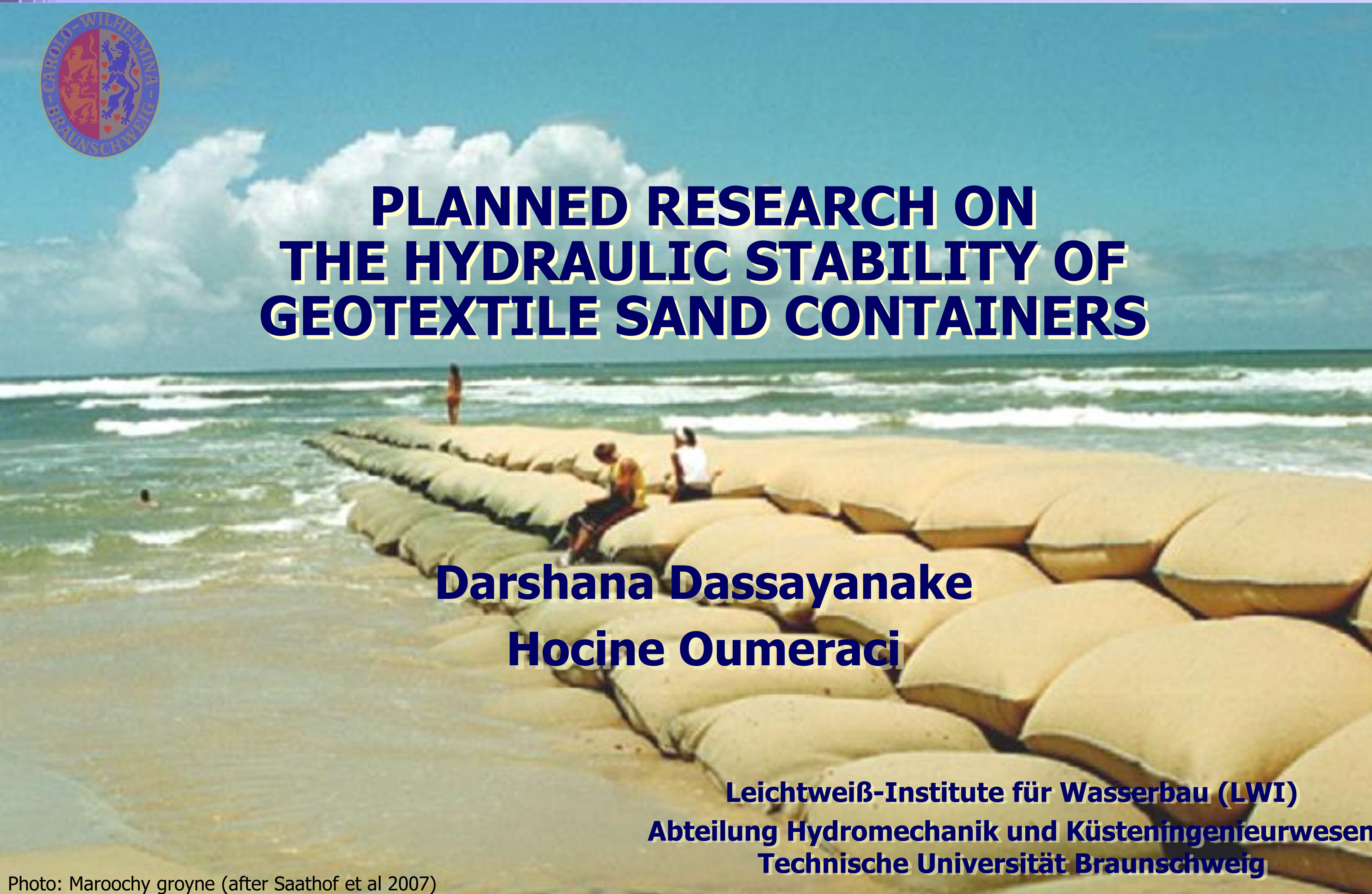

PLANNED RESEARCH ON THE HYDRAULIC STABILITY OF GEOTEXTILE SAND CONTAINERS

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Photo: Maroochy groyne (after Saathof et al 2007)

Contents

- Background
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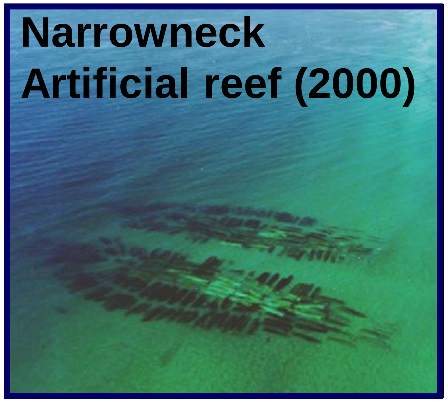
- Overview of Complete Research Programme


Narrowneck Artificial reef (2000)


Maroochy groyne no. 1 (2002)


Jumaira Beach revetment (2003)

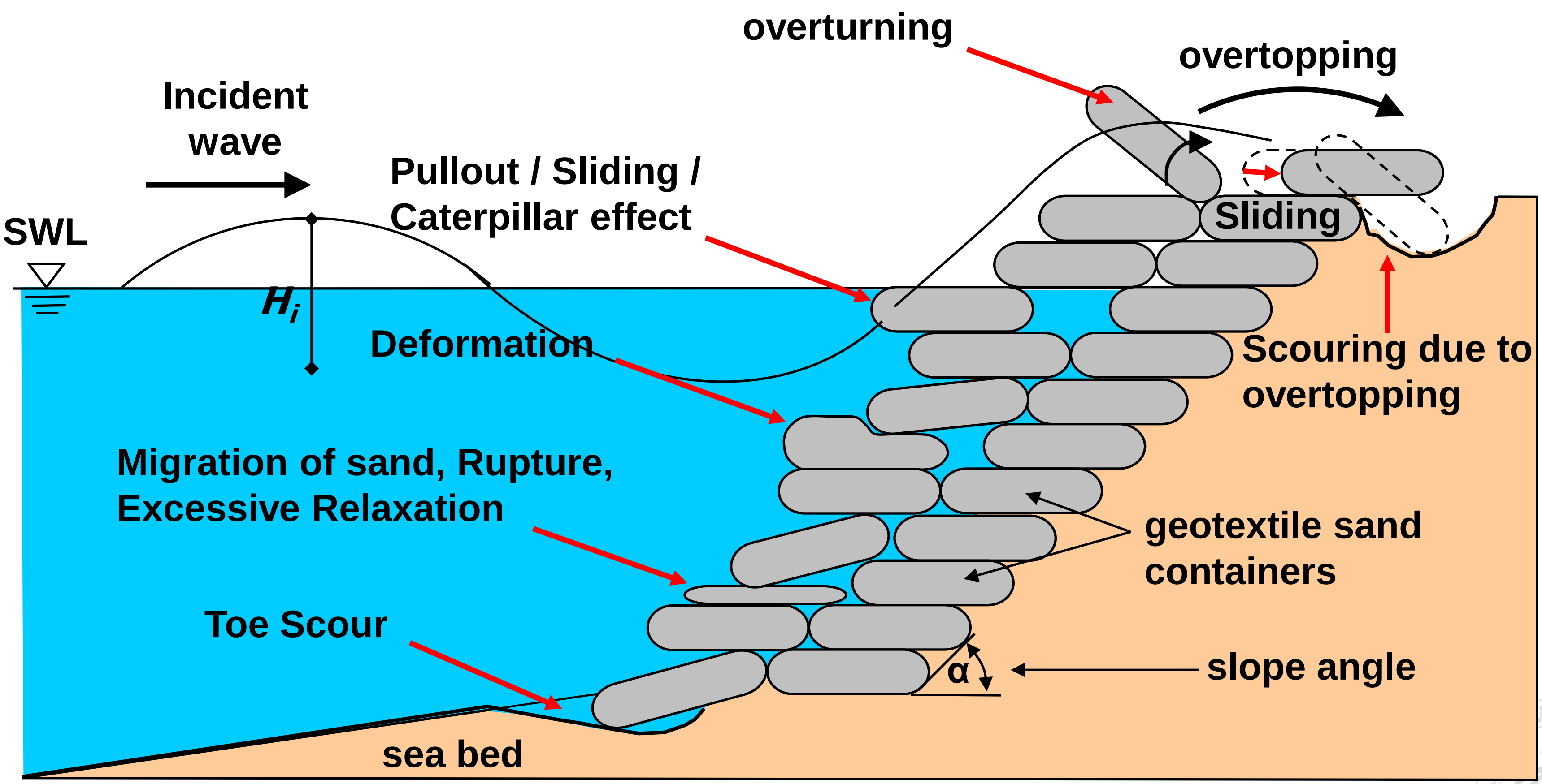
(after Saathof et al 2007)

Background I

Strength / weakness	Conventional Hard Structures	GSC-Structures
Applicability as a coastal structure to conventional coastal problems	high	high
Resistance against wave action and coastal relates natural hazards, if properly designed.	high	high
Adaptability to changing site conditions and morphological foundation changes.	low	**high**
Total construction and life cycle **cost savings** (compared with conventional structures)	N/A	**high**
Respond to cyclic hydrodynamic loads	moderate	high
Pleasant and "**natural" appearance**	low	**high**
Removability, if engineering measures did not prove successful	low	**high**
deep understanding of the hydraulic processes affecting the stability of GSC-structures	high	moderate
reliable design tools which can compromise the safety under different conditions	**high**	low
Requirement of **consideration of site specific conditions** for design and construction	moderate	high
Understanding of long term effect on structural durability in marine environment	**high**	low

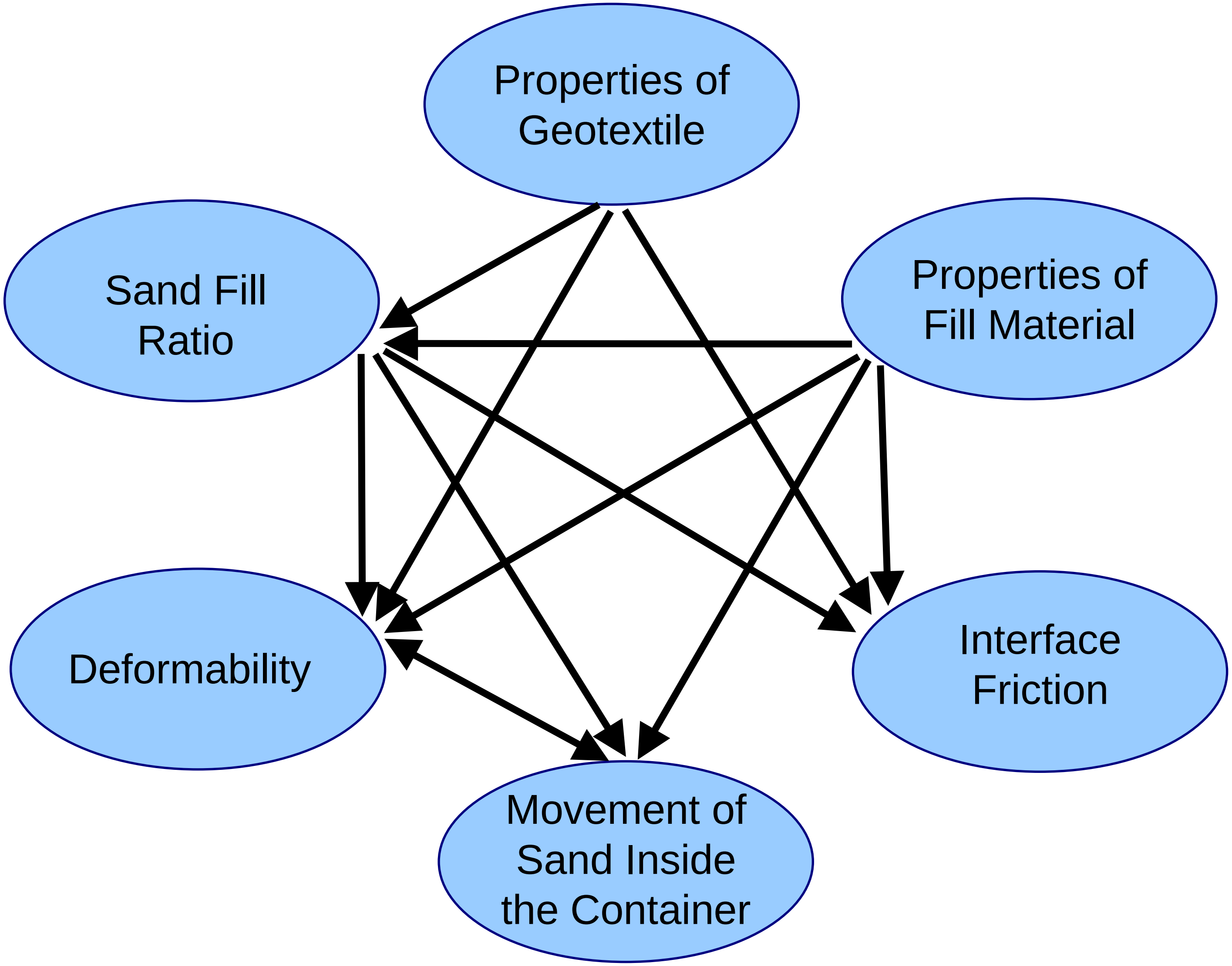
After Recio (2007)

Potential Failure Modes of GSC-Revetments



After Oumeraci et al (2002, 2003), Jackson (2006), Recio (2007), Deltares (2008), Lawson (2008), Oumeraci & Recio (2009)

Mechanical Properties of GSCs

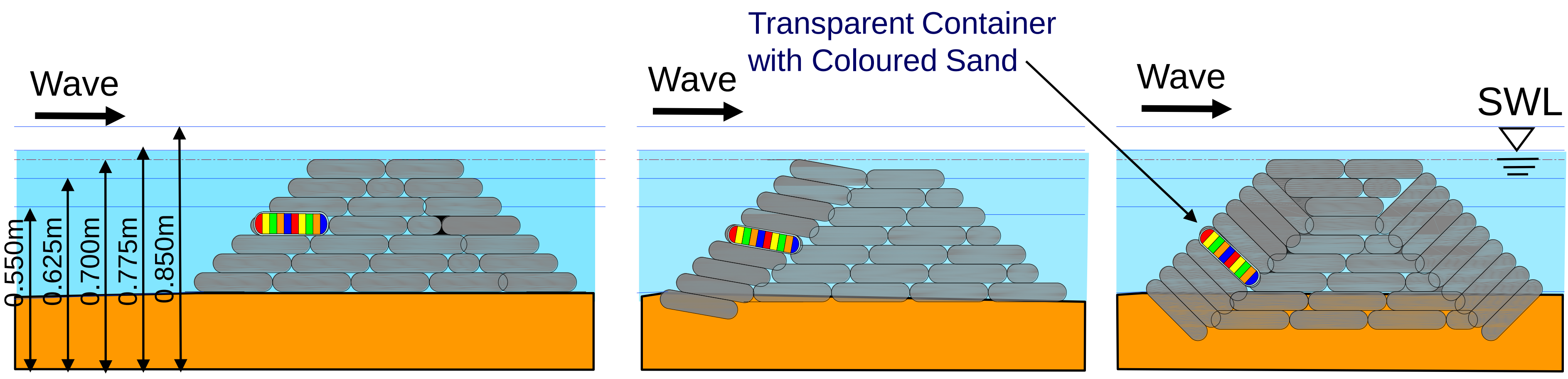


Objectives

- Sand fill ratio and it's effect on hydraulic stability
- Other fill materials for GSCs and their effect on hydraulic stability
- Friction between GSCs and it's effect on hydraulic stability
- Further development and make simpler the Recio's Formulae (2007).
- To develop an operational modelling tool based on CFD model, CSD model and Empirical Results.

