Comparison of core sampling and visual inspection for assessment of sewer pipe condition

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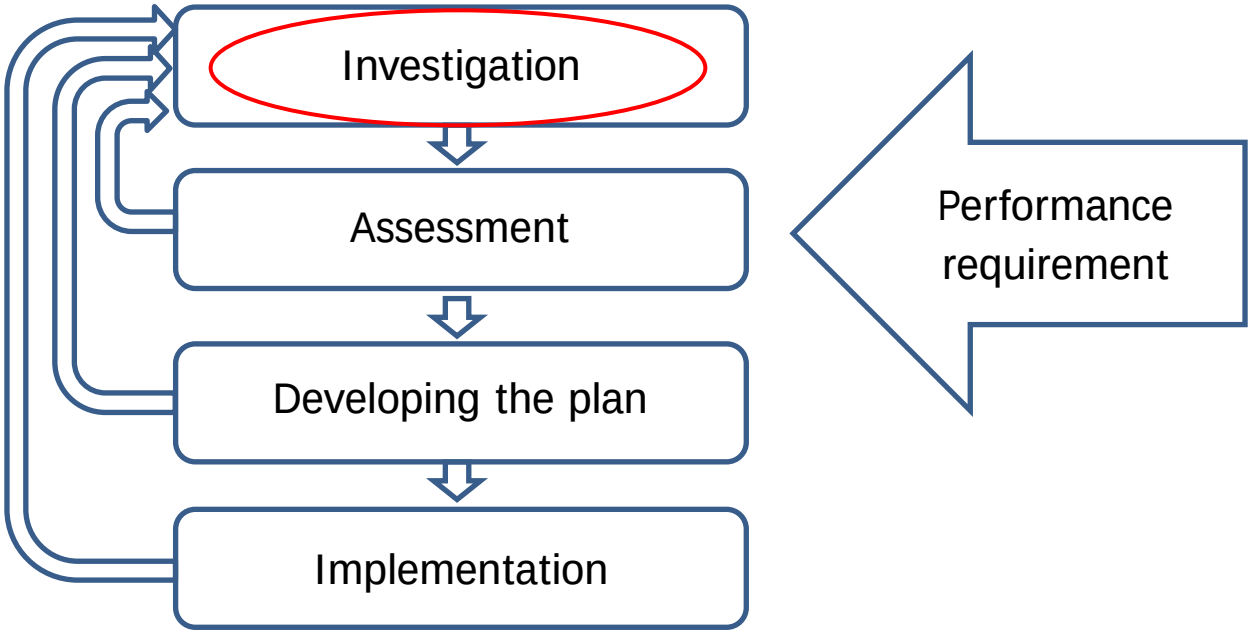
Integrated sewer system management

Schematics



EN 752. (2008). Drain and sewer systems outside buildings. European Committee for Standardization.

Sewer inspection

Quality Information

Closed Circuit Television (CCTV):

- examines empty pipes above the water surface;
- advantage: relatively cheap;
- disadvantage: subjective interpretation of defect type and severity ;

Ground Penetrating Radar (GPR)

Infra-red thermography

Core drilling

Study location and methodology

City of the Hague

- Sewer of one street located in domestic housing area.

- The sewer system in the area is a combined sewer, egg-shaped with dimensions of 300/450 mm and made of concrete.

- I Part of the sewer (about 274 m) was constructed in 1931.
- II part (about 42 m) was constructed in 1960.

1. CCTV inspection to determine conditions of the inner surface of the sewer.
2. Core sampling to determine the strength properties of pipes.

Sewer inspection

Visual inspection - CCTV

1. Cleaning

Sewer inspection

Visual inspection - CCTV

2. Installation of camera

Sewer inspection

Visual inspection - CCTV

3. Assessment

Sewer inspection

Drill core sampling

1. Drilling

Sewer inspection

Drill core sampling

2. Sample taking

Sewer inspection

Drill core sampling

3. Sample storing

Sewer inspection

Drill core sampling

4. Sample analysis

Determining of sewer conditions

Municipality of the Hague

The most common defects in the municipality of the Hague are: surface damage (BAF) and crack (BAB).

