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Monitoring of primary road network

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The Netherlands

- Mainport to EU
- 41.526 km² area
- 17 million inhabitants
- 5.076 km primary road network

Highway

Dutch primary road network

- Functional aspects
  - congestion (*PA & monitoring at traffic speed*)

Porous Asphalt / Dense Asphalt Concrete

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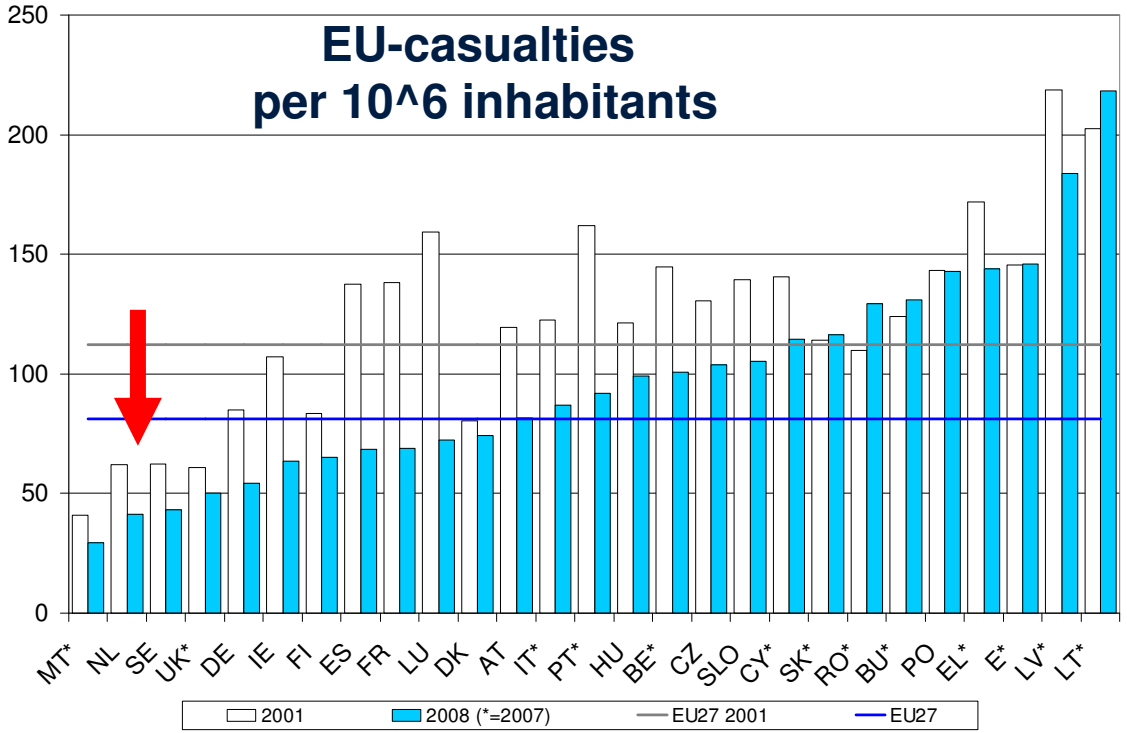
  - high level of traffic safety



Dutch primary road network

- Functional aspects
  - congestion (*PA & monitoring at traffic speed*)
  - high level of traffic safety
  - noise reducing surface layers
- Surface type
  - 90% PA (mostly 1, sometimes 2 layers)

2-layer Porous Asphalt

Dutch primary road network

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  - high level traffic safety
  - noise reducing surface layers
- Surface type
  - 90% PA (mostly 1, sometimes 2 layers)
    - representative distresses
      - ravelling
      - lack of wet friction

Changes in contracts

Phase	Executing party	Old way	New way
Prepara-tion	principal		
	bidding party		
Execu-tion	principal		
	contractor		
Contract period	principal		
	contractor		

Changes in contracts

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Prepara-tion	principal	-design of pavement -design of work process	
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Execu-tion	principal	-guidance of process -quality check of the delivered product	
	contractor	-execution of building process	
Contract period	principal	-monitoring of surface characteristics	
	contractor	-3 year guarantee for hidden or early failures	

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Contract period	principal	-monitoring of surface characteristics	-check on monitoring of surface characteristics
	contractor	-3 year guarantee for hidden or early failures	-responsible for maintenance for 7 up to 30 years contract -***monitoring***

Scope of presentation

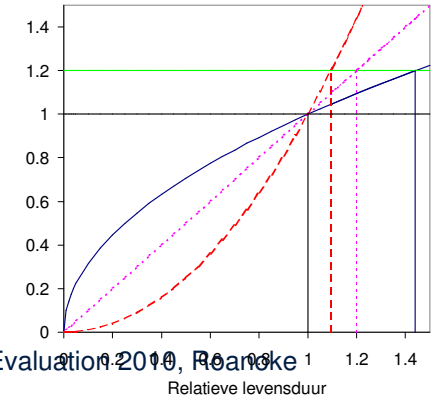
- New way of contracting road works
  - transfer of
    - tasks
    - responsibilities
    - risks to contractor
- Contractor has a lack of knowledge on long term behaviour of his own products
  - how to quantify risks?
  - how to design a monitoring program?

