



Technische
Universität
Braunschweig



CIRCOPAV - CIRCular and COnnected PAVements for carbon-neutral digital roads

SpongePave - Sustainable green infrastructure for climate neutral cities

Marcela Maria Toscano Krau, M.Sc.

1. CIRCOPAV

2. CIRCOPAV at ISBS – IRP3 I_AM_PAVE

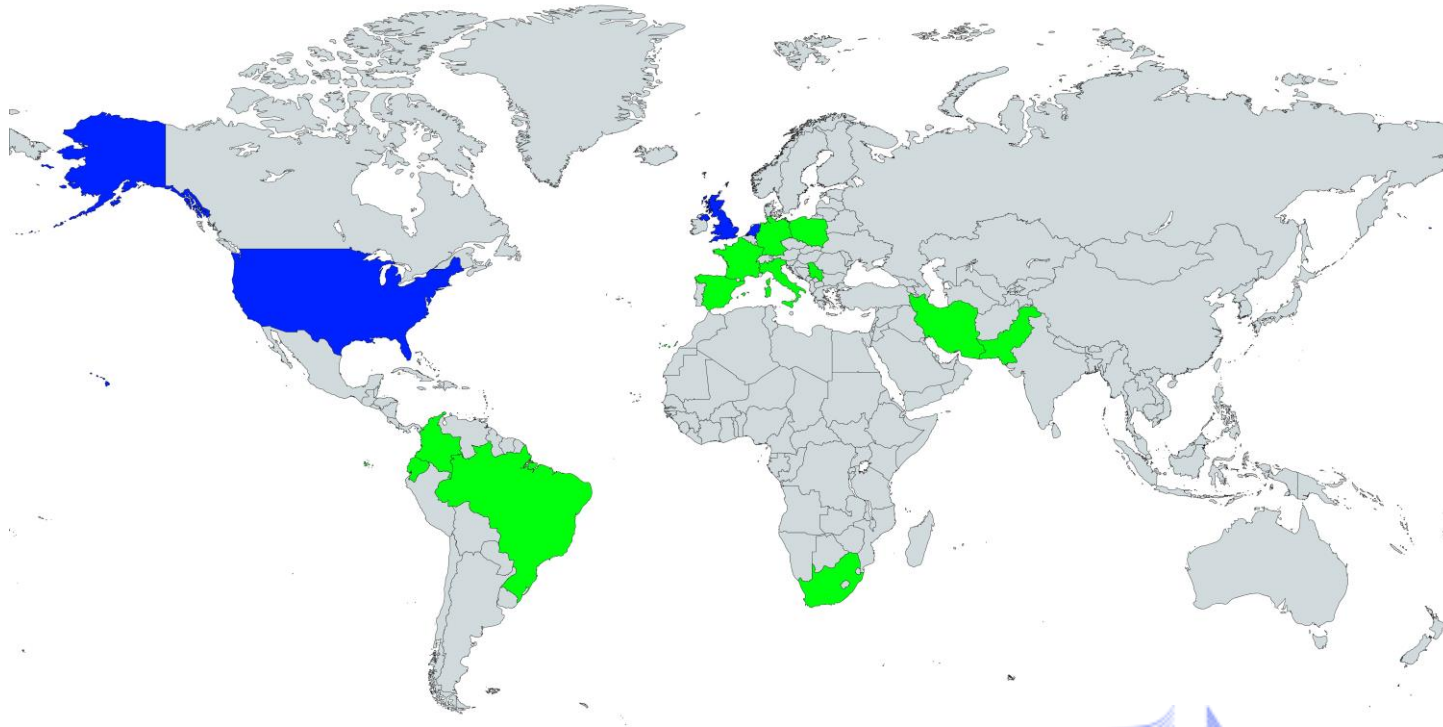
- PhD: Lucas Sassaki
- Goals of the Project

3. CIRCOPAV at ISBS – IRP9 SpongePave

- PhD: Marcela Krau
- Goals of the Project
- Brief methodology plan

CIRcular and COnnected PAVements for carbon-neutral digital roads

15 countries



Beneficiaries:



This project has received funding from the European Union's Horizon Europe research and innovation program under the Marie Skłodowska-Curie Grant Agreement No 101072820.