CCTV classification for BAF/BAB with associated action

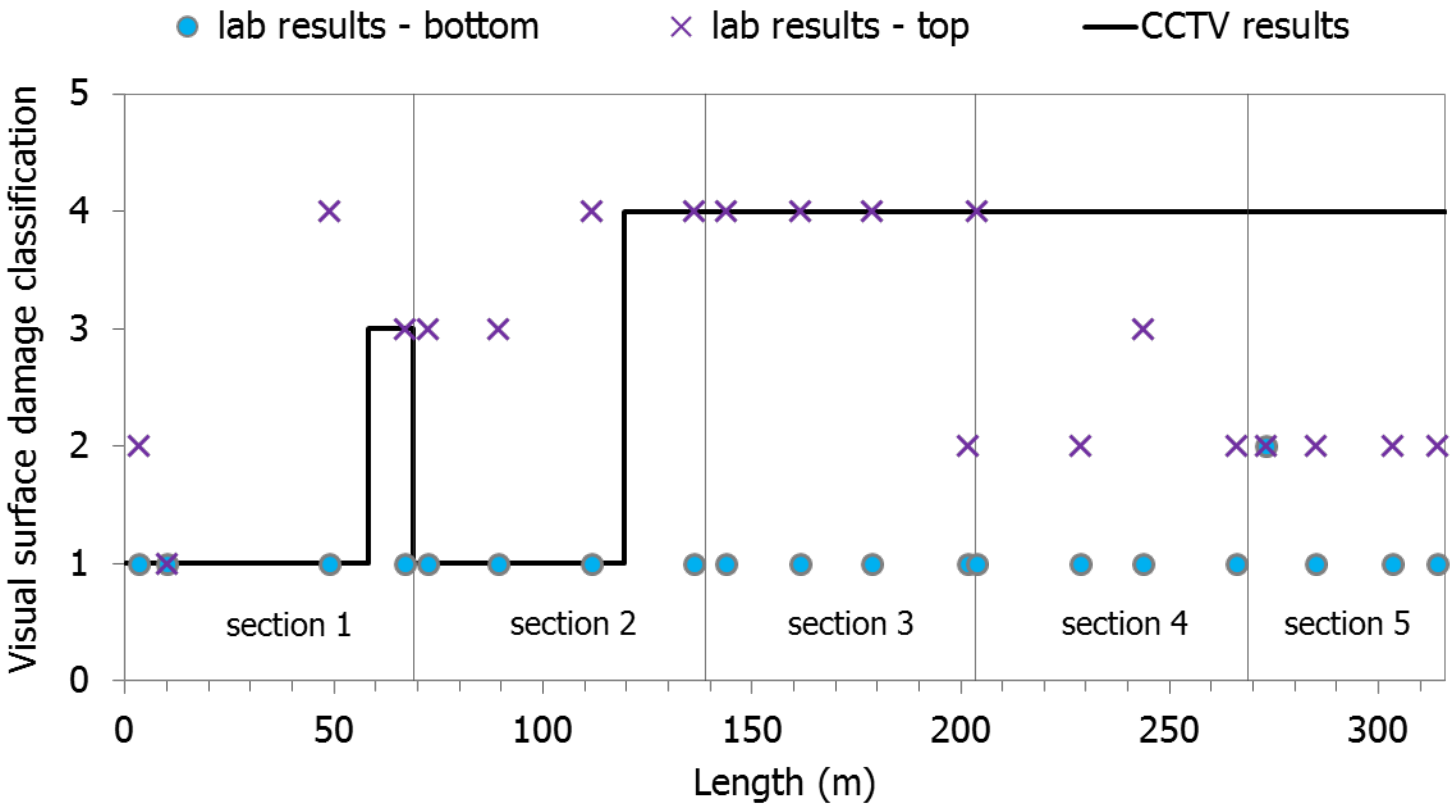
Classification	1	2	3	4	5
BAF	no	no	no	drill core	replacement
BAB	no	no	no	replacement	replacement

Drill core classification according to "The Hague"

	class 1	class 2	class 3	class 4	class 5
Splitting tensile strength (N/mm^2)	>6	5-6	2.6-4.9	2.5-2	<2
Water absorption (%)	<8	8-9	9-11	11-13.5	>13.5
Specific weight (kg/m^3)	>2275	2230-2275	2190-2229	2150-2189	<2150

