

KRACHT-GERELATEERDE BEOORDELLING VAN LASGEOMETRIE

Coenraad Esveld

Esveld Consulting Services

SCHADE DOOR SLECHTE LASGEOMETRIE



FORCE-BASED ASSESSMENT OF WELD GEOMETRY

Paper Title: Force-based Assessment of Weld Geometry



7th World Congress on Railway Research

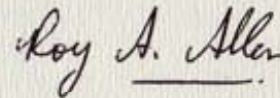
June 4-8, 2006

Montréal, Canada

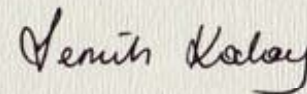
Best Paper Award
for Infrastructure
Winners

C. Esveld, M. Steenbergen

“Congratulations on your outstanding paper and contribution to the advancement of Railway Technology”