Proposed Tests I

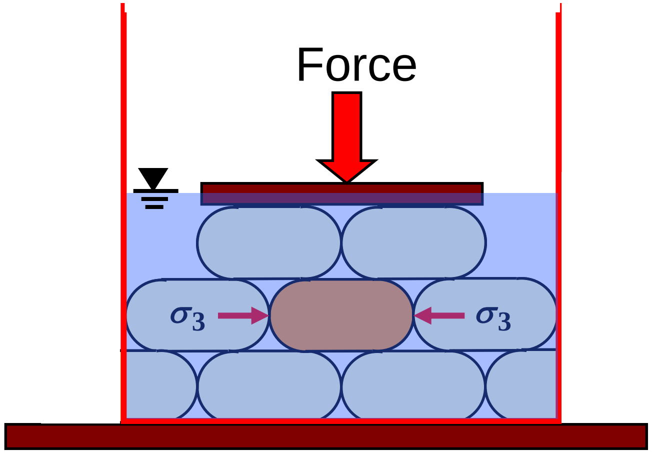
2D models to find the influence of fill ratio, type of geotextile material, type of fill material on cyclic deformation and internal movement of sand



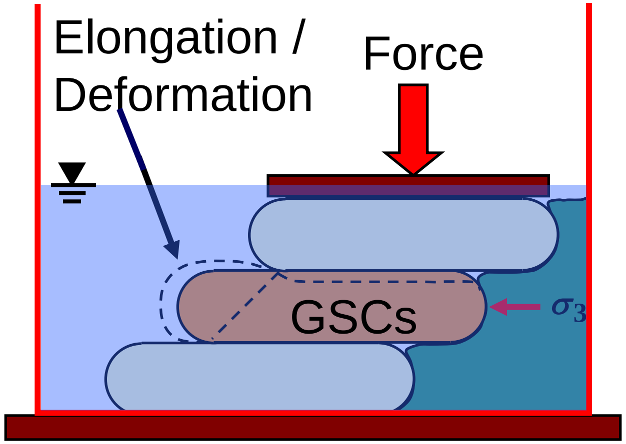
Hs [m]	Tp [s]	Water Level [m]	Fill Ratio [-]	Type of Fill [mm]	Type of Geotextile [-]	Type of structure [-]	Inclination angle of GSCs [deg]	Geometry of Container	Seaward Slope Angle [deg]
Hs1	Tp1	d1	70%	$D_{50} < 0.1$	Woven1 (W1)	Single GSC	0	5:2.5:1	1:0
Hs2	Tp2	d2	80%	$D_{50} = 0.2$	Woven2 (W2)	Submerged Breakwater	10		1:1
Hs3	Tp3	d3	85%	$D_{50} = 0.5$	Nonwoven1 (NW1)		45		1:2
Hs4	Tp4	d4	90%		Nonwoven2 (NW2)	Revetment			
	Tp5		100%						

Proposed Tests II

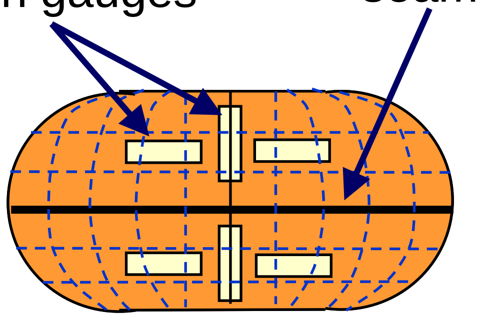
Laboratory tests to find the deformation of GSC under imposed loads