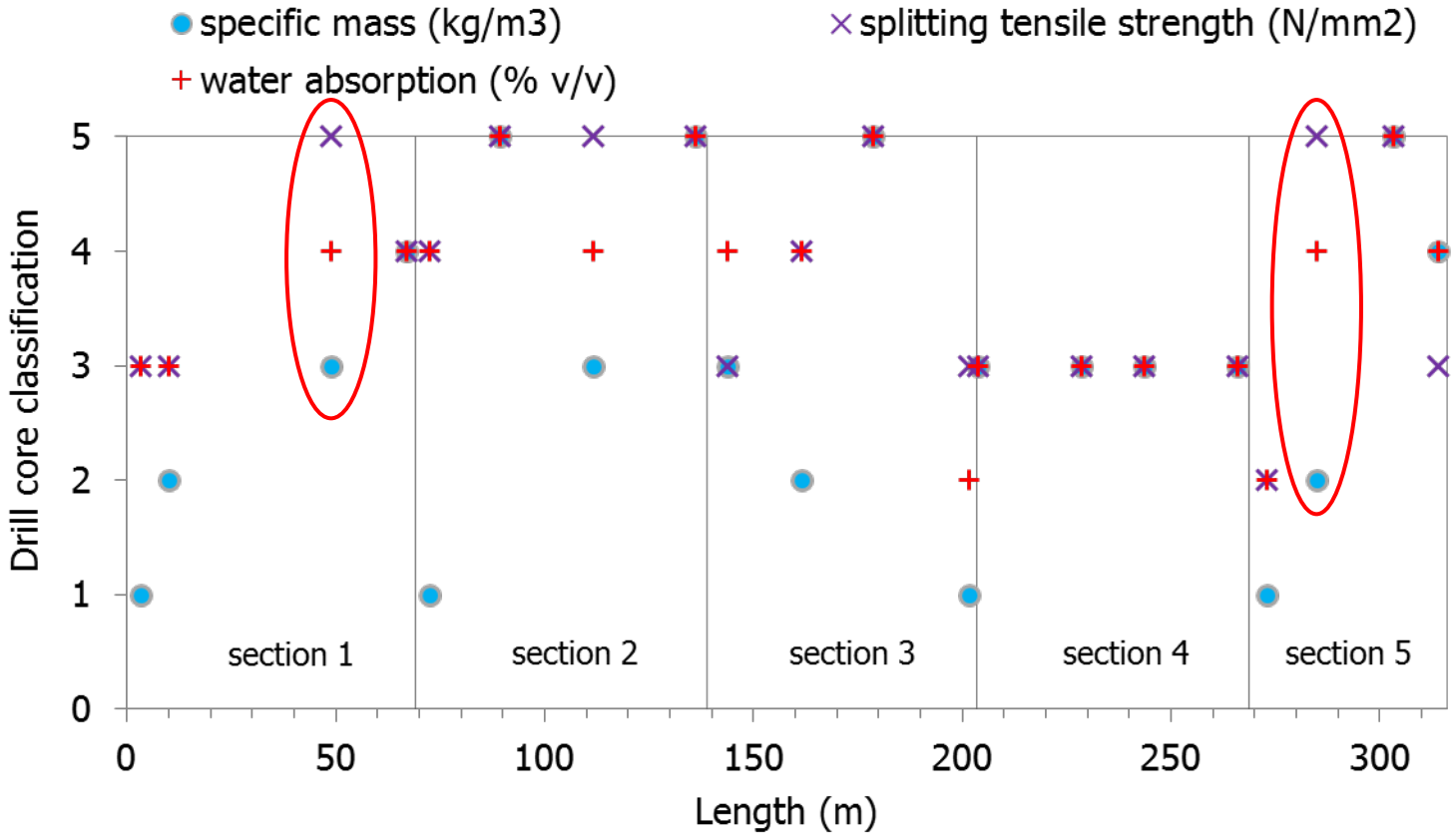
Experimental results

CCTV and lab. visual inspection results of the drill cores



