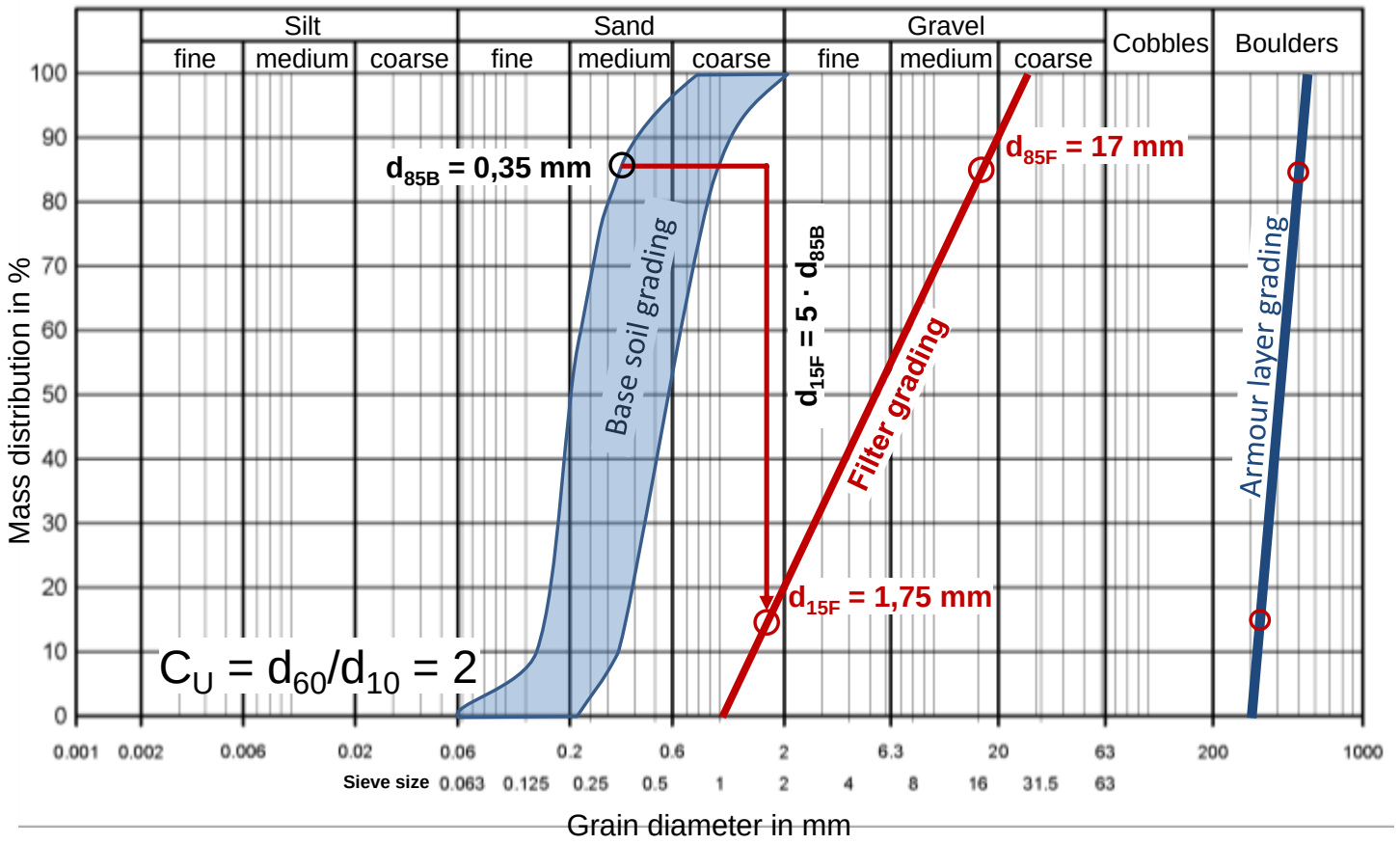
Filter Design

Example Case

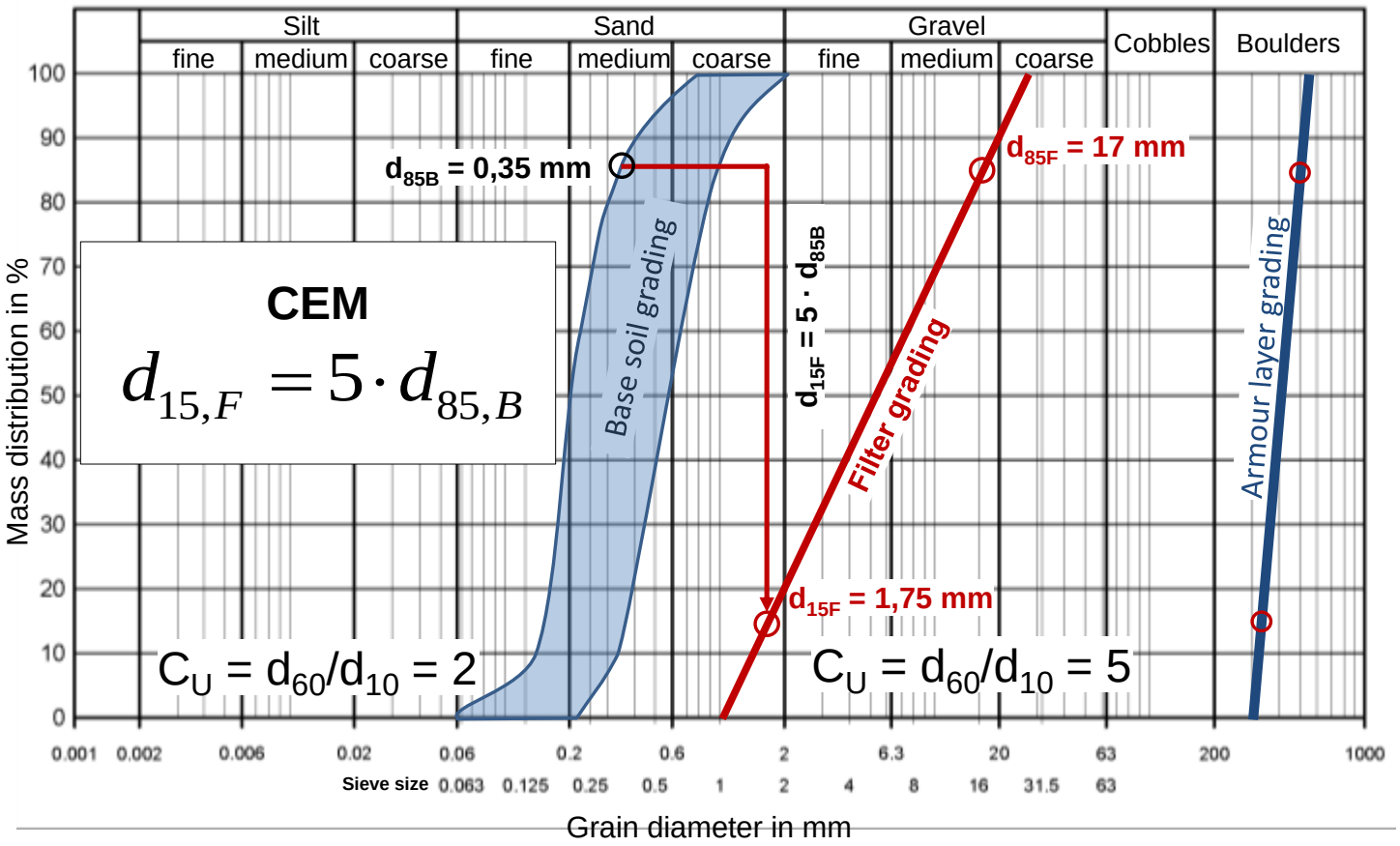
- Subsoil
  - d_{50B} = 0.20 mm
- Cover layer (preliminary design)
  - d_{50D} = 420 mm
  - porosity of cover layer n_D = 0.40
  - thickness of cover layer S_D = 0.90 m
  - dry density of cover material ρ_C = 2900 kg/m³



Filter Design



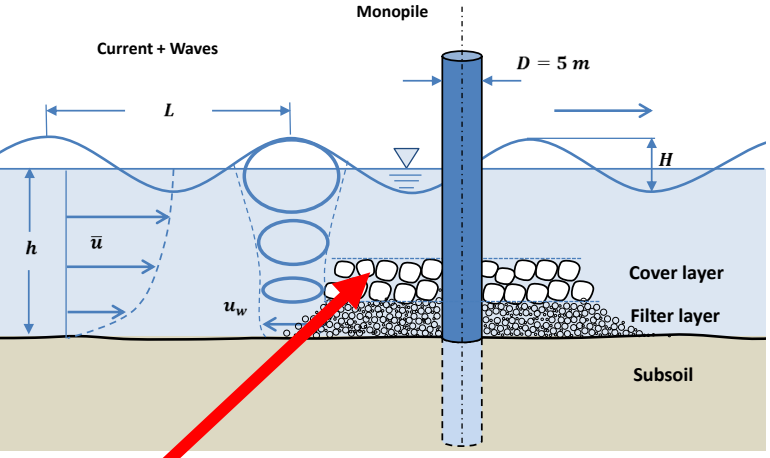
Filter Design



Filter Design

Design Approach of Wörman (1989)

$$S_C = 0{,}16 \cdot \frac{\left[\left(\rho_C / \rho_W\right) - 1\right]}{\left[\left(\rho_F / \rho_W\right) - 1\right]} \cdot \frac{n_C}{1 - n_C} \cdot \frac{d_{85,C} \cdot d_{15,C}}{d_{85,F}}$$



S_C = 1.2 m instead of 0.9 m

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Conclusions and Outlook

Open Issues:

- Contact erosion under **oscillatory flow perpendicular** to the interface
- **Pore pressure distribution** under perpendicular oscillatory flow
- **Incipient motion/**transport of base material, including internal erosion
- Design approach for the combination of **oscillatory and unidirectional flow**
- **Alternatives**: dynamic design approach, construction and maintenance

Conclusions and Outlook

Future Prospects:

- Improve understanding of hydro-geotechnical **processes** inside porous media
- Preliminary tests with a **bidirectional flow apperatus**

  Federal Waterways Engineering and Research Institute (BAW), Karlsruhe, Germany
- Hydraulic model tests in a **wave flume**
- Development of generic and process-based formulae for the design of granular filter

Thank you for your attention!

Wind park alpha ventus, (DLR, DOTI/J.Oelker/2010)

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