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2nd IWA Leading-Edge Conference & Exhibition on
Strategic Asset Management

**Uncertainty in inspection data and the impact
on rehabilitation decisions**

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LESAM 2007 – Lisbon 17-19 October 2007

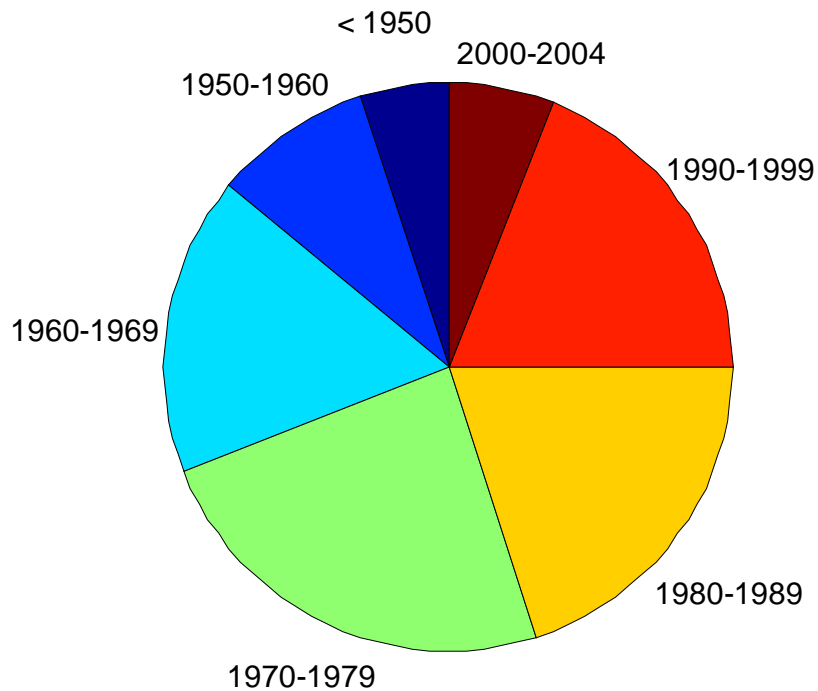
Pipe rehabilitation decisions

- Pipe rehabilitation decisions:
≈ 50% of investments (NL)
- Basis for decisions:
video inspection data
- Ability of inspection data
to predict sewer
deterioration:

Uncertain



Sewer rehabilitation in the Netherlands



Predicted lifetime:
~60 years

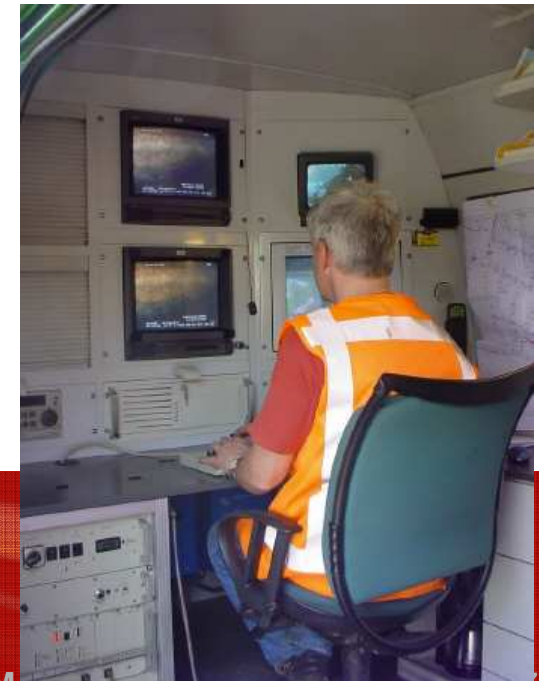
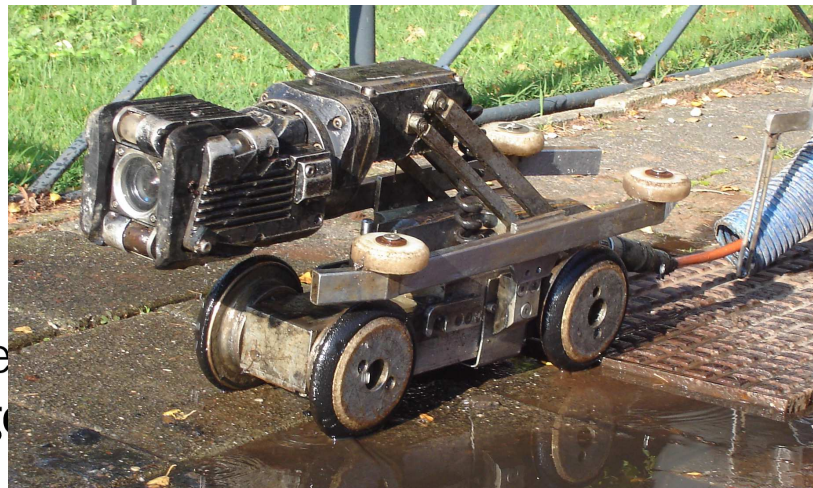