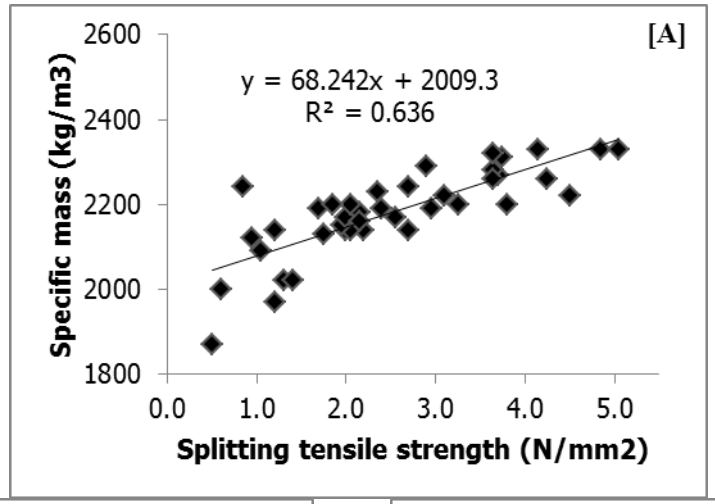
Experimental results

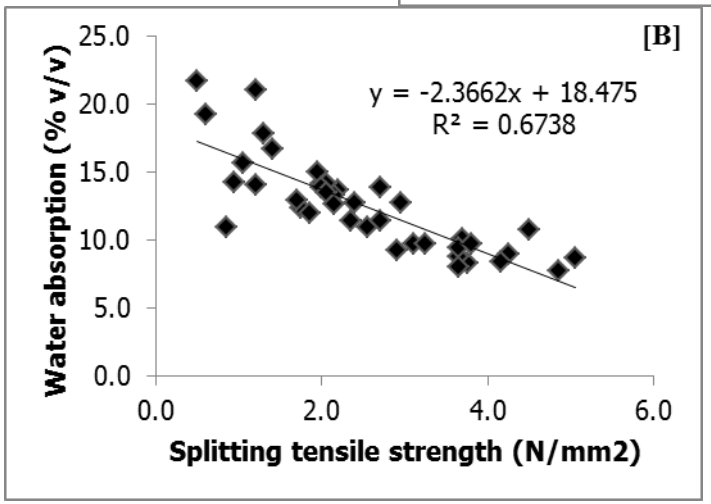
Drill core classification from the top of the sewer

