

Ground penetrating radar for asphalt quality control

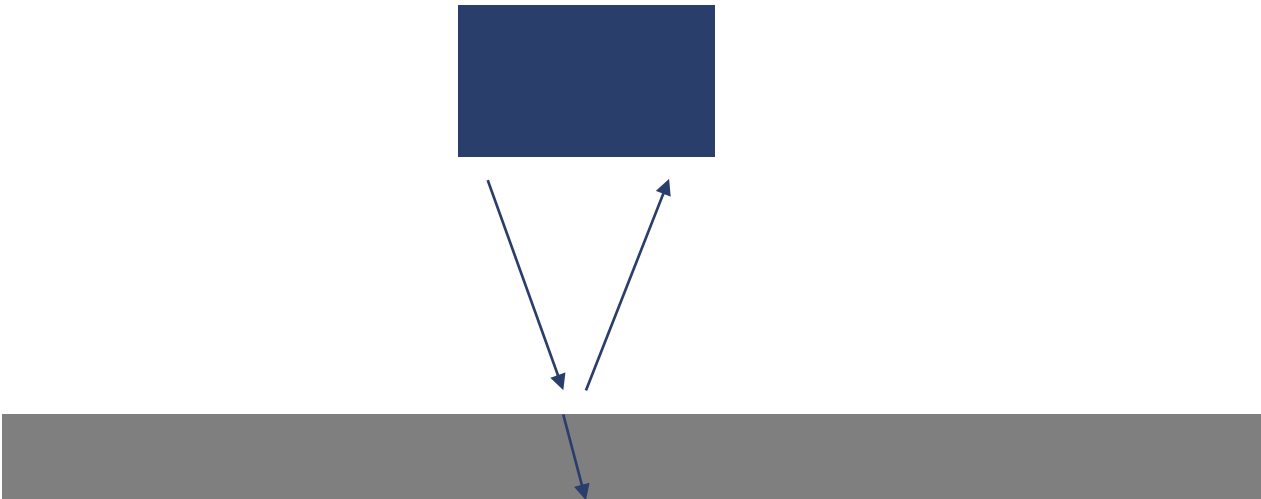
Eric Gardner

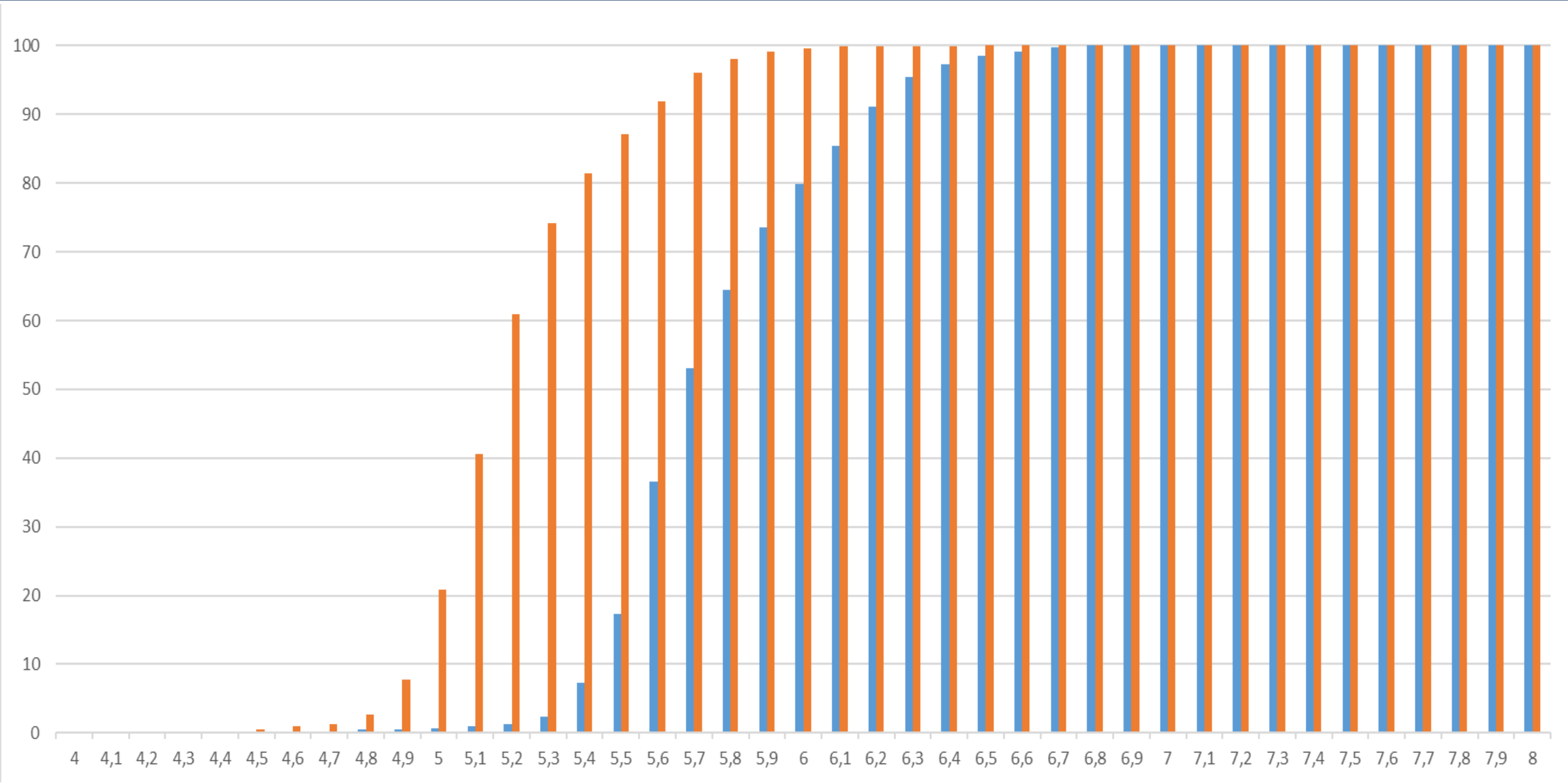
Skanska Teknik

Surface reflection method

- EM-signal in the radar spectrum
- Amplitude of reflected signal
- Reflection of the top layer is used
- It is unit less and relative in value to vacuum

$$\bullet \epsilon_{HMA} = \left(\frac{1 + \left(\frac{A_0}{A_p} \right)}{1 - \left(\frac{A_0}{A_p} \right)} \right)^2$$





Material properties

- Material properties are the main factor
- Composite materials depend on material proportions
- Water can prevent measuring

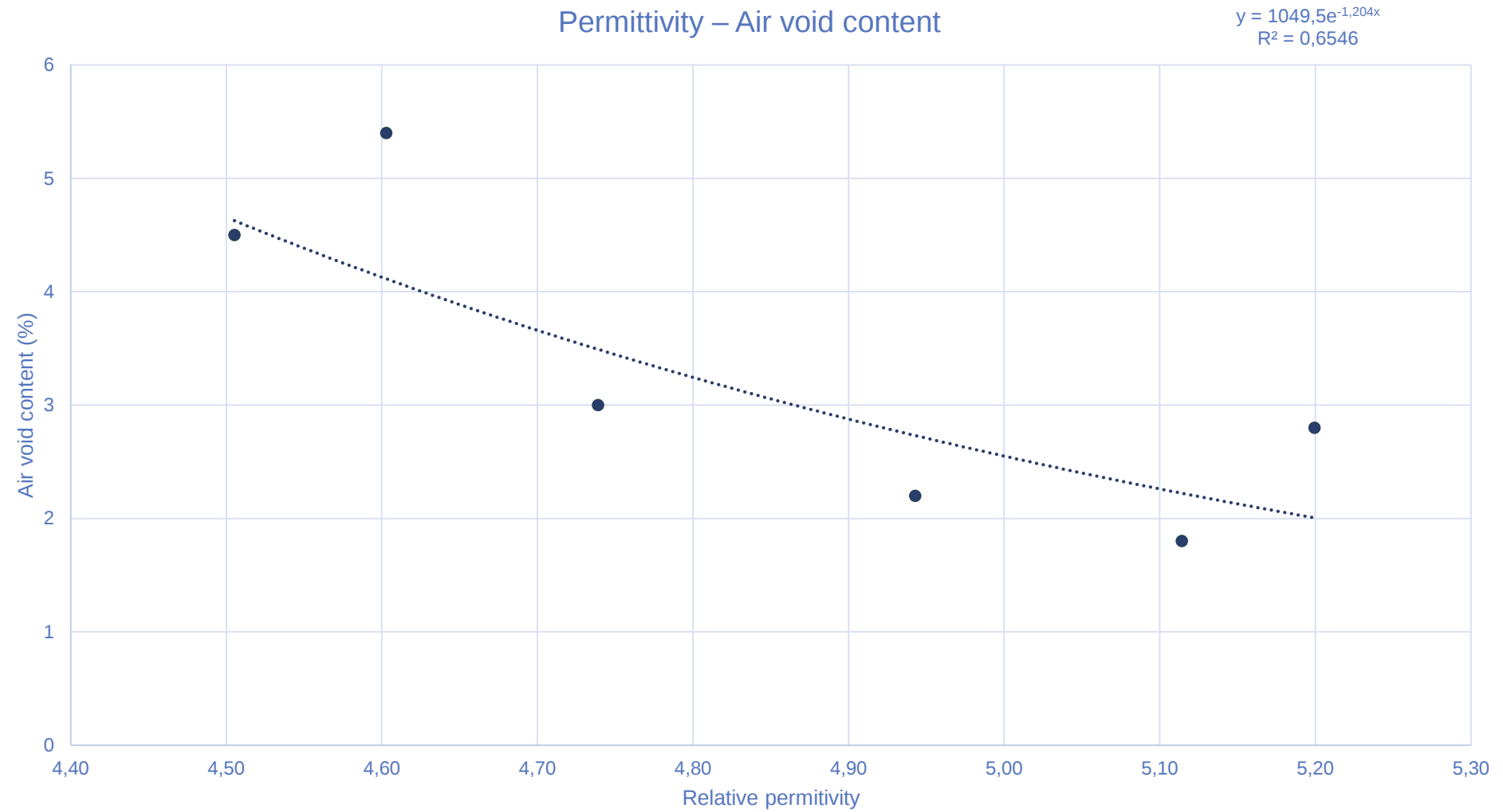
Material	Permittivity
Air	1
Binder	2,5
Stone	6-8
Water	80

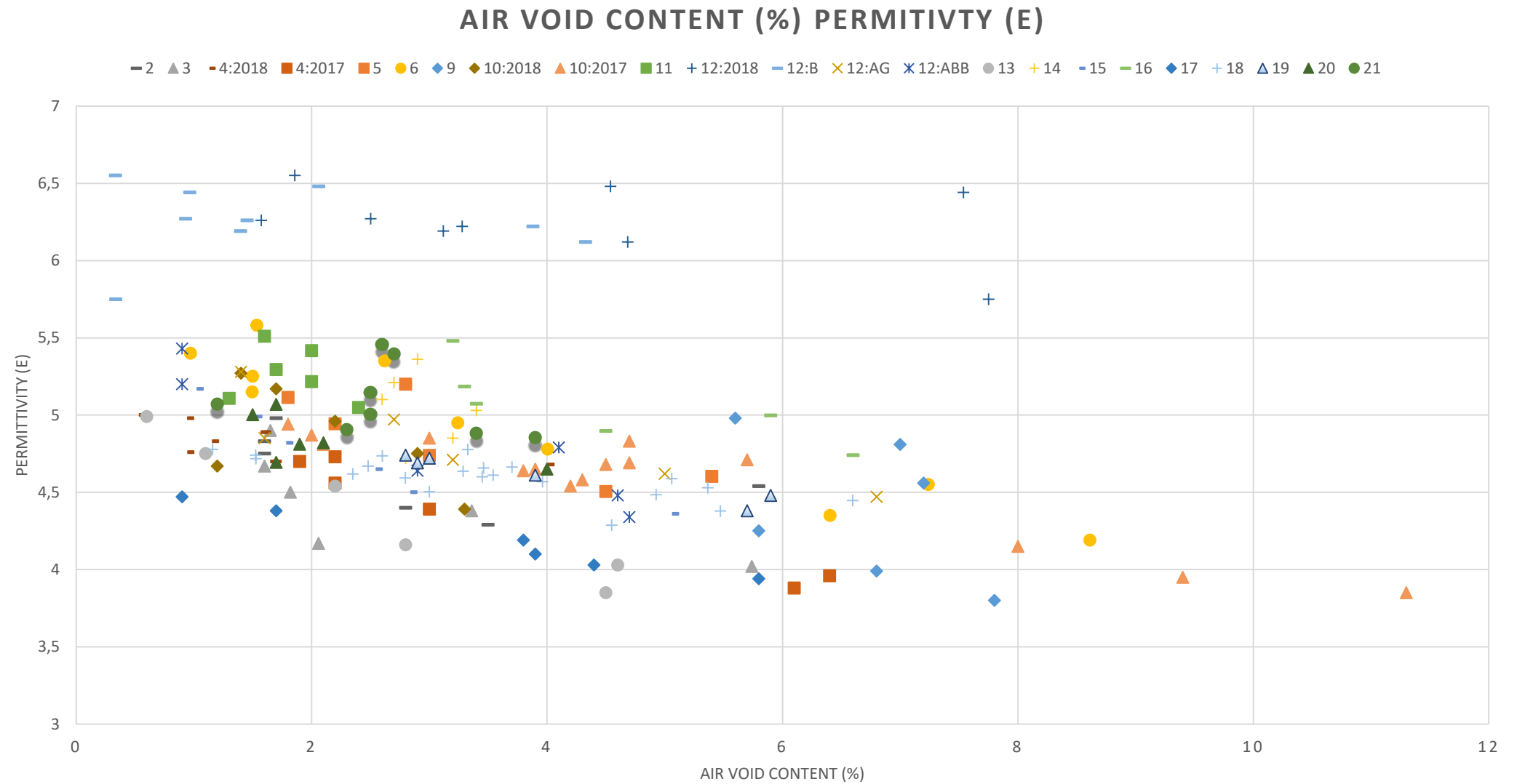
Data collection



Air void correlation

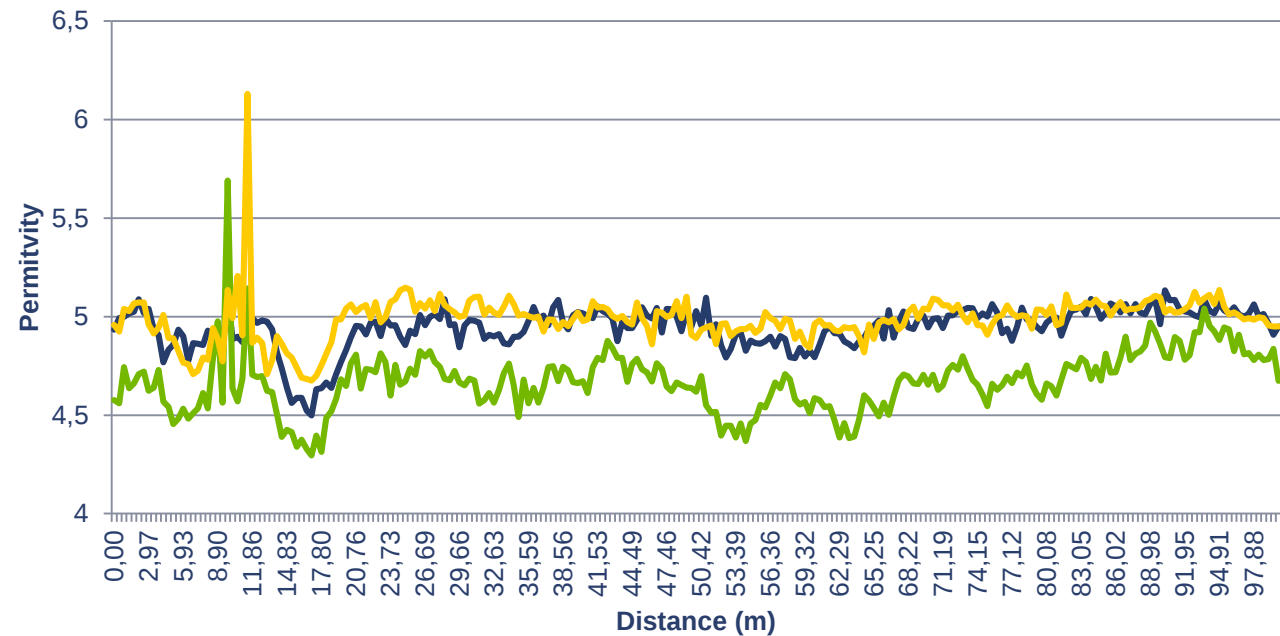
- Sample cores for calculation of air void content
- Selection of cores should correspond to the range of permittivity values observed
- Larger diameter cores give a better correlation
- Can possibly be taken from another object using the same mixture
- Frequency of new cores?



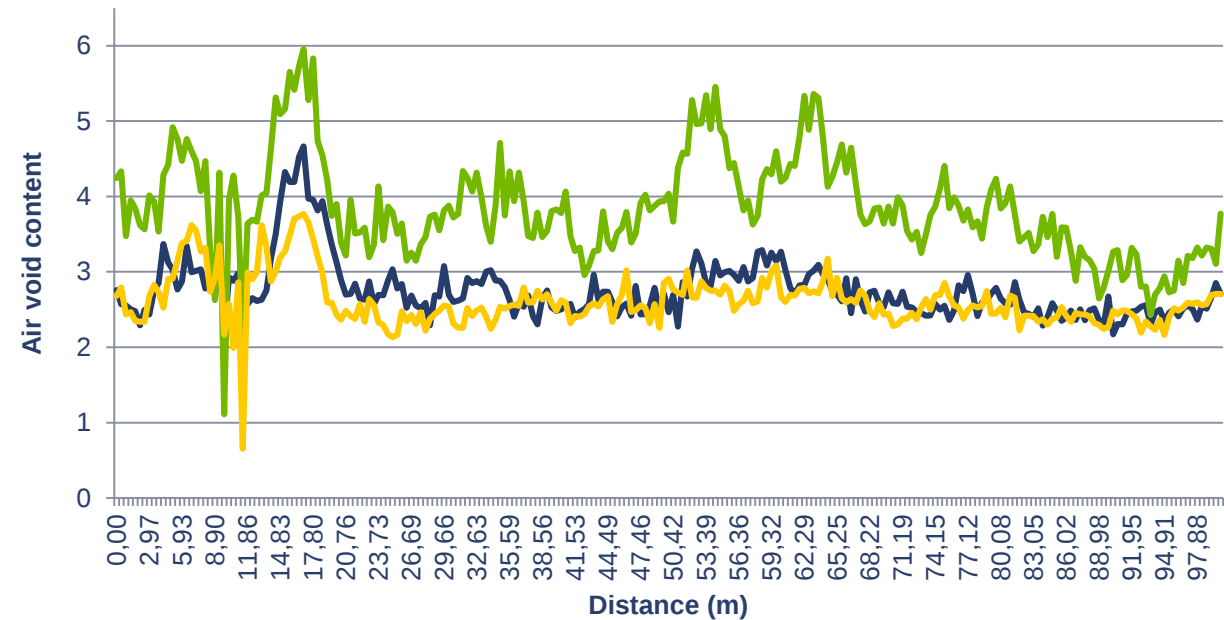


Permittivity & Air void content

Permittivity



Air void content



Measurement inaccuracy and core selection

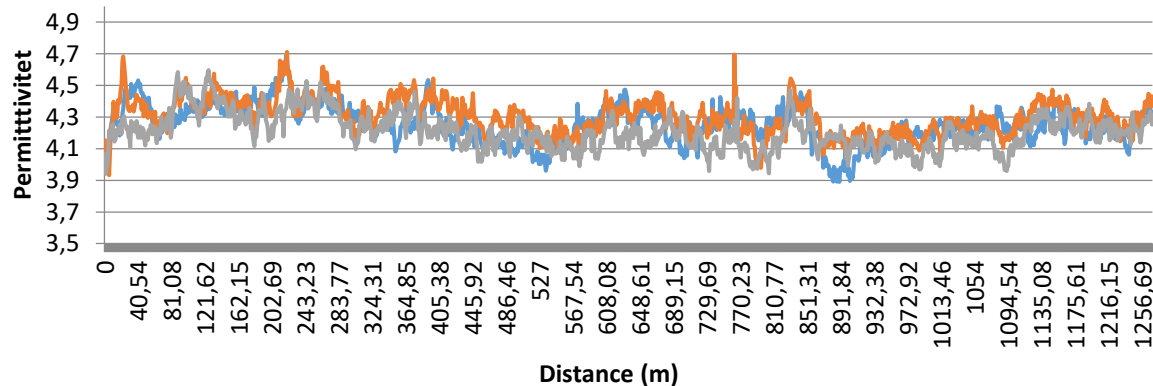
- Compounded by the inaccuracy of determining density
- A large spread of dielectric values helps achieving a good correlation
- Avoid anomalous areas when selecting core locations



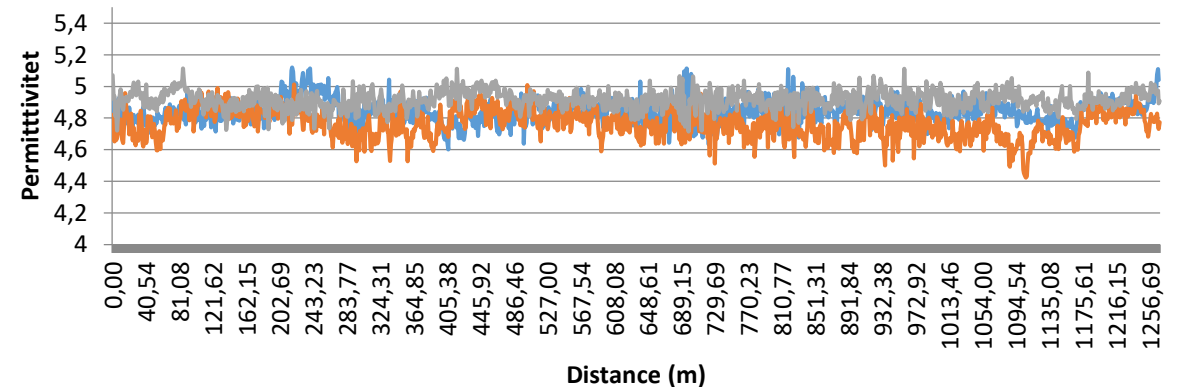
Traffic compaction over time

- Traffic compaction after paving changes GPR results
- A new set of cores confirms this
- Measurements should preferably be carried out before opening the road to traffic

Permittivity 2017



Permittivity 2018



Advantages

- Several orders of magnitude greater coverage
- Non destructive
- Data driven quality control
- Less randomness in quality control
- Possibility for quick data overview

Issues

- Dependent on a dry weather conditions
- Requires core calibration to calculate air voids/density
- Initial costs for implementation

Implementation challenges from a technical POV

- Determining acceptable conditions for measurements
- Calibration and core outliers
- Frequency for new core samples?
- Time from paving to measuring
- Statistical evaluation system for compaction data