Supervisors:



Dr. Mª Carmen
Rubio-Gámez



Dr. F. Moreno-
Navarro



Prof M. Wistuba



Dr F. Geisler



Prof K. Jenkins



Prof G. Tebaldi



Prof F. Freddi



Prof S. Mangiafico



Prof. C Sauzéat



Prof H. Di Benedetto

WP1

Smart and Connected Assets

Non-destructive Management
Self-Sustaining Bridge
Navigators
Auscultation
Dynamic Systems
Digitalisation
Sensors

<https://circopav.com/>

WP2

Climate Neutral and Resilient Pavements

Circular Economy
Green Infrastructure
Quality
Fatigue
Cold in place recycling
Climate Change
Bio-Binder
Management
Sustainable
Sponge City

Industry, innovation and
infrastructure



Sustainable cities and
communities



Responsible consumption
and production



Climate action



Smart and Connected Assets

WP1



Karolina Wolukanis
IRP1_University of Granada



Ana Karolina Bezerra
IRP2_ENTPE



Lucas Silva
IRP3_TU Braunschweig



Sher Muhammad Nizamani
IRP4_University of Parma



Hamed Hasani
IRP5_University of Parma

Climate Neutral and Resilient Pavements

WP2



Walter A. Mera Intriago
IRP6_University of Granada



Nemanja Nešković
IRP7_Stellenbosch University



Andressa C. Borges Chaves
IRP8_EIFAGGE



Marcela Krau
IRP9_TU Braunschweig



Sergio H. Manjarrés Paredes
IRP10_ENTPE

Education & skills:



Lucas Sassaki Vieira da Silva

27 Years Old



- **Today – PhD at Technische Universität Braunschweig (TUBS)**
“I_AM_PAVE: Interactive Analysis System for the Management of Pavements”
- **2023 – Master’s in Transportation Engineering – Federal University of Ceará (UFC)**
“Influence of moisture damage on fatigue cracking of asphalt binders, aggregate-binder interface, and mixtures”
- Scholarship from the National Petroleum Agency (ANP)
- **2021 – Bachelor in Civil Engineering – (UFC)**
“Influence of coring specimens on mechanical properties of asphalt mixtures”



Interactive Analysis System for the Management of Pavements

Main Supervisor: Prof. Michael P. Wistuba

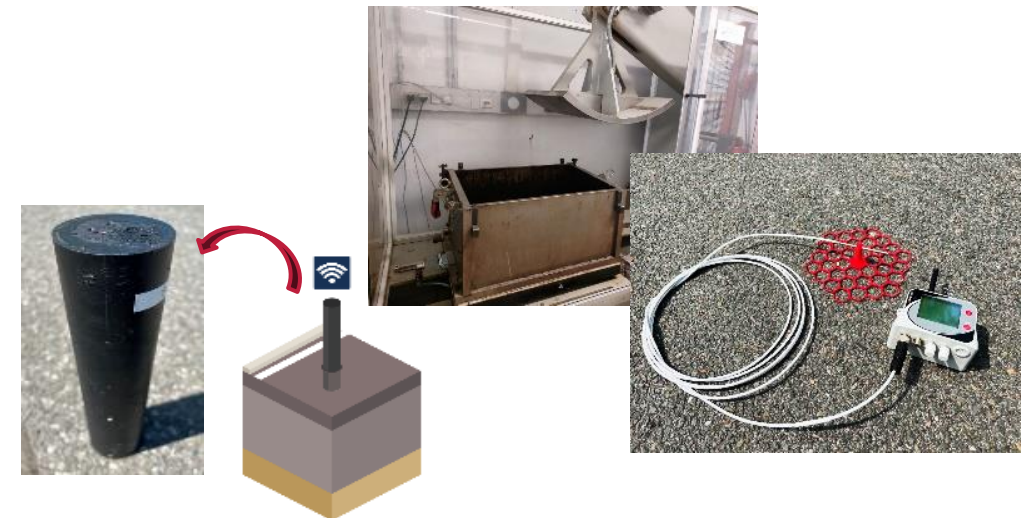
Co-Supervisors: Gabriele Tebaldi, Ersun Görener

Location: Institut für Straßenwesen (ISBS) – TU Braunschweig

The aim is to screen and to use different types of sensors to measure response in asphalt layers, e. g. **temperature, acceleration, stress and strain**. The obtained data are evaluated for their applicability in **road management and asphalt technology**, e. g. for analyzing traffic (speed, direction, axle loads), for **long-term observation** of material and structural pavement characteristics (strength, modulus, bonding), or for **monitoring the construction process** (WMA compaction).

Some testing and expectations

- Segmented compaction with different WMA.
- Temperature profile and acceleration.
- Test-track: lab vs. in-situ.





Education & skills:

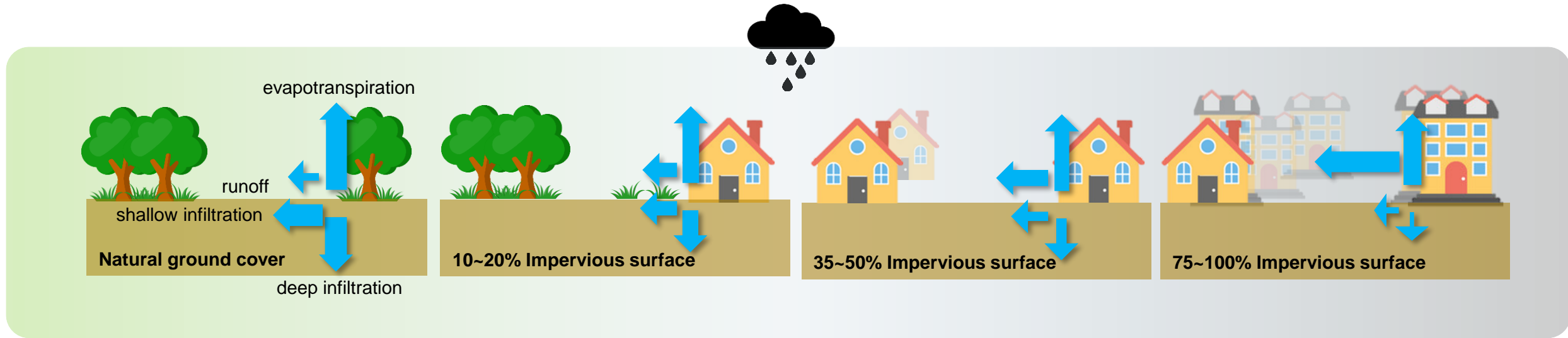


Marcela Maria Toscano Krau

27 Years Old



- **Today – PhD at Technische Universität Braunschweig (TUBS)**
“SpongePave - Sustainable green infrastructure for climate neutral cities”
- **2023 Master’s in Geotechnics at the Federal University of Rio de Janeiro (UFRJ)**
“Life Cycle Assessment Cradle-to-laid of asphalt pavements incorporated with RAP and PET”
Researching scholarship - PETROBRAS.
 - Experience with carbon emission estimation - SimaPro.
- **2020 Bachelor in Civil Engineering in Federal University of Campina Grande (UFCG)**
“Study of the rheological properties of the modified asphalt binder with addition of residual vegetable oil”
 - Conducted studies:
 - Mechanical & rheological evaluations.



China, 2023
Beijing
35,000 people were evacuated



Brazil, 2023
Rio Grande do Sul
39 deaths
6.000 homeless



Germany, 2023
Lower Saxony



Greece, 2023
Thessaly region
800 people have been rescued



Spain, 2023
Buenache de Alarcón
288 incidents related to floods and
strong winds in Catalonia