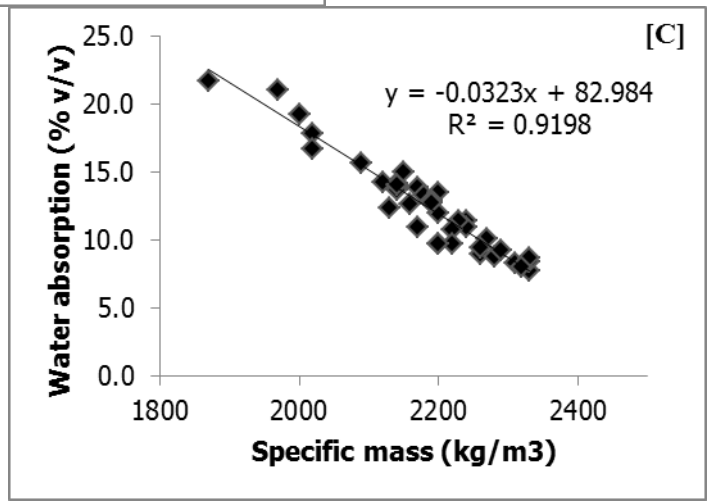


Experimental results

Correlation - Three criteria of the drill core classification

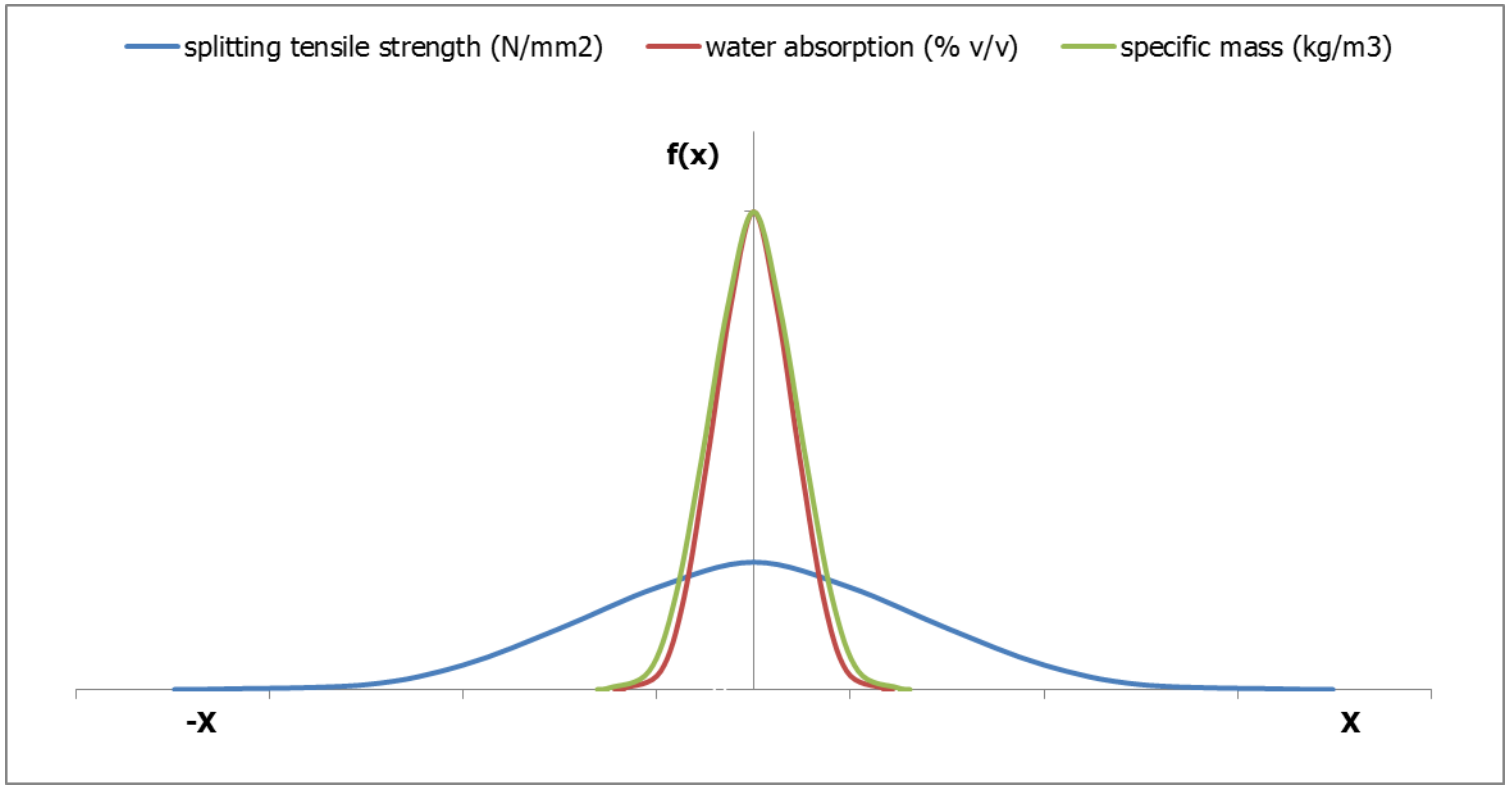






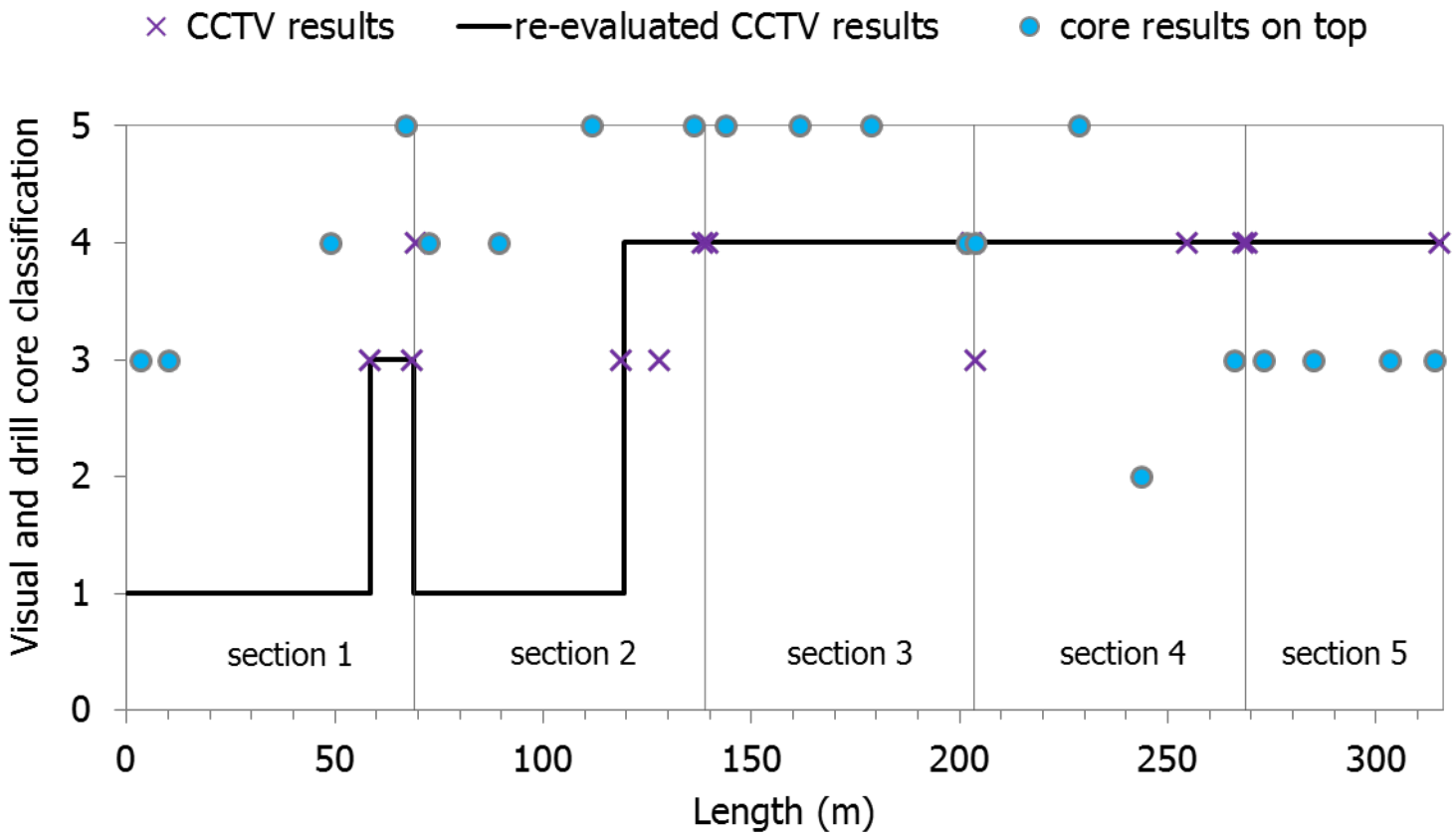
Experimental results

Uncertainties of the three drill core criteria



Experimental results

Final conditions assessment



Main conclusions

- Laboratory visual assessment of core samples and CCTV visual assessment of sewer condition showed that classification can differ due to the different size of the observed surface area and subjective assessment.

- The quality of final core classification depends on selection of parameters and their classification.

- Different factors like non-uniform deterioration, height/diameter ratio, experimental uncertainty and damage during drilling influence the proper estimation of the splitting tensile strength which makes results unreliable.