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Sewer inspection in the Netherlands

- Yearly ~7% of the total sewer length
- Daily practice since mid 1990s
- Sewer inspection by CCTV
- Footage interpreted by qualified/certified inspectors
- Classification system
 - <2004 Dutch standard
 - >2004 European standard

} similar

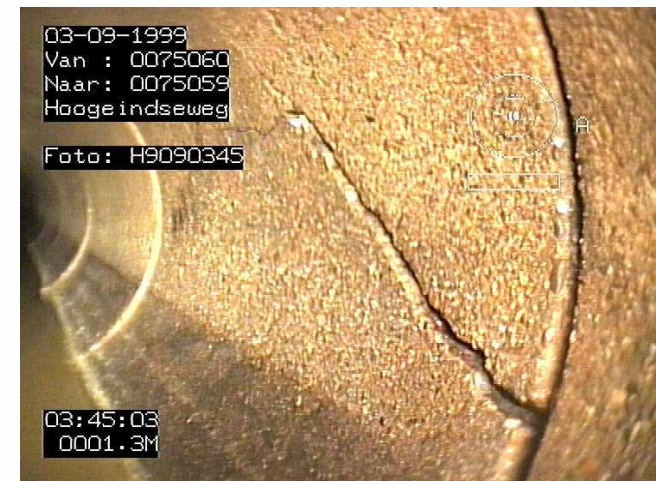


Classification system

List of defects

	aspect	code	classification
leaktightness	infiltration of groundwater	A1	1,2,3,4 or 5
	ingress of soil from surrounding ground	A2	1,2,3,4 or 5
	longitudinal displacement	A3	1,2,3,4 or 5
	radial displacement	A4	1,2 and 5
	angular displacement	A5	1 or 5
	intruding sealing ring	A6	1,3 or 5
	intruding sealing material	A7	1,2,3,4 or 5
stability	damage	B1	1 or 5
	surface damage by corrosion or mechanical action	B2	1,2,3,4 or 5
	fissure (cracks and fractures)	B3	1,2,3,4 or 5
	deformation of cross sectional shape	B4	1,2,3,4 or 5
flow (gradient)	intruding connection	C1	1,3 or 5
	root intrusion	C2	1,2,3,4 or 5
	fouling	C3	1,2,3,4 or 5
	encrustation of grease or other deposits (except for sand)	C4	1,2,3,4 or 5
	settled deposits (sand and waste)	C5	1,2,3,4 or 5
	other obstacles	C6	1,2,3,4 or 5
	water level	C7	1,2,3,4 or 5

If a condition is rated '0' the aspect might be present but unable to detect because of visual obstructions



Classification system

discrete classification system
preferably based on measurable boundaries

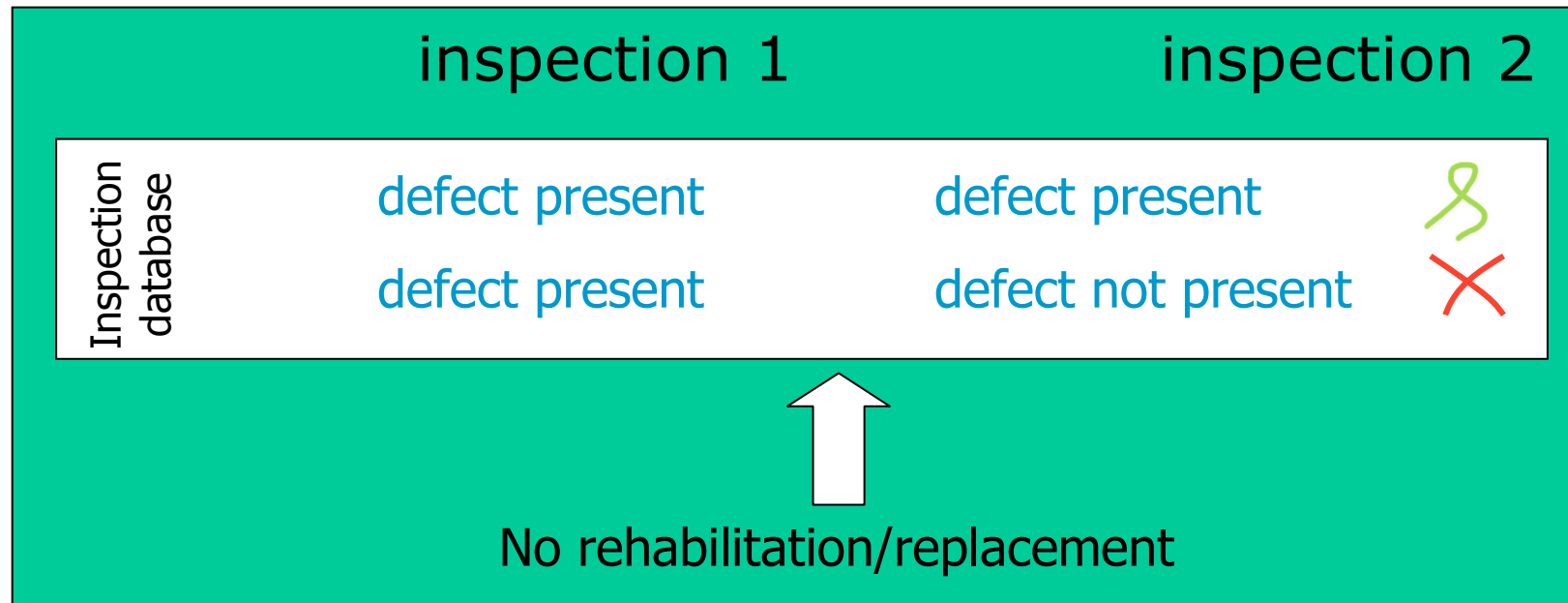
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Good data/ bad data → method

Inspection data of double inspected sewer pipes



Data used for the analysis

- 4 Dutch municipalities
- only defects that do not disappear between two subsequent inspections:

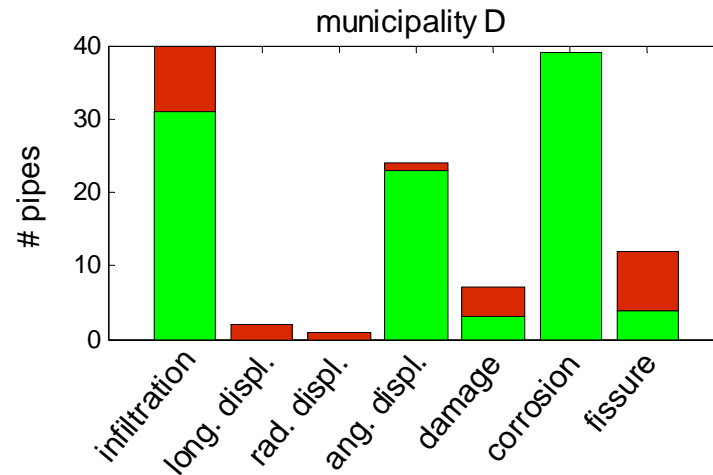
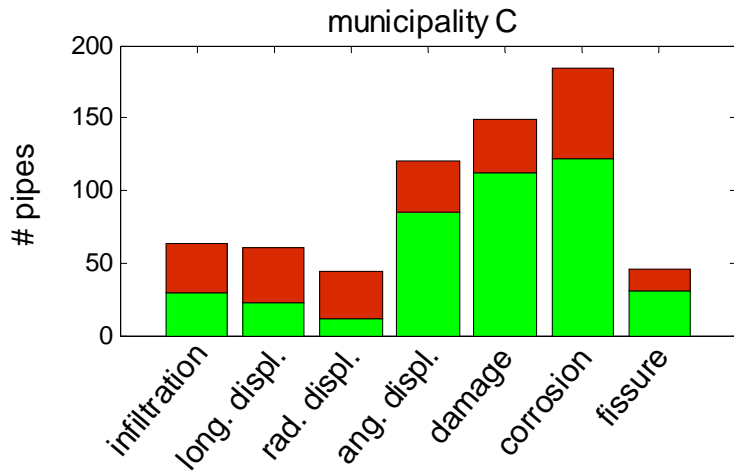
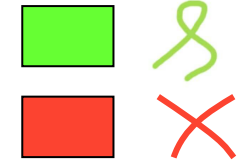
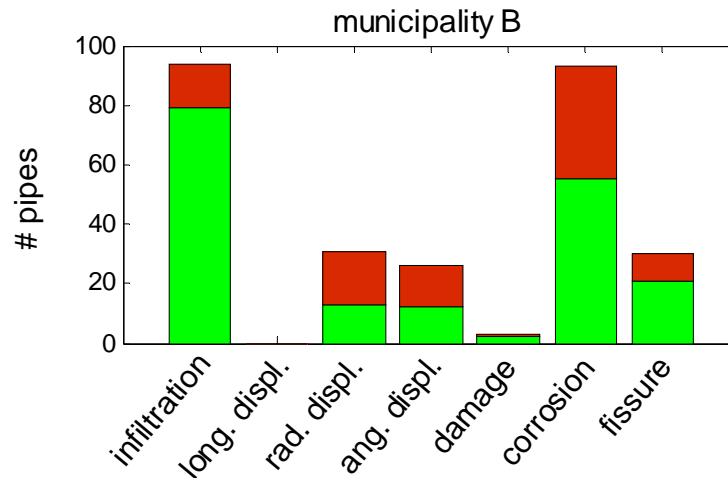
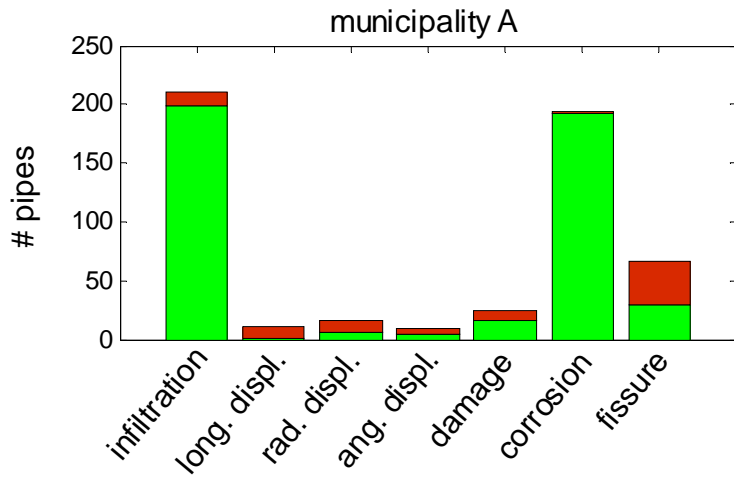
infiltration longitudinal displacement radial displacement angular displacement damage corrosion fissure	ingress of soil root intrusion fouling deposits obstacles water level etc.
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- description of defects equal in both standards
- concrete pipes