Sustainable green infrastructure for climate neutral cities

Main Supervisor: Prof. Michael P. Wistuba

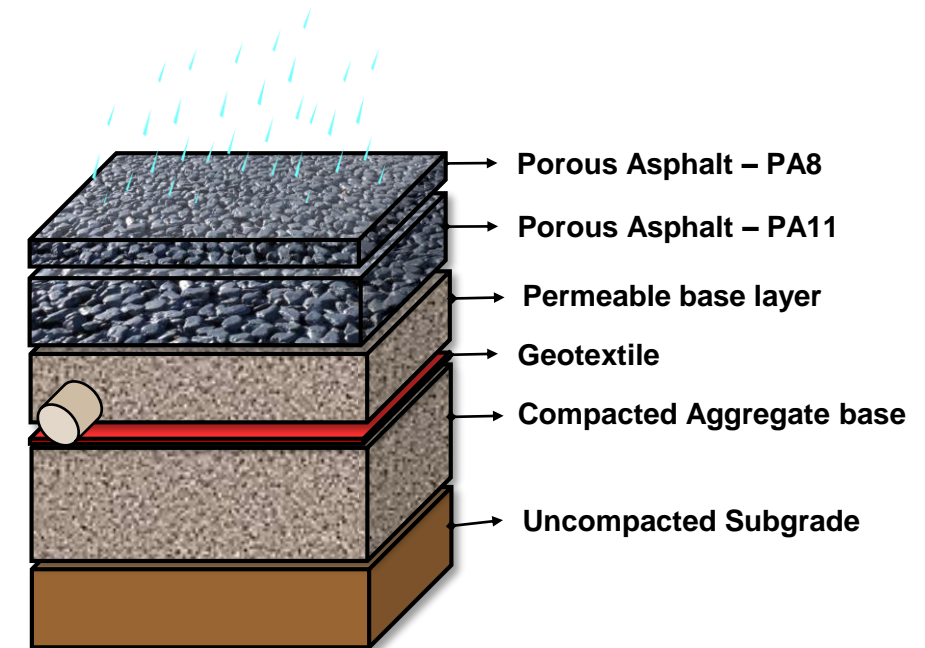
Co Supervisor: Dr.-Ing. Hannes Müller-Thomy

Location: Institut für Straßenwesen - TU Braunschweig

Partners: TUBS LWI-Hydrology and River Basin Management, BPI Hannover

Goals

- Enhance the understanding of the hydrological behavior and **performance of porous asphalt mixtures**
- Contribute to the advancement of sustainable pavement solutions porous improving the **poor stress property** that contradicts the water permeability condition
- **Increase the water infiltration** amount to reduce the impact on the local water balance



IRP9 SpongePave

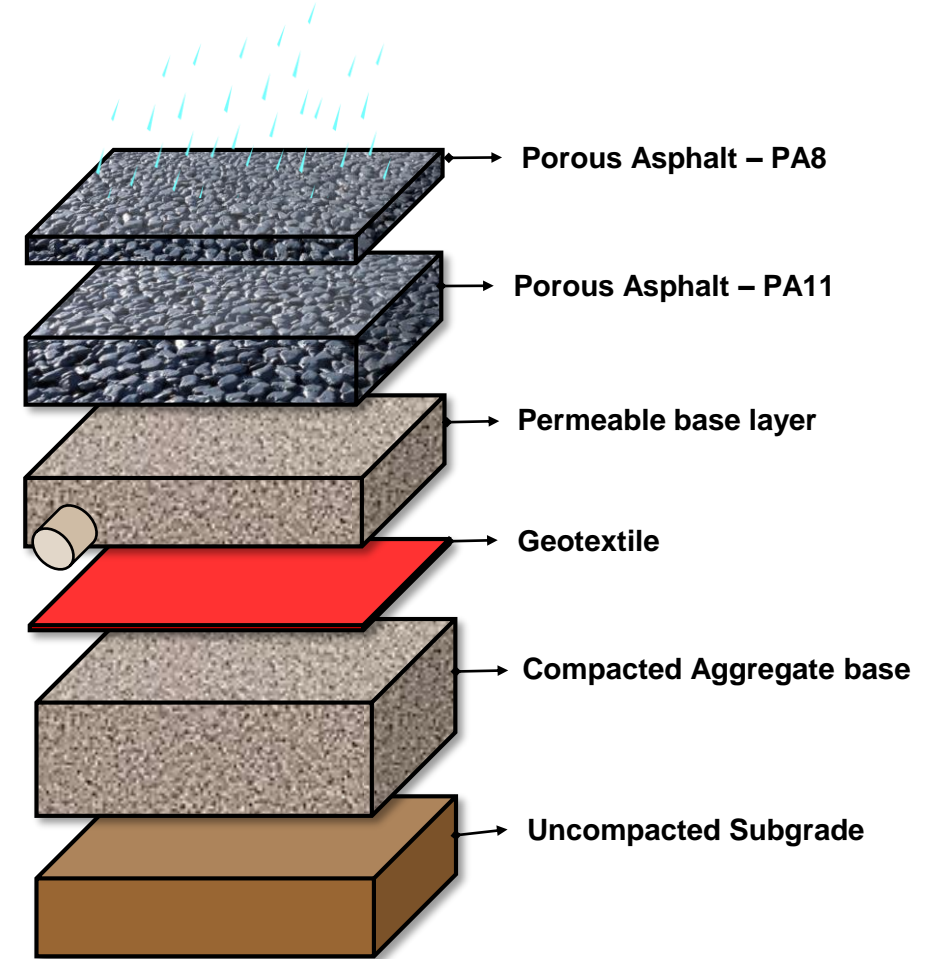
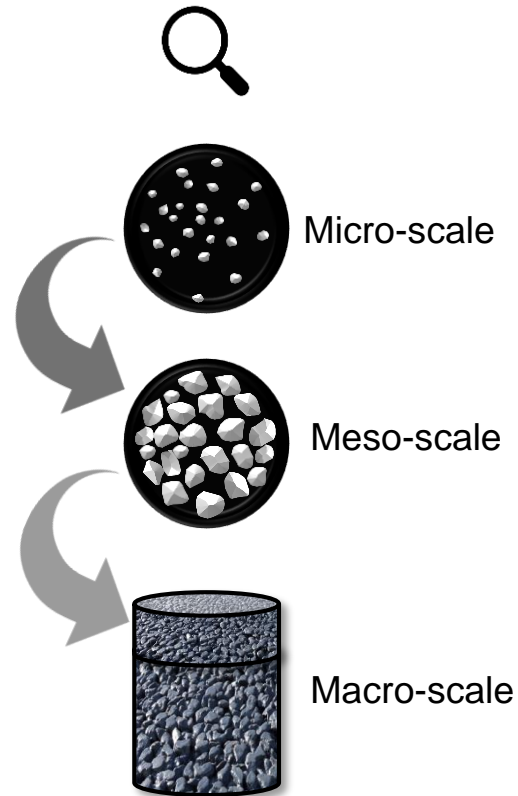
Main gaps that will be addressed

Durability

- Adhesion
- Ageing → Weathering conditions
- Moisture damage

Infiltration capacity

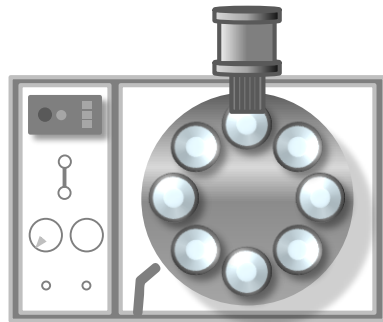
- Voids percentual
- Infiltration rates
- Precipitation/rainfall simulator
- Durability/Clogging



