Damage of sewer pipes: the interaction with soil

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Problem statement

Danger of sewer collapse
Premature replacement

Goal

Provide an accurate tool to assess the condition of a sewer pipe to help municipalities make a decision on maintenance or replacement

Research question

What is the expected lifetime of an in-situ deteriorated sewer pipe?
Sewer system

Pipe in soil trench

Dutch soils: sand, clay, peat, loam

Strength of system: pipe + soil

Damage of sewer pipes: the effect of soil
Soil Erosion

*Loss of support*

*Washing away of particles*

*Soil ingress in pipe*

*Hard to detect*
Damage of pipe

Chemo-mechanical deterioration
Emergence of micro-cracks

Collapse due to

Nearby excavations
Change in external loading
Severe deterioration of concrete
Loss of support
Research question

*What is the expected lifetime of an in-situ deteriorated sewer pipe?*

What we need to investigate

*Process of deterioration*

*Relation damage – residual strength of pipe*

*Relation soil – strength of system*
Soil modelling

**Friction sliding**

**Volumetric compaction**
Numerical approach (FEM)

Yield surface

Boundary between reversible and irreversible deformations

Reversible: elastic deformation of particles

Irreversible: frictional sliding, particle crushing (volumetric compaction)
Results soil model

Comparison experimental results

Characteristic of erosion

Washing away of particles

Numerical approach

‘Fading’ of particles
Characteristics of fracture of sewer pipe

First cracks at bottom and top

Later damage at sides
Numerical approach

Cohesive zone modelling

Damage of sewer pipes: the effect of soil
Preliminary results

Comparison experimental results

Future work

Relate amount of damage to residual strength of pipe

Large scale load test on pipes

Small test on pipe samples to assess material properties

New and old pipes

Round and egg-shaped

Several diameters

Different ages
Questions?