Front View

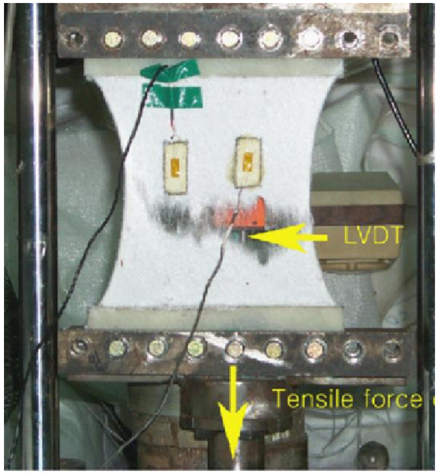


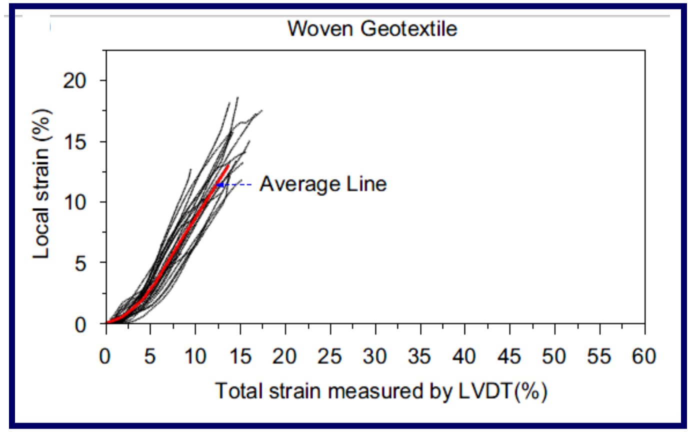
Sectional view

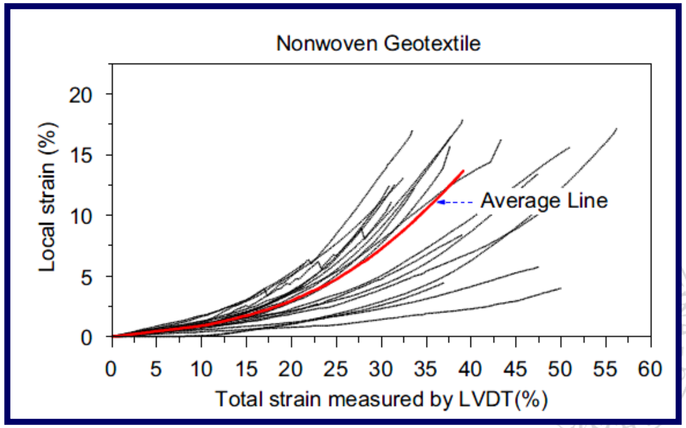


GSCs

After Won and Kim (2007)