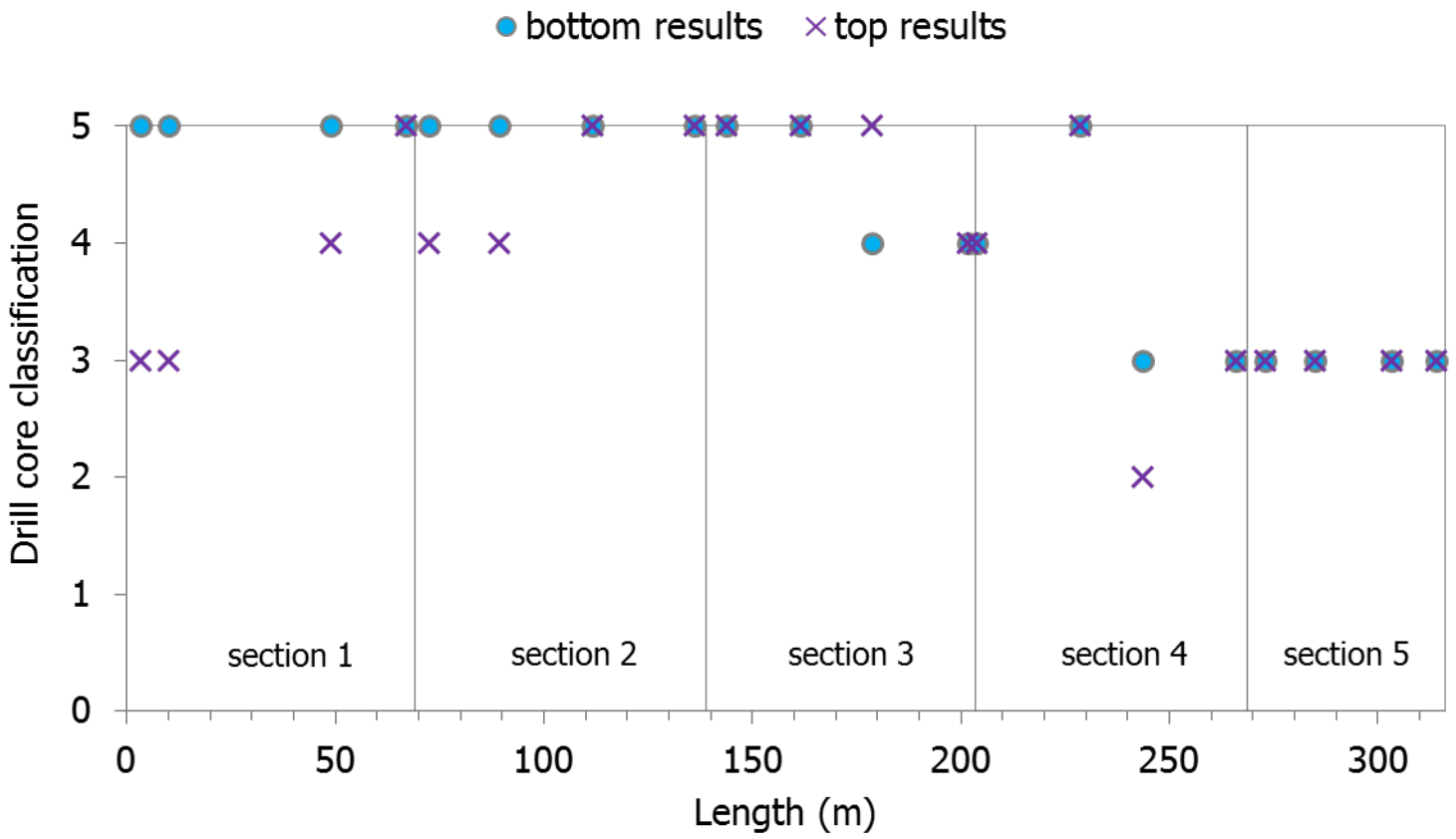
- There is no obvious correlation between results of visual inspection and results of drill core analysis.

Questions

Thank you
for your attention.

Experimental results

Comparison of invert and top of the sewer drill cores



Sewer inspections

Advantages and disadvantages

Inspection Technique	Use / Where to use	What will be found	Advantages	Disadvantages
Conventional Closed Circuit Television (CCTV)	- examine pipe wall surface - empty pipes, partially filled pipes above the water surface	- visible deformation - surface crack, fracture - break/collapse - visible spalling/wear and - intruding/defective conections - displaced joints - defective repair and sag - missing bricks/mortar - visible roots and other objects - infiltration	- standard techinque - considerable body of knowledge available to aid in interpreting - relativly cheap - evaluates the entire length of - other inspection test can be done together with CCTV	- may miss defects hidden behind obstructions or under water - if not combined with other techniques examins only wall - subjective interpretation of defect type and severity - difficult to accurately compare evaluations of the same sewer conducted at different times
Core Sampling	- method of obtaining strength properties of pipes, including burst strength, through - surface sampling	- strength properties of pipes - burst strength - pipe thickness - level of corrosion - also soil sampling	- reliable method of assessing pipe wall deterioration	- disturctive method - excavates and physically exposes the pipe - expensive and disruptive process - sample doesn't describes of pipe wall throughout whole -quality of drilling afects quality of samlpe