Methodology - Micro approach

Thermal ageing

RTFOT

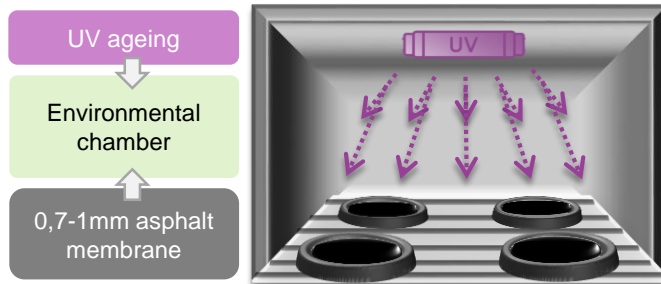


PAV



Weather ageing

UV Radiation

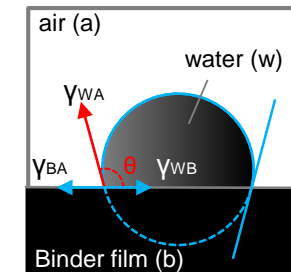


Water



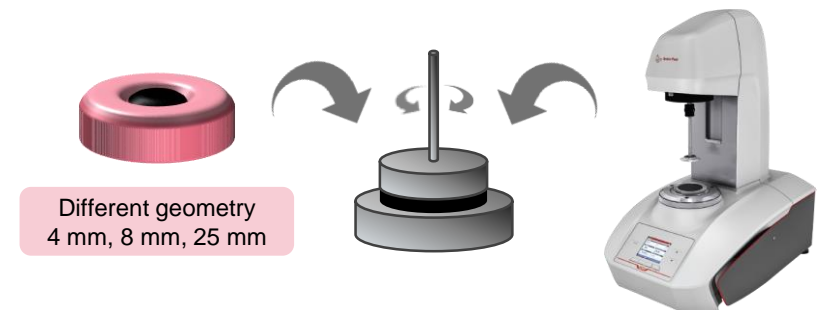
Adhesion

Contact Angle θ



Analysis

DSR



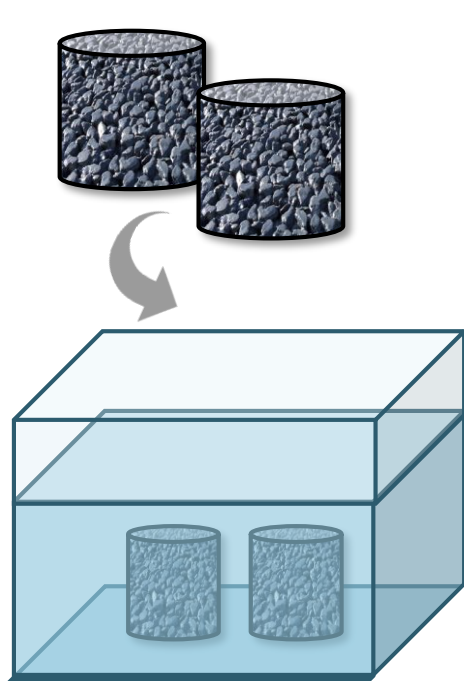
IRP9 SpongePave

Methodology - Macro approach

Adhesion/ Stripping

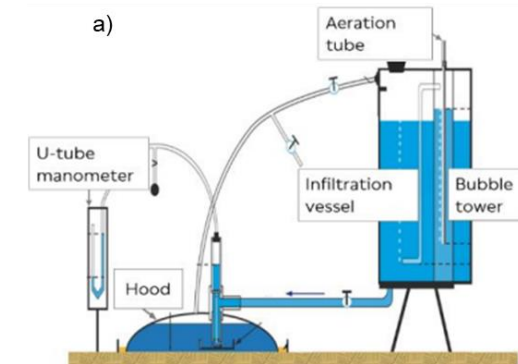
Water immersion

Rolling bottle

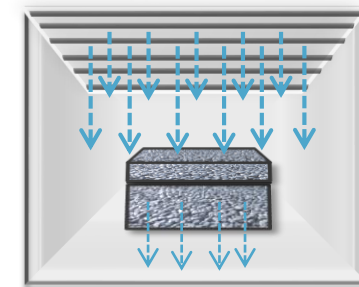


Hydrology

Infiltration



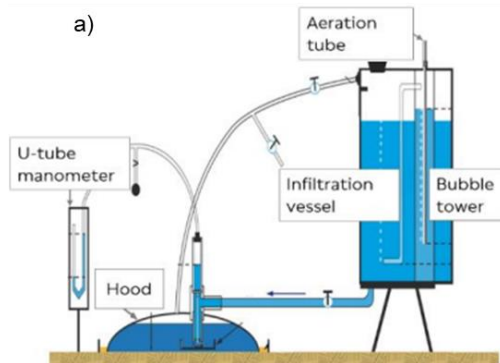
Rainfall simulation



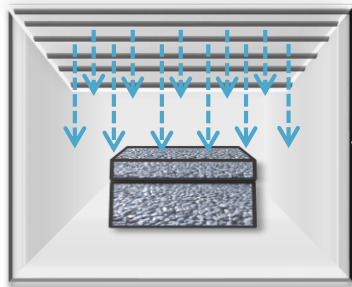
Methodology - Macro approach -> Hydrology assessment

Hydrology

Infiltration



Rainfall simulation



Interdisciplinary collaboration:

- TUBS LWI-Hydrology and River Basin Management,
- BPI Hannover



Physical rainfall simulator at LWI

Thank you

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CIRCOPLAN

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