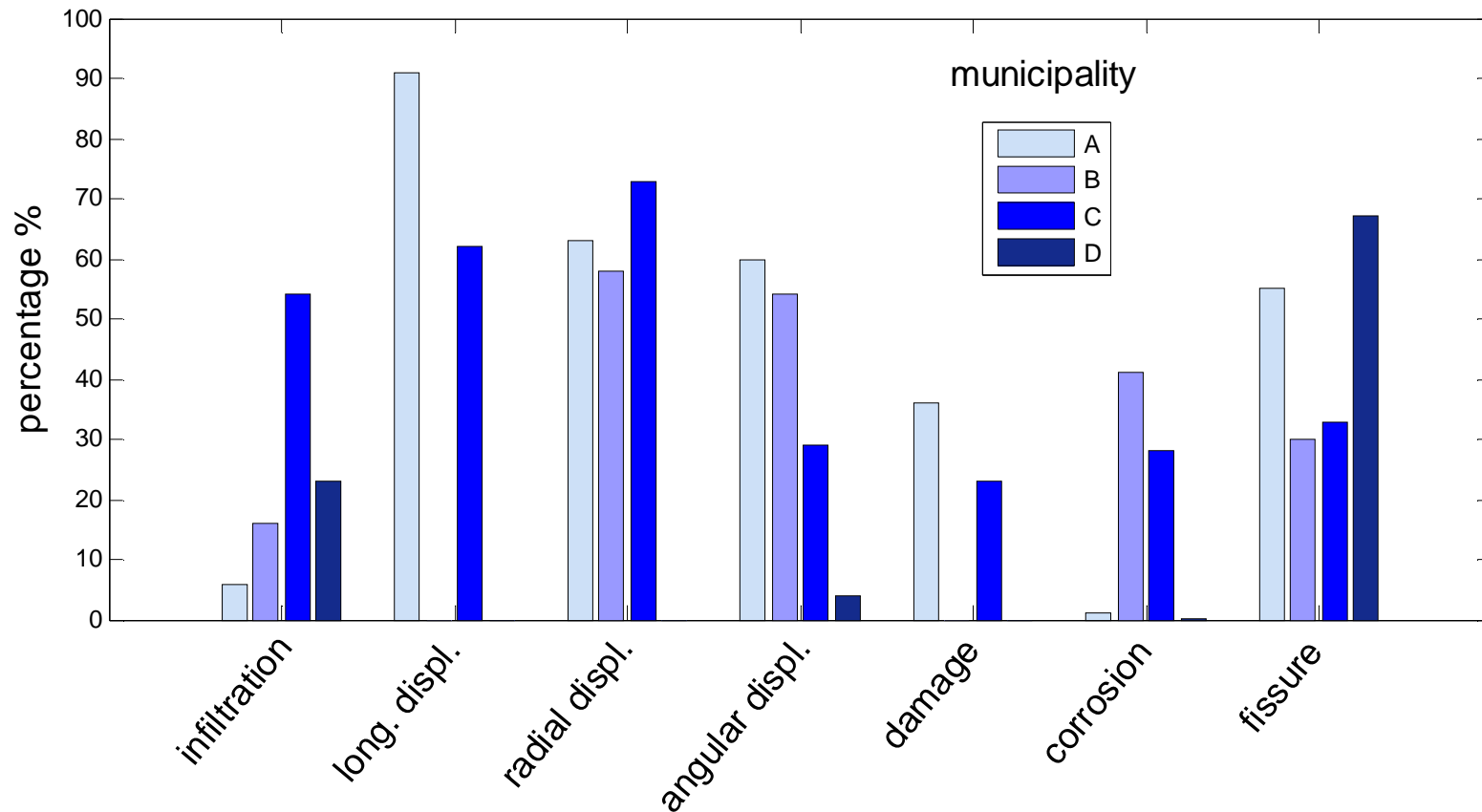
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Results



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Comparison of results >10 pipes



correct data: 0% disappearing defects

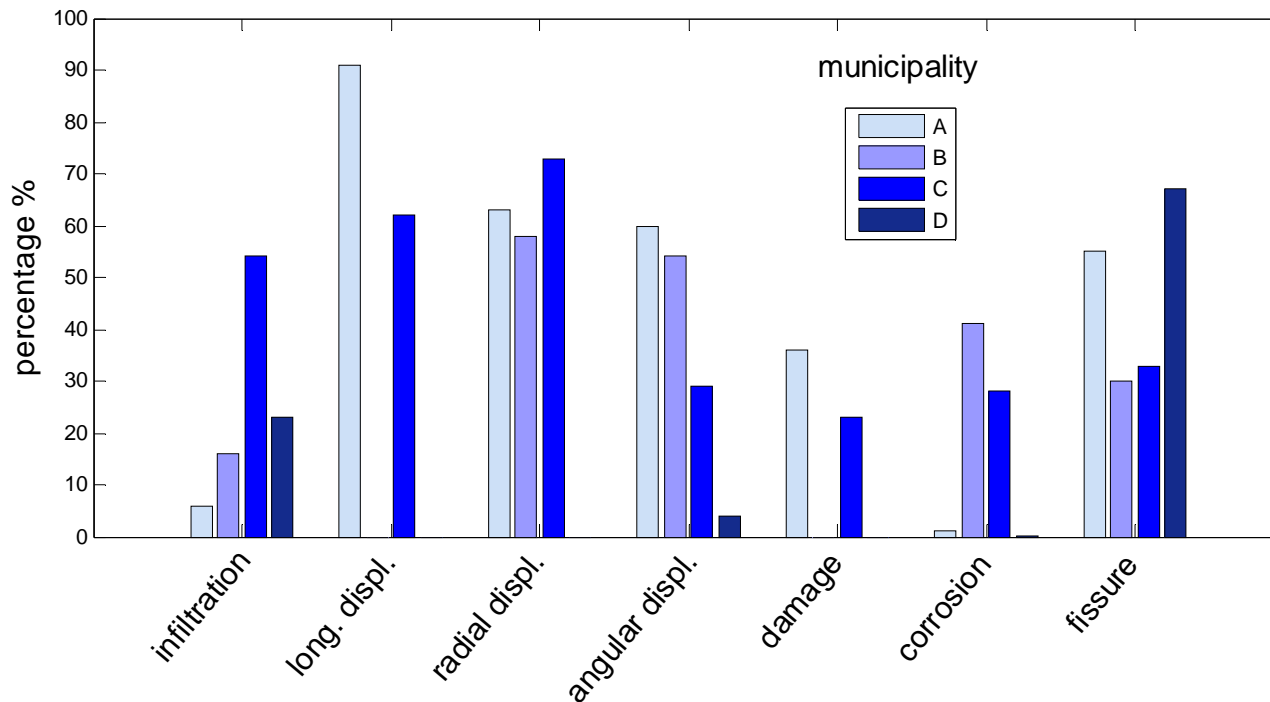


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Influence factors

Local circumstances:

- incidence of a defect
 - low : inspector less alert
- classification of a defect



Why do aspects disappear?

Uncertainty of general information files:

- maintenance/replacement without making notice

Uncertainty in judgment of footage:

- defect may not be visible
- interpretation is subjective
- conditioning of judgment inspector



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Uncertainty in judgment of footage

Korving (PhD Thesis 2004)

Examination results of sewer inspection course:

probability of wrong classification
answer \neq correct classification

significant (>15%)

infiltration
radial displacement
corrosion
fissure

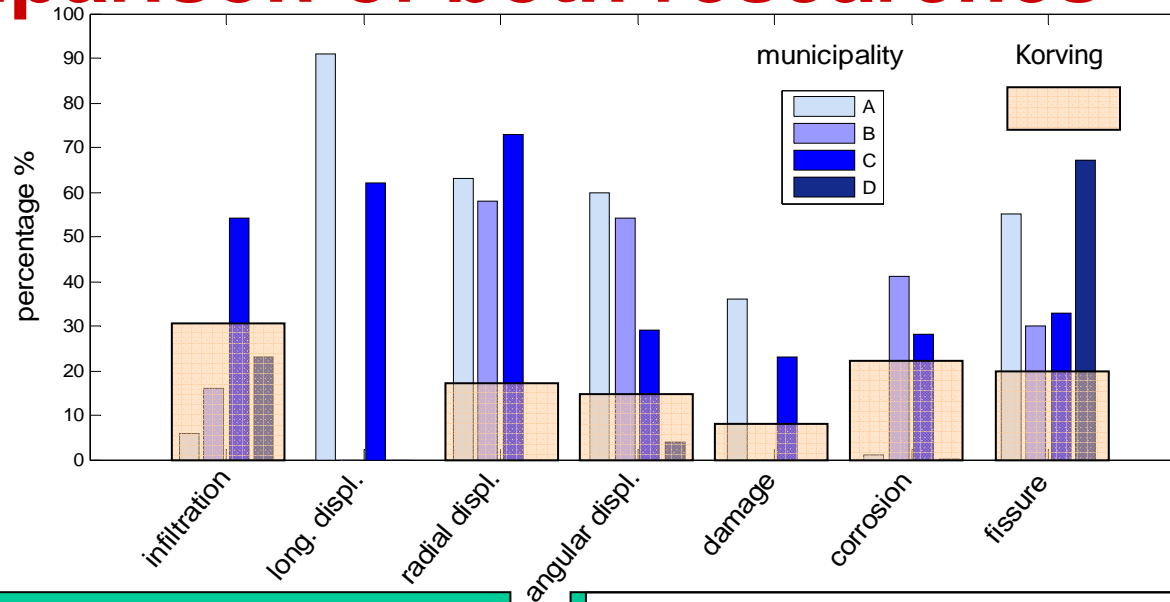
+other

not significant (<15%)

break/collapse
longitudinal displacement
angular displacement

+other

Comparison of both researches



inspection data

- probability of disappearance
- large sample size
- videos
- not recently educated

examination results

- probability of wrong classification
- some defects were hardly present in the examinations
- photo's
- recently educated

Conclusion

Uncertainty of general information files:

SIGNIFICANT

Uncertainty in judgment of footage:

SIGNIFICANT

Usage of historic databases of inspection data for deterioration modeling and sewer rehabilitation decisions is questionable



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**Thank you for
your attention**



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