



#### EXPERIMENTAL AND NUMERICAL MODELLING OF THE HYDRAULIC STABILITY OF GEOTEXTILE SAND CONTAINERS UNDER WAVE LOADS

Darshana T. Dassanayake and Hocine Oumeraci | 2013, Feb 26 | 9. FZK-Kolloquium

#### Contents

- Introduction
- Objectives and methodology
- Experimental investigations: wave flume tests
- Numerical modelling: CFD-CSD simulations
- Concluding remarks and outlook









## **Objectives**

The current research at LWI focuses on developing reliable design tools for coastal structures made of GSC with a focus on hydraulic stability formulae.

The main objective of this specific study is to investigate the effects of the <u>sand fill ratio</u>, the <u>type of geotextile material</u> (friction between GSCs) and <u>inclined placement</u> of the GSC on the hydraulic stability of submerged and low-crested GSC-structure.





### Laboratory experiments : wave flume tests

Wave flume tests to study the influence of <u>sand fill ratio</u>, <u>type of geotextile</u> <u>material</u>, and <u>inclined placement</u> on the hydraulic stability of submerged and low-crested GSC-structures.



#### Wave flume : 90m x 2m x 1.2m

Model setup – hydraulic stability tests in the 2m wide wave flume of LWI





#### New hydraulic stability curves







#### **Numerical simulations**

Partially combined CFD and CSD models of the hydraulic stability of GSC-structures [COBRAS-UC / UDEC 5.0]









#### Validation of the CFD model [COBRAS-UC]

#### An example numerical simulation: CFD + CSD models







#### **Concluding remarks**

- <u>New hydraulic stability curves</u> were developed based on the experimental results.
- <u>100%</u> filled GSCs show <u>higher hydraulic stability</u> compared to 80% filled GSCs.
- Inclined placement and geotextile materials with <u>high friction properties</u> enhance the hydraulic stability as well as slow down the damage progress.
- Results from COBRAS UDEC modelling system show a relatively good agreement with the experimental data.

However,

- This system has serious <u>limitations</u> because of the <u>2D simplification</u> of a truly 3D-problem.
- Therefore, one of the future research tasks is to extend the COBRAS UDEC to a coupled 3D-model system.





#### **Outlook: computational tool for the design of GSC-structures**







#### Acknowledgement

Financial support provided for the first author by <u>German Academic</u> <u>Exchange Service (DAAD)</u> is greatly acknowledged.

> DAAD Deutscher Akademischer Austausch Dienst German Academic Exchange Service

<u>Leichtweiß Institute</u>, Germany and <u>NAUE GmbH & Co. KG</u> and are gratefully acknowledged for their financial support to conduct laboratory investigations.







# Thank You for Your Kind Attention

Clifton Springs Breakwater (2004)

(Photos: www.elcorock.com)

Darshana Dassanayake **MSc** Leichtweiß-Institut für Wasserbau Technische Universität Braunschweig Tel.: 0531 / 391-3988 E-mail: d.dassanayake@tu-bs.de





Technische
Universität
Braunschweig



## Different model configurations and test series:





