Co-UDlabs

Building Collaborative Urban Drainage research Labs communities

Webinar on Key findings from Co-UDlabs research and where to access them

11 March 2025

Session II – Evaluation of Assets and Deterioration in urban dranage systems

Damage scenarios

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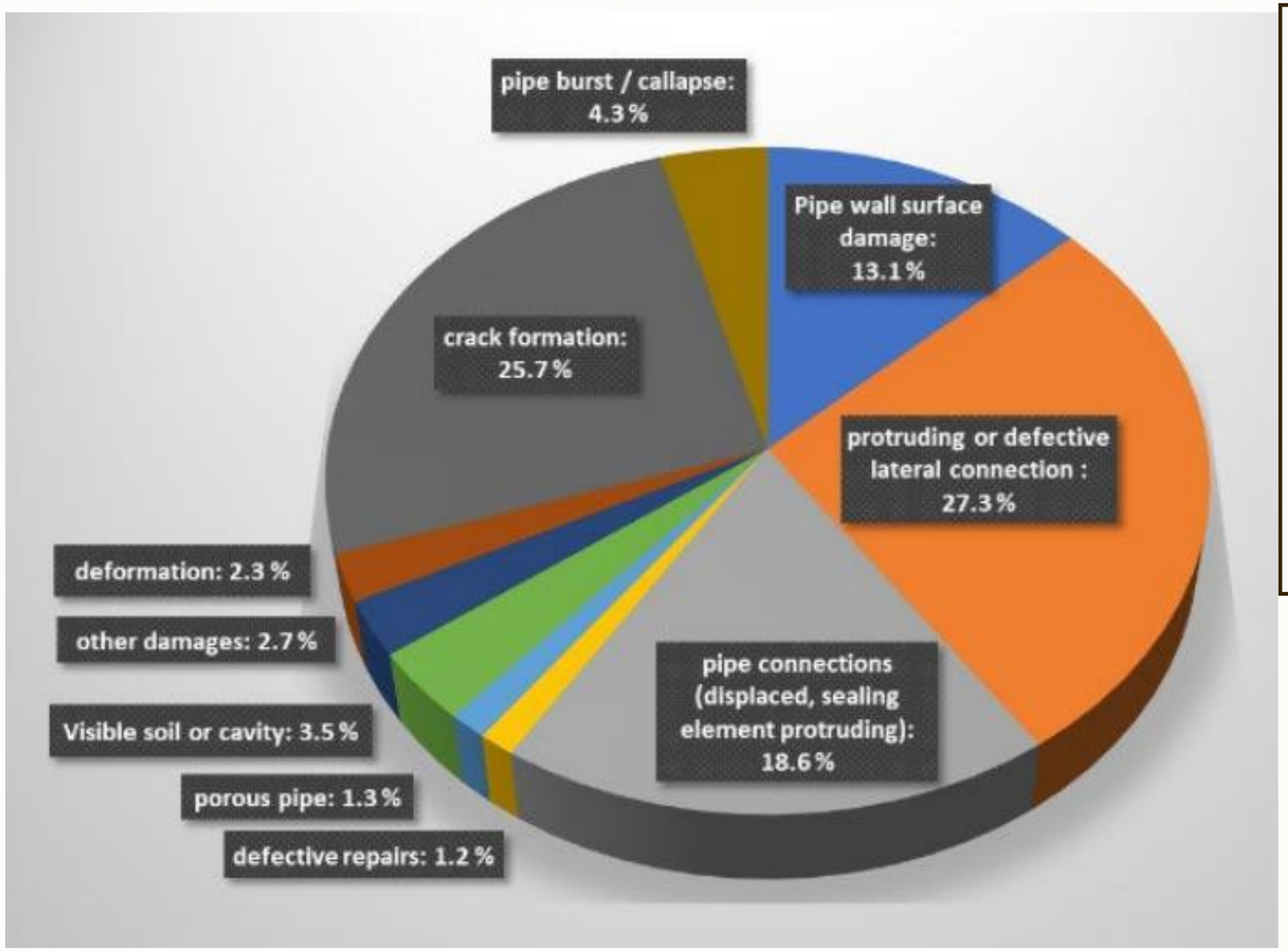
Typical defects in sewers



DWA survey 2020, Germany

Scientific questions to be investigated at lab, e.g.:

- ex- und infiltration behavior
- failure mechanismen (stability, tightness)
- Lifespan/Service life
- Influence on operation
- performance of renovation procedures and materials

Overall question:
how to create typical defects at lab?

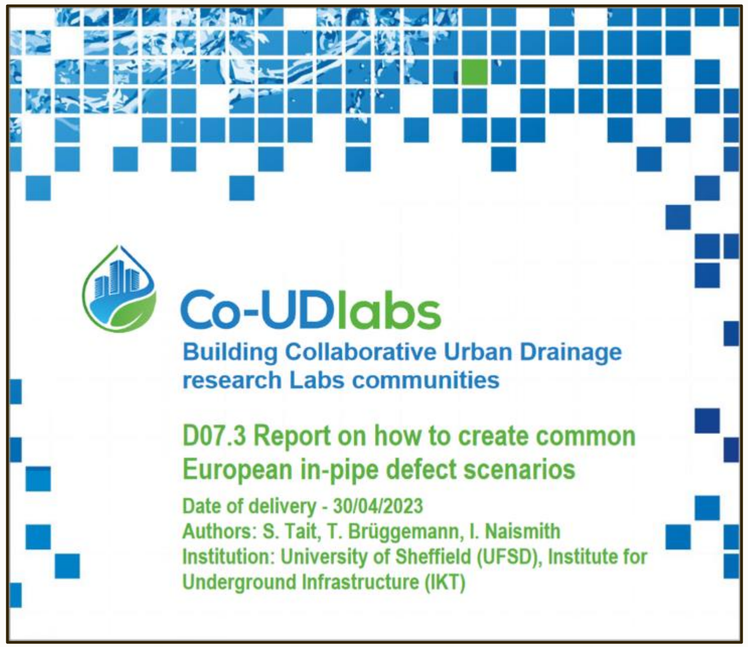
How to create typical defects at lab?

What to have in mind?

- the scientific question shoud be clearly defined to select a appropriate defect,
- using a defect at lab with its relevance in terms of its frequency, location and accurance in reality
- defect at lab should be based on characteristics of the corresponding defect in reality
- to ensure the reproducibility of the defect at lab
  (e.g. using a template, the same tools and the same staff)
- detailed, traceable and transparent documentation of each step in the production of defects at lab
  (decision making, planning and installation) => it is needed for justification and argumentation
- recommendation that network operators/Municipalities/Water companies are involved in the decision-making to ensure practical (e.g. project steering committee)

How could “lab defects” look like?

Co-UDlabs report „Defect catalog“



1.2 Fissure (Code: BAB)

(Source: MKULNV, 2014)
Cracks or fracture is visible.

fissure / crack

Creation for laboratory tests (examples)

requirement profile: **rehabilitation of house connection pipes using (CIPP-) short liners**
stoneware pipe, expansion: 45 x 10 cm, crack width: 4 mm

(IKT, 2018)

requirement profile: **inspections systems for property drainage**
stoneware pipe DN 100, transverse crack, length approx. 20 cm

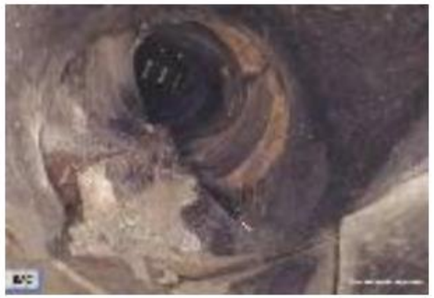
(Bosseler/Kaltenhäuser, 2005)

requirement profile: **inspections systems for property drainage**
stoneware pipe DN 100, longitudinal crack, length approx. 30 cm

(Bosseler/Kaltenhäuser, 2005)

How to create typical defects at lab?

1.3 Break / Collapse (Code: BAC)



(Source: MKULNV, 2014)

The pipe is broken or has collapsed.

Breack / collapse

Creation for laboratory tests (examples)

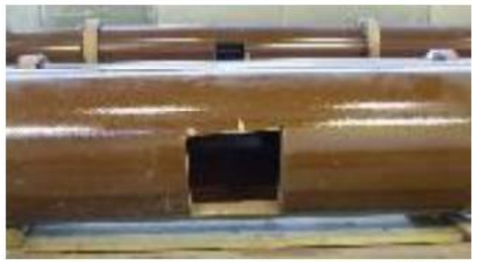
requirement profile: R**ehabilitation of house connection pipes using (CIPP-) short liners**

Stoneware pipe, expansion in longitudinal direction: 25 cm, piece of spigot end is inserted

(IKT, 2018)

requirement profile: **Rehabilitation of house connection pipes using (CIPP)-short liners**

stoneware pipe DN 150, missing shard (approx. ½ x 10 x 5 cm)



requirement profile: **Repairing methods for sewers (DN 200 – DN 600)**

stoneware pipe DN 200, breakout in the middle of the pipe below the springline (approx. 20 x 20 cm

ing

How to create typical defects at lab?

1.10 Displaced joint (Code: BAJ)

displaced joint

(Source: MKULNV, 2014)
description according to EN 13508-2: Adjacent pipes are displaced from their intended position in relation to each other.

Requirement profile: **rehabilitation of house connection pipes using (CIPP-)short liners**
Expansion: ≥ 20 mm,
rehabilitation under groundwater inflow
at approx. 50% of the pipe height

Requirement profile:
rehabilitation of rising mains
axially displaced socket joint, with 31 mm longitudinal offset (circumferential)
(Bosseler/Ulutas, 2022)

Requirement profile:
inspections systems for property drainage
stoneware pipe DN 150,
Vertical offset (sealing ring removed)

How to create typical defects at lab?

1.18 Infiltration (Code: BBF)

infiltration

(Source: MKULNV, 2014)
description according to EN 13508-2: The ingress of water through the wall of the pipe or through joints or defects.

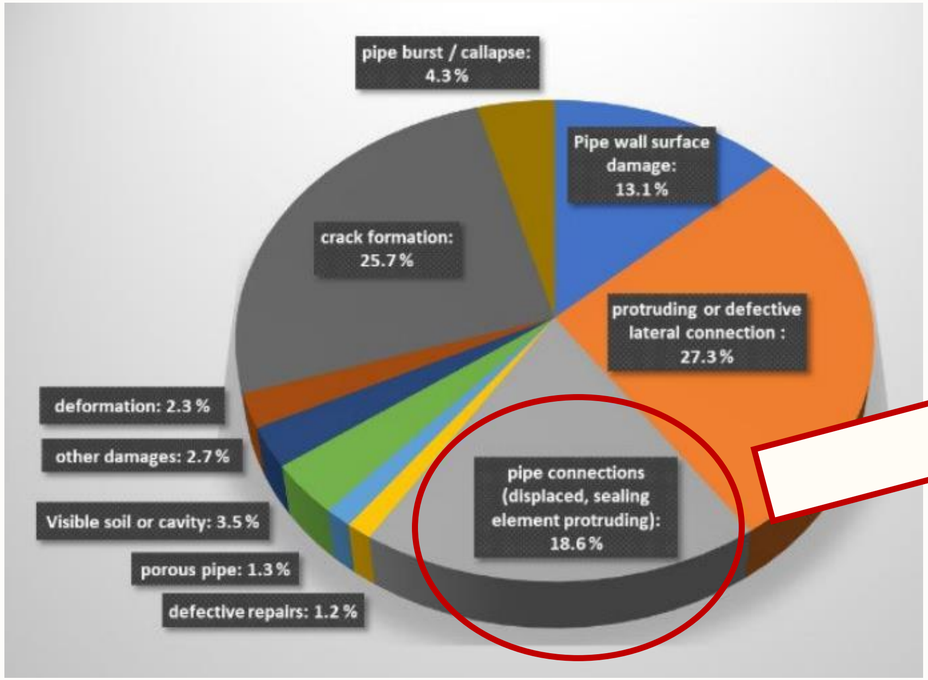
Creation for lab tests (examples)

Requirement profile: testing **CIPP liners for house connection** (Bosseler/Redmann, 2010)

displaced joint

Input / idea: creating defect **„damaged sealing“** at pipe joint and **„displaced joint“**

Background:
pipe joint displacement identified by CCTV, but no statement about exfiltration risk for this defect possible



Scientific question investigated within Co-UDlabs:
Pipe joint displacement and their impact on exfiltration throught the joints
=> complementary tests at UoS and IKT

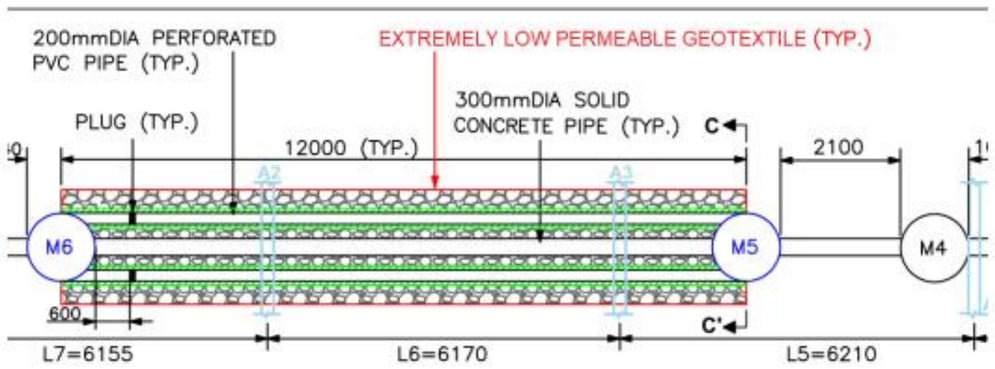
Lab exfiltration test setup at IKT

1) Pipe joint displacement at IKT without surrounding soil

Measuring water exfiltration rate under change of conditions:

- pipe material: concrete, clay and PVC
- variing angles at pipe joint
- with and without damaged sealing

2) Pipe joint displacement at UoS wit surrounding soil

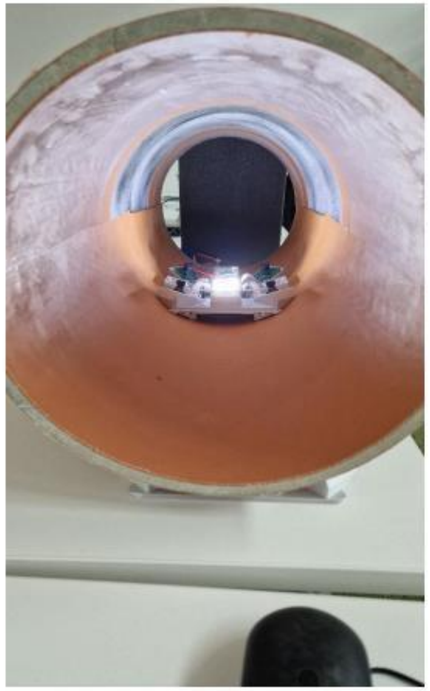


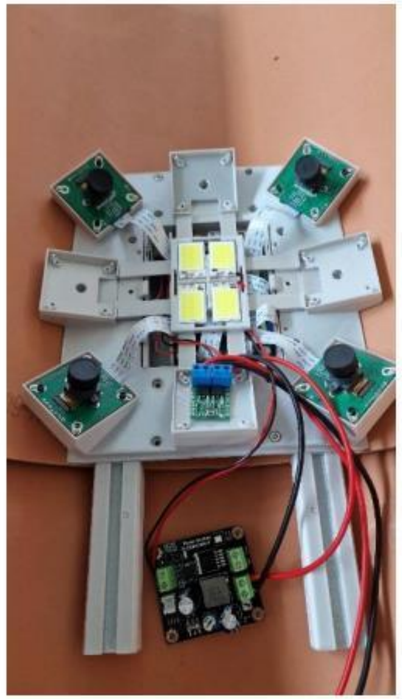
Measuring water exfiltration rate under conditions:

- pipe material: concrete
- Surrounding soil
- Load to create pipe joint displacement

3) Devolopment and demonstration of In-pipe joint displacement measurements (DIC-system of UoS)

Digital Image Correlation (DIC) –
based on the analysis of changes between images taken before and after deformation of a target surface of its spatial and optic characteristics





Development and optimization at UoS

Demonstration at lab exfiltration test setup at IKT

Conclusion

1) high level of water tightness for a wide range of pipe articulation for clay, concrete and PVC

2) damaged seailing:

- **clay/concrete:** stiff pipe section continue to deform the joint seals as articulated to higher angels
  => higher exfiltration rate than PVC
- **PVC:** for an articulation angle more than 2°
  => pipe itself deformed the joint geometry remained similar => exfiltration rate reduced to negligible values

Table 2. Internal and external articulation angles vitrified clay and plastic pipes in the IKT tests

Vitrified Clay		Plastic	
IKT Measured Angle	DIC Measured Angle	IKT Measured Angle	DIC Measured Angle
0°	0.44°	0°	0.3°
1°	0.67°	1°	0.2°
2°	1.93°°	2°	1.7°
3°	2.8	3°	1.2°
4°	3.71°	4°	1.6°
5°	4.90°	5°	1.9°
6°	6.0°	6°	3.6°
7°	6.90°	7°	2.5°

Conclusion

3) Functioning and effectiveness of the low-cost DIC measurement system could be demonstrated

4) “Bedding” material surrounding did not significantly impact the exfiltration from pipe joints (tests at UoS/ICAIR)

=> in-air exfiltration test (IKT) could be used to estimate exfiltration rates from articulated pipes (with and without damaged seal at joints)

Reports:

how to create defects: https://co-udlabs.eu/wp-content/uploads/2023/05/Co-UDlabs_D7.3.v1.0.pdf

exfiltration of pipe joint displacement: https://zenodo.org/records/14187492