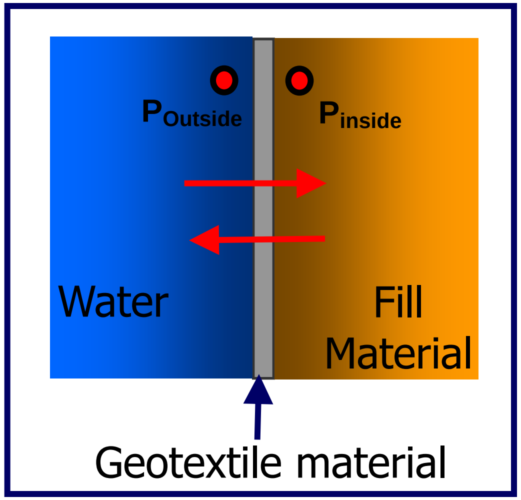


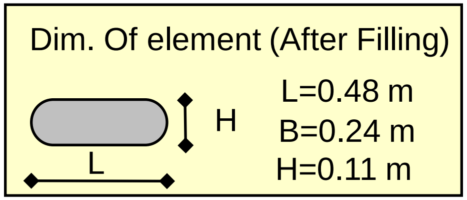


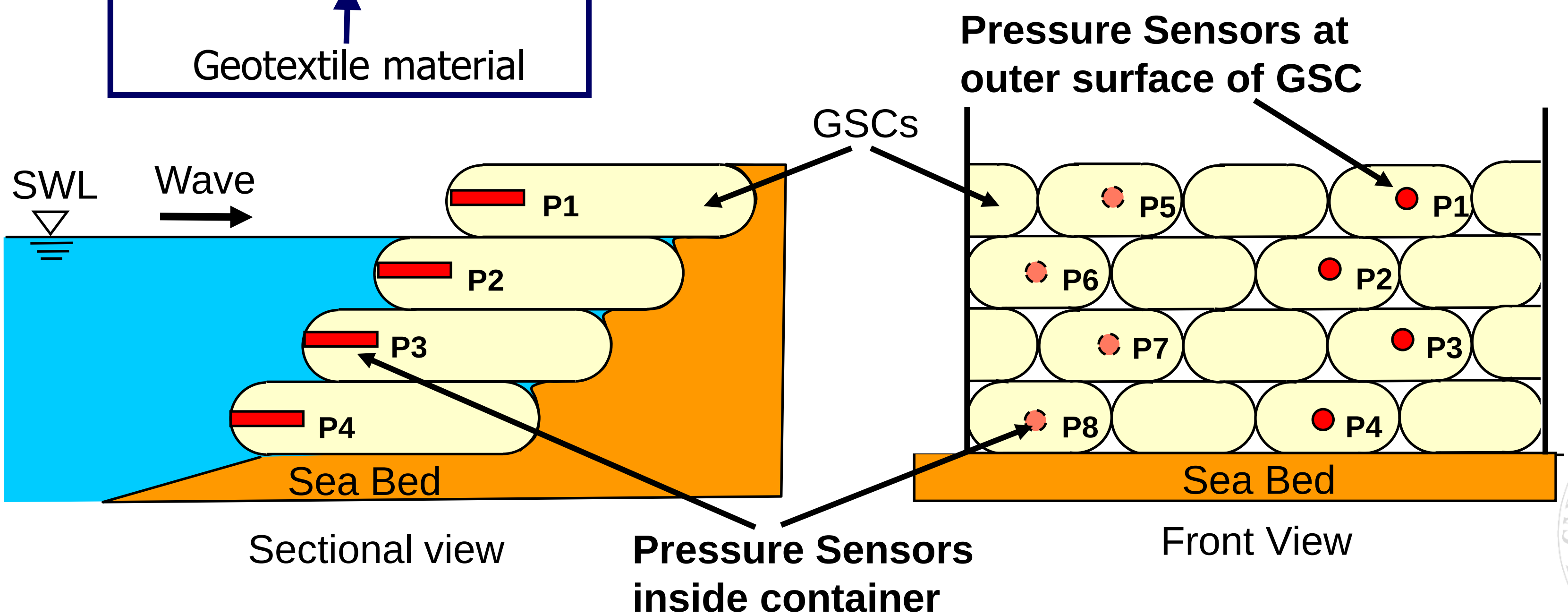


Proposed Tests III

2D model test to quantify the lost of fine materials of a GSCs over the time under wave action







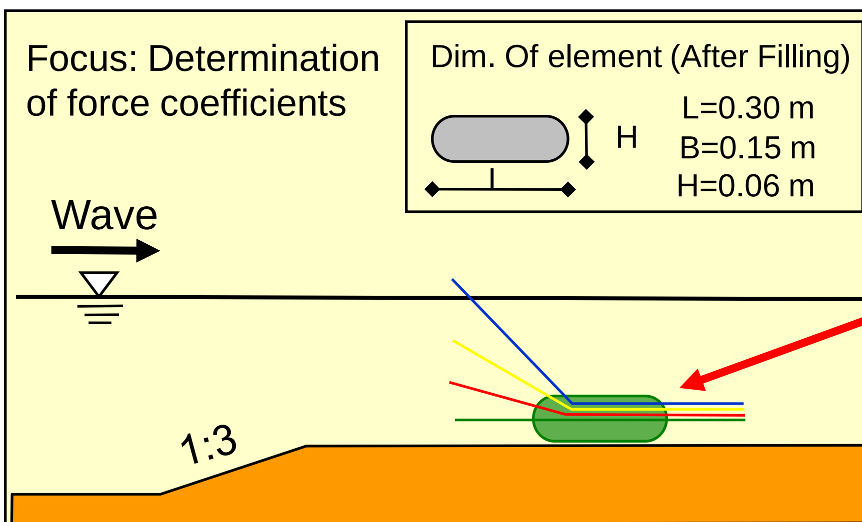
Proposed Tests IV

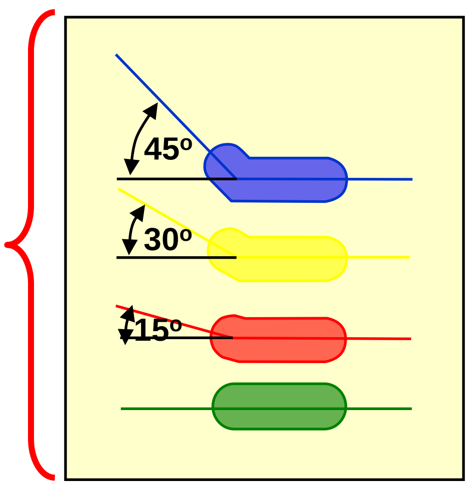
2D model test with deformed container (stiff) to find the new force coefficients (C_D, C_M & C_L)

Stability Formulae for GSCs Including the Effect of Deformation

Sliding	Overturning
Required container length $l_{c(sl)} \ge u^2 \dfrac{[0.5KS_{CD}C_D + 2.5KS_{CL}C_L\mu]}{\left[\mu KS_R\Delta g - KS_{CM}C_M \dfrac{\partial u}{\partial t}\right]}$	Required container length $l_{c(ov)} \ge u^2 \dfrac{[0.05KO_{CD}C_D + 1.25KO_{CL}C_L]}{\left[0.5\Delta KO_R g - 0.1KO_{CM}C_M \dfrac{\partial u}{\partial t}\right]}$
Required container mass $W_{GSC} \ge \rho_s \left(u^2 \dfrac{[0.5KS_{CD}C_D + 2.5KS_{CL}C_L\mu]}{\left[\mu\Delta KS_R g - KS_{CM}C_M \dfrac{\partial u}{\partial t}\right]} \right)^3 /10$	Required container mass $W_{GSC} \ge \rho_s \left(u^2 \dfrac{[0.05KO_{CD}C_D + 1.25KO_{CL}C_L]}{\left[0.5\Delta KO_R g - 0.1KO_{CM}C_M \dfrac{\partial u}{\partial t}\right]} \right)^3 /10$

By Recio (2007)





Overview of Research Programme

State of the Art Related to the Hydraulic Stability of Geotextile Sand Containers (GSC)

Performance of New Process-Oriented Laboratory Experiments

1. 2D models to find the influence of fill ratio, type of geotextile material, type of fill material on cyclic deformation and internal movement of sand
2. Laboratory tests to find the deformation of GSC under imposed loads
3. 2D model test to quantify the lost of fine materials of a GSCs over the time under wave action
4. 2D model test with deformed container (stiff) to find the new force coefficients (CD, CM & CL)
5. PIV tests to find the flow around geotextile submerged breakwaters

Numerical Modelling of GSC-Structures

Numerical simulations of GSC-structures using partially coupled hydrodynamic model (RANS-VOF model) and structural dynamic model (Coupled DEM-FEM model)

Modification of Formulae of Recio (2007)

Development of simplified hydraulic stability formulae and computational composite model as design tool

Performance of Model Tests for verify the modeling system for GSCs

Conclusions

Vielen Dank für Ihre Aufmerksamkeit

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Clifton Springs Breakwater (2004)

Maroochy Beach (2004)

(Photos: www.elcorock.com)