Product properties

- Monitoring in the past
  - regular task of road authorities
  - in research programs
    - SHRP-NL and IPG (Innovation Program on Noise) CROW Silent Road Surfaces
  - not enough data of contractor's own products
- Overall knowledge gained by private monitoring companies

Monitoring in QA-plan

- Goal
  - to prevent pavement condition to transgress contract specifications
  - timely warning for corrective measures
- Smart and lean
  - measurements based on overall knowledge of
    - service life
    - shape of long term behaviour



Specification Pyramid

Level in Specification Pyramid	Characteristic	Monitoring characteristics			
		Check at time of completion	Removing warning signs	Periodical check within contract period	Check at end of contract period
1 Road	availability				
2 Surface Characteristics	wet skid resistance	x		x	x
	dry braking deceleration	x			
	dry skid resistance		x		
	longitudinal evenness	x		x	x
	transversal evenness			x	x
	texture	(x)		(x)	(x)
	ravelling			x	x
	cracking			x	x
	cross fall	(x)		(x)	(x)
	noise reduction	(x)		(x)	(x)
3 Pavement structure	bearing capacity	x			x
	layer thickness	x			
	compaction	x			
4 Asphalt mix	fatigue	x			
	stiffness	x			
	resistance to deformation	x			
	water sensitivity	x			
5 Material	polished stone value (PSV)	x			

Properties to be monitored

Level in Specification Pyramid	Characteristic	Monitoring characteristics			
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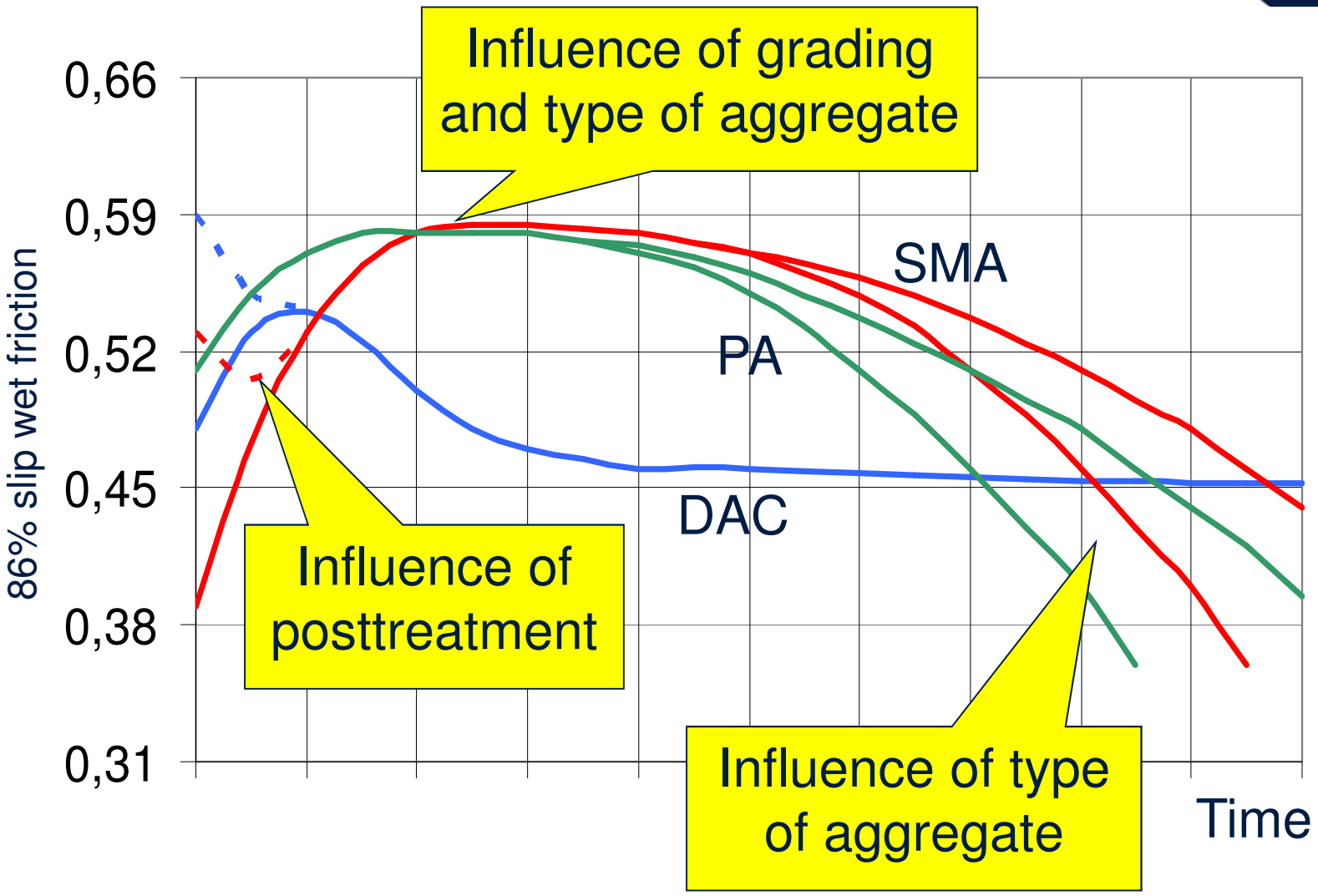
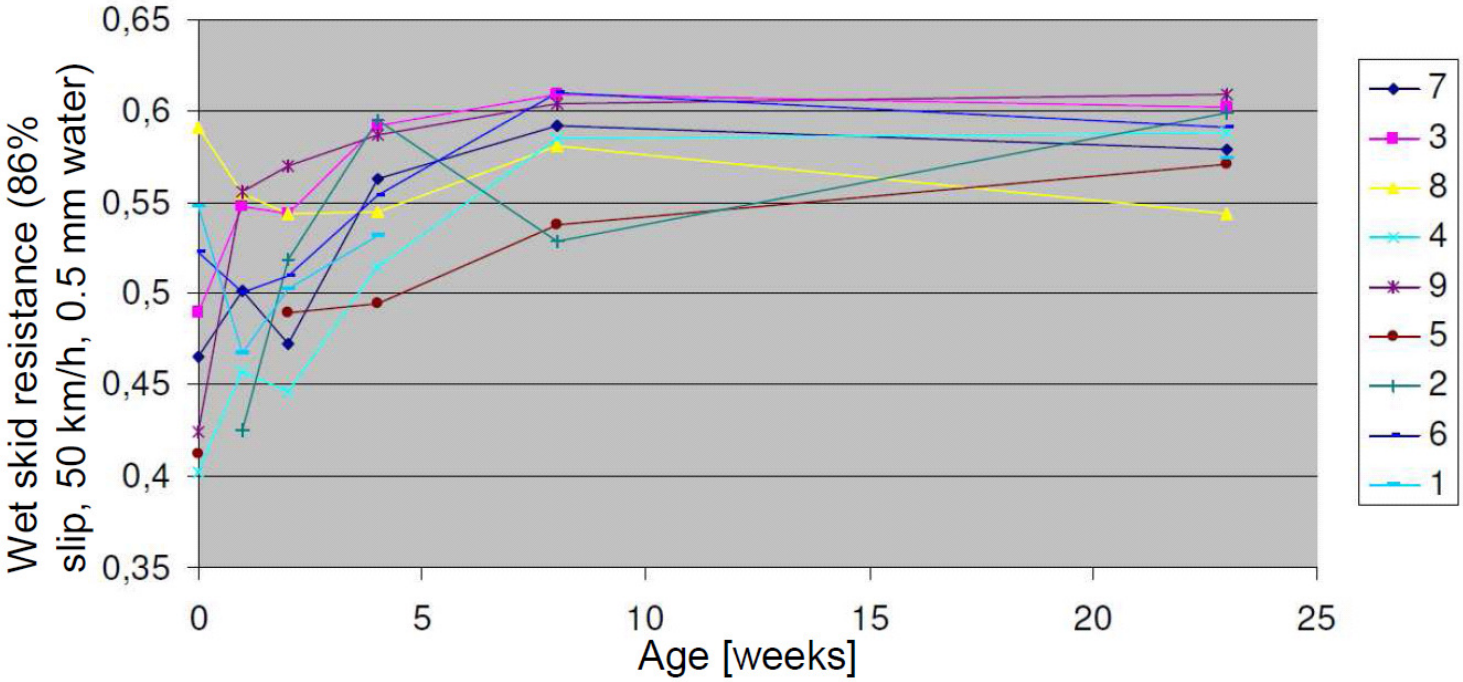
2 Surface Characteristics	wet skid resistance	x		x	x
	dry braking deceleration	x			
	dry skid resistance		x		
	longitudinal evenness	x		x	x
	transversal evenness			x	x
	texture	(x)		(x)	(x)
	ravelling				
	cracking				
	cross fall	(x)			
	noise reduction	(x)			

Long term behaviour of Wet friction



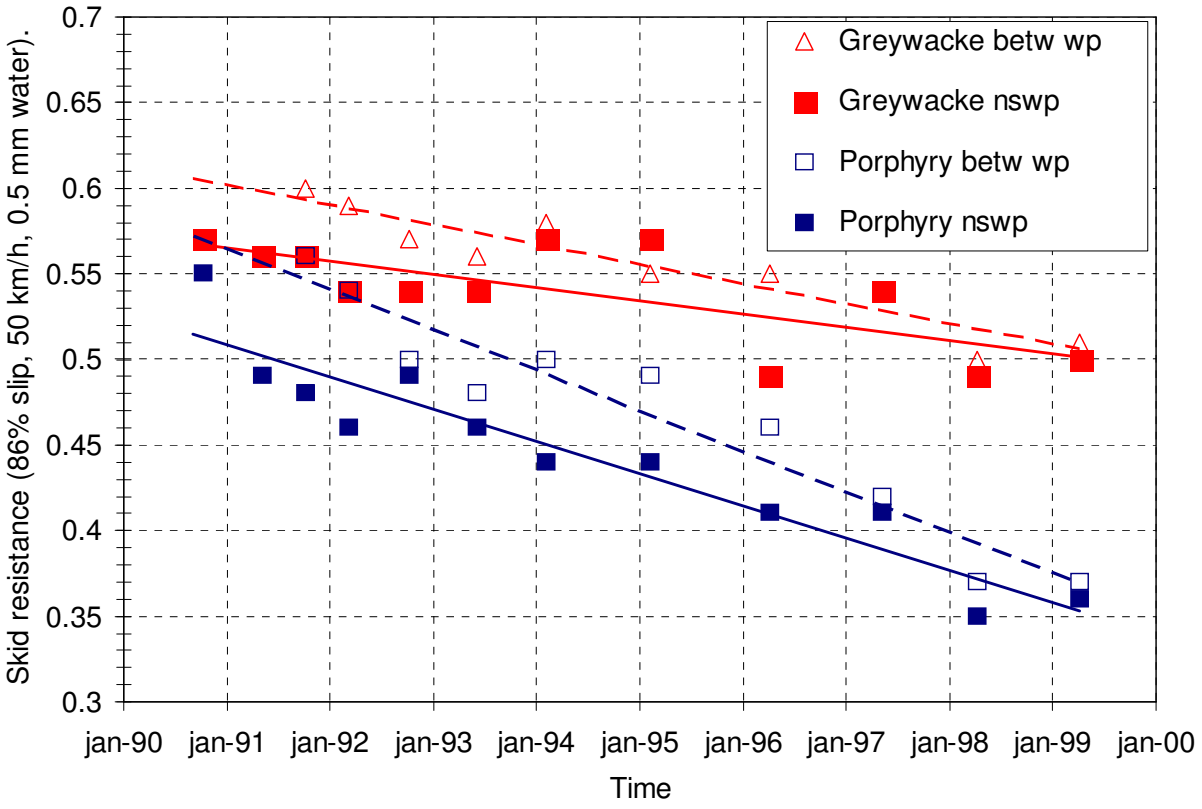
First weeks of wet friction

- Silent Thin Surfacings 2/5

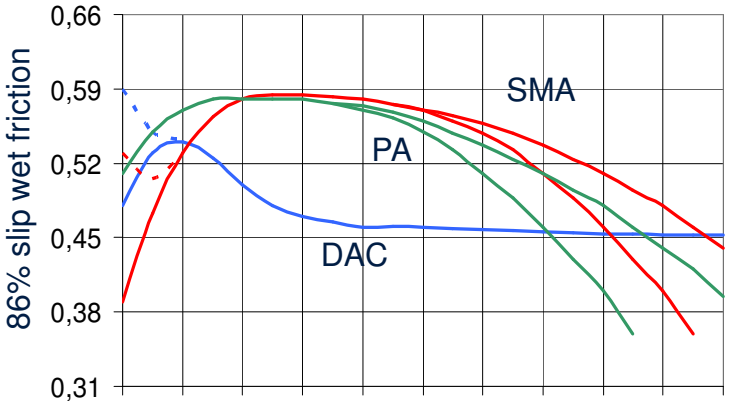


- Intervention level is 0.38 (50 km/h)

Downwards period



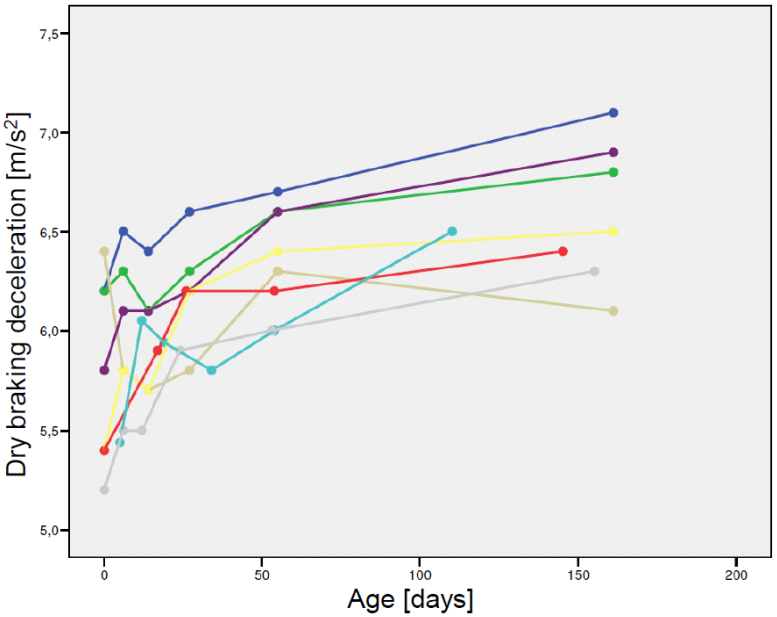
Monitoring Wet friction



- in first 6 weeks
- after 1 year
- then every 2 or 3 years depending on the friction level
- every year when friction is lower then warning level

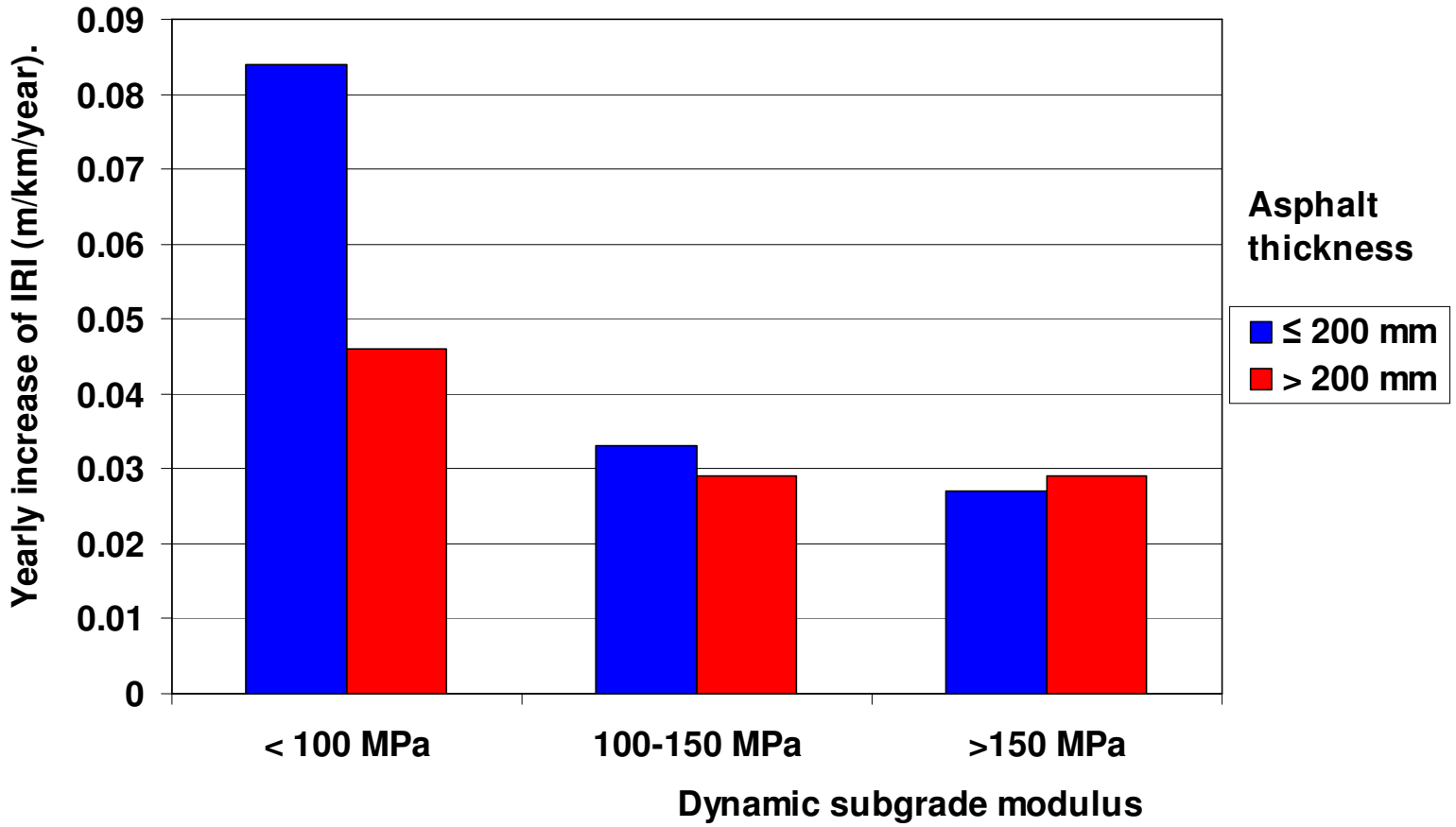
Dry friction

- First months of PA and Silent Thin Surfacings 2/5

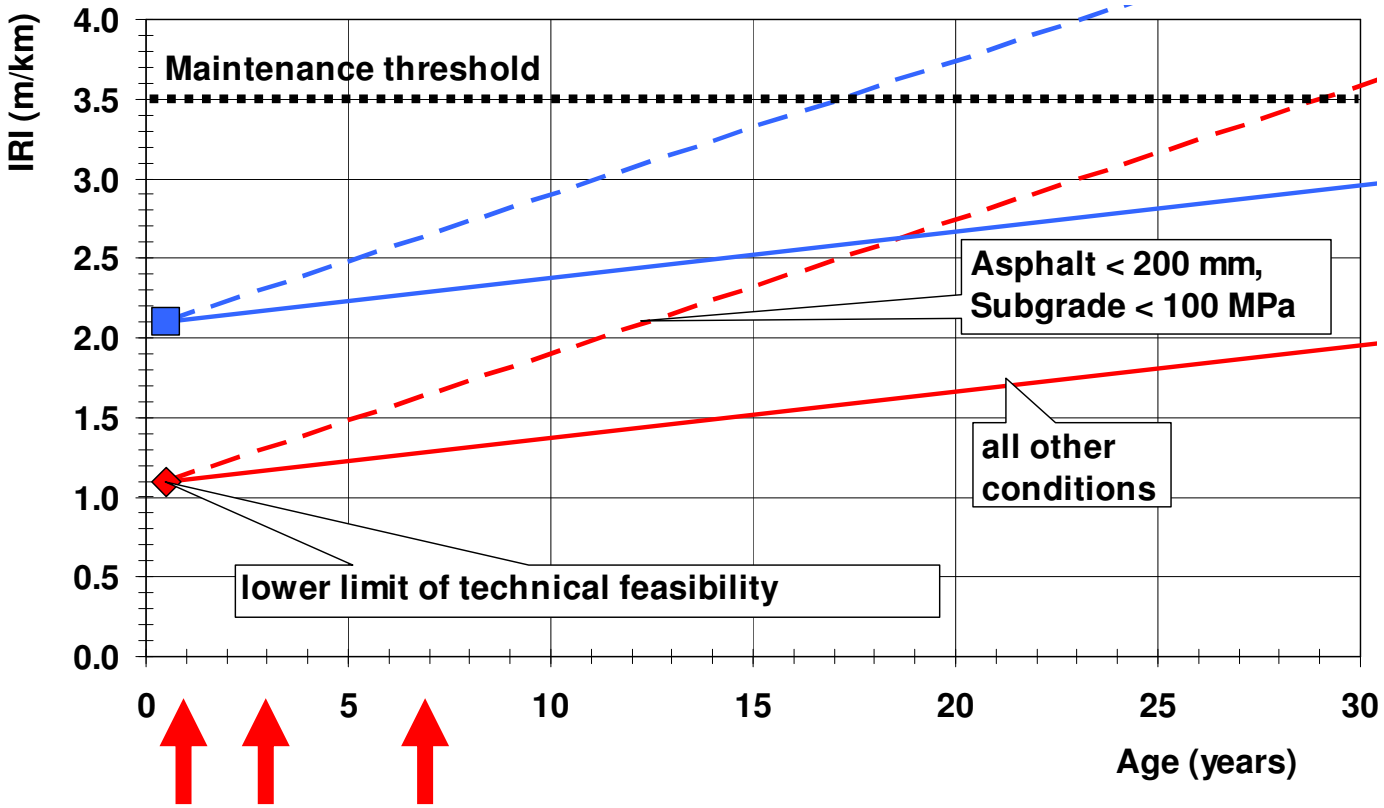


- Minimum accepted level 5.2 m/s² and < 6.5 m/s²
  - warning signs 'New road surface, longer braking distance'
- Warning signs removed when level ≥ 6.5 m/s² (3-6 months)
  - dry friction trailer (100% slip, 70 km/h)

Longitudinal evenness

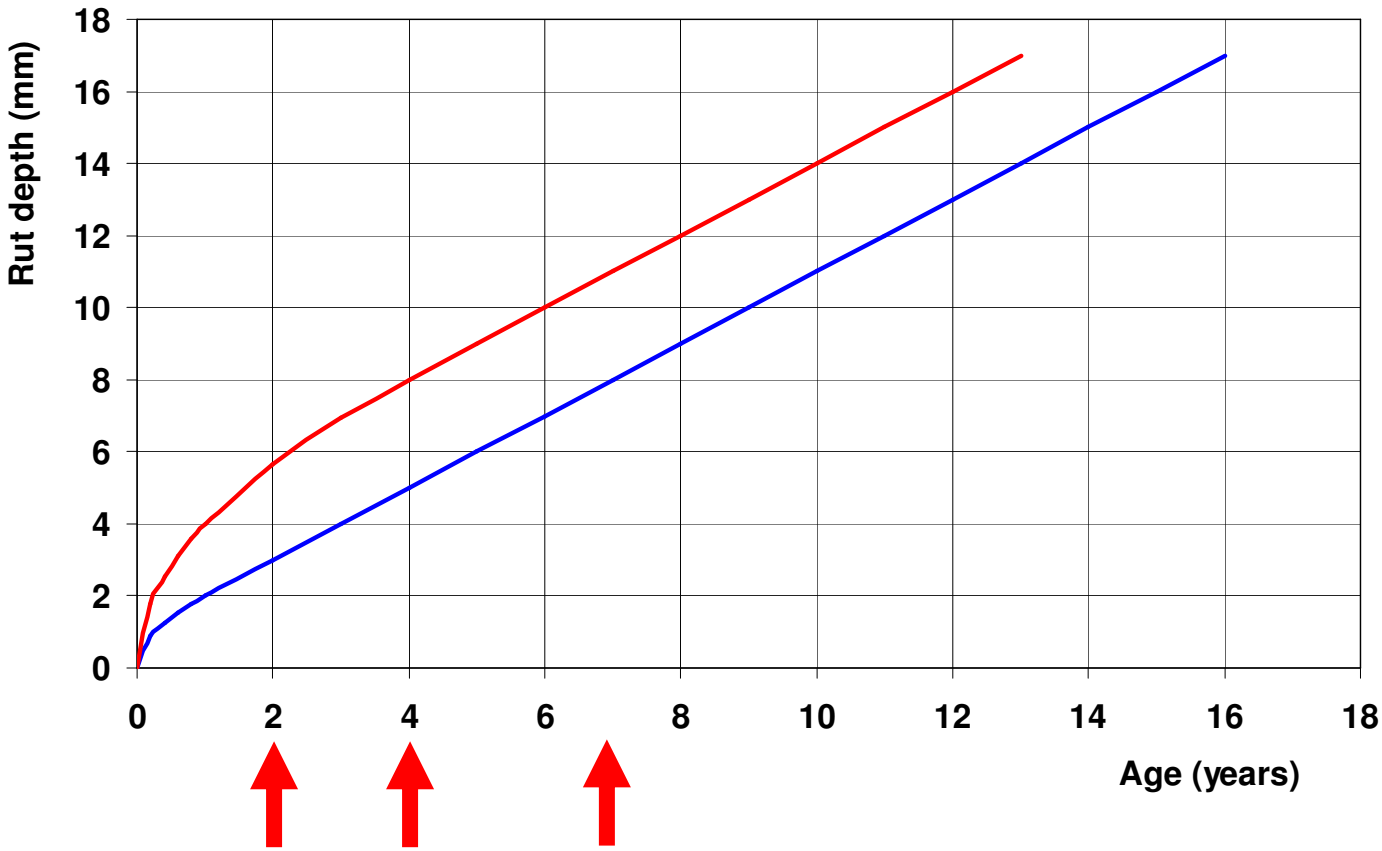


Longitudinal evenness



Measurements at traffic speed using laser/SDP-systems

Transversal evenness



Measurements at traffic speed using laser technology

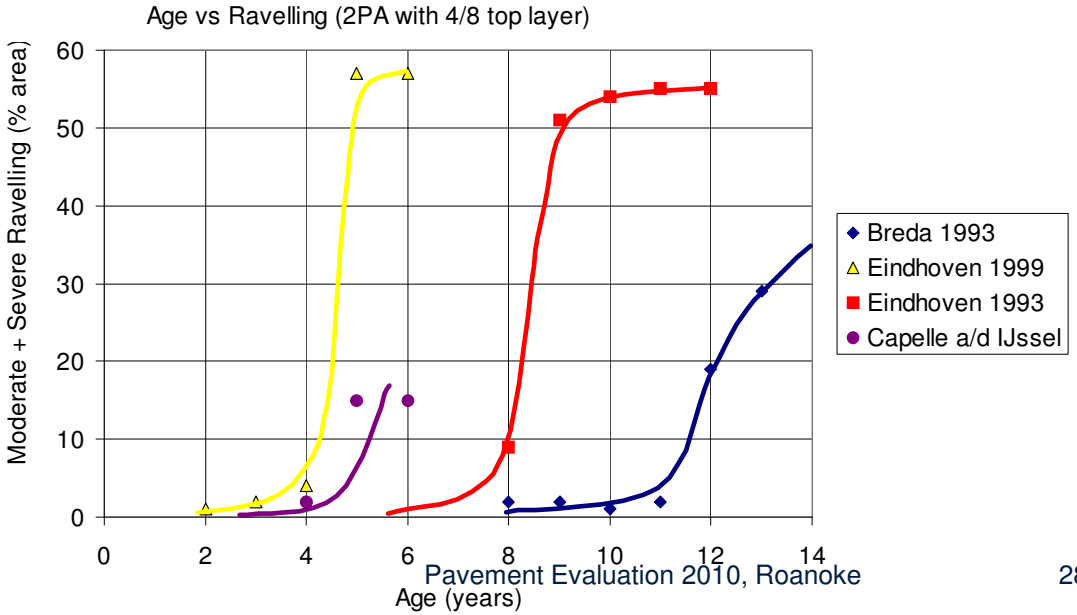
Ravelling PA

Slight

Moderate

Severe

- Influenced by
  - wrenching tires
  - low temperatures

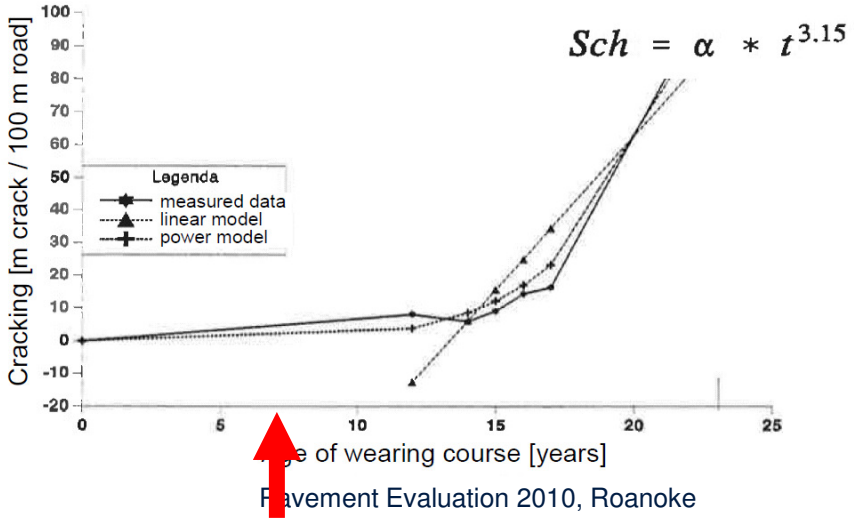


Monitoring Ravelling PA

- Ravelling hard to qualify & quantify in VC
- Development of automated detection
  - using 2D-texture lasers (CROW, 1999)
  - LCMS (RWS, 2009)
- Using automated detection
  - using (2D-) texture lasers
    - simultaneously with friction measurements
  - LCMS (3D)
    - every 2 years

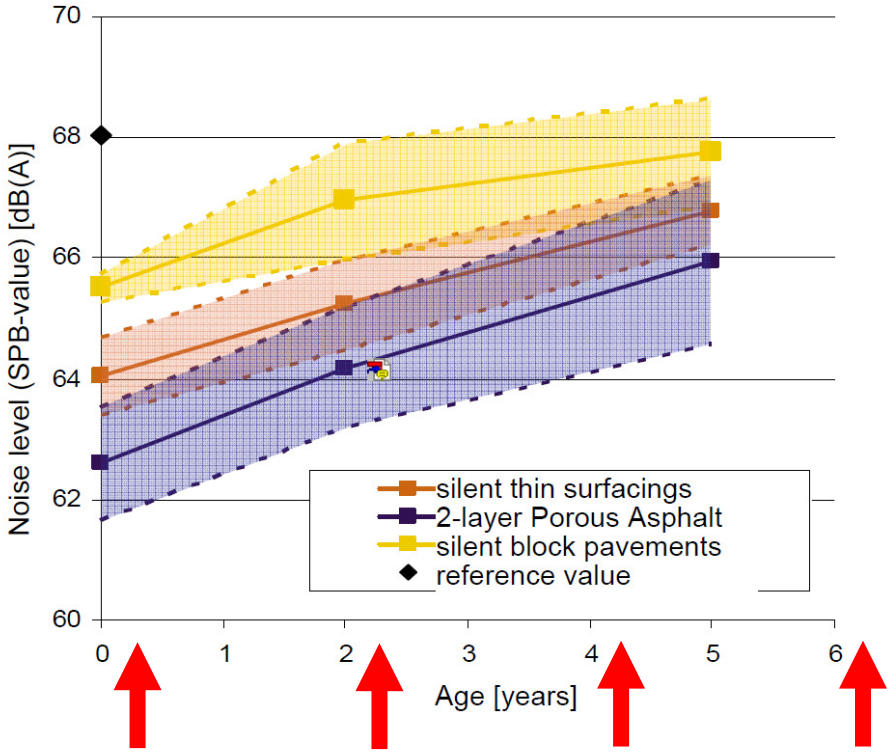
Cracking

- Cracking is not representative for the Dutch highway system
- Development of automated crack detection lower priority
- VCS at end of contract period is adequate (up till now)



Noise reduction

- CPX-measurements (Close Proximity) at 80 km/h combined with
- SPB-measurements (Statistical Pass By)



Conclusions

- It is possible for contractors to compose a monitoring program
- This smart and lean Monitoring program is based on long term pavement behaviour
  - service life
  - ‘shape’ of behaviour during service life
- Measurements executed at traffic speed
  - safe
  - efficient
  - no disturbance of the traffic flow

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Questions??

Thank you for your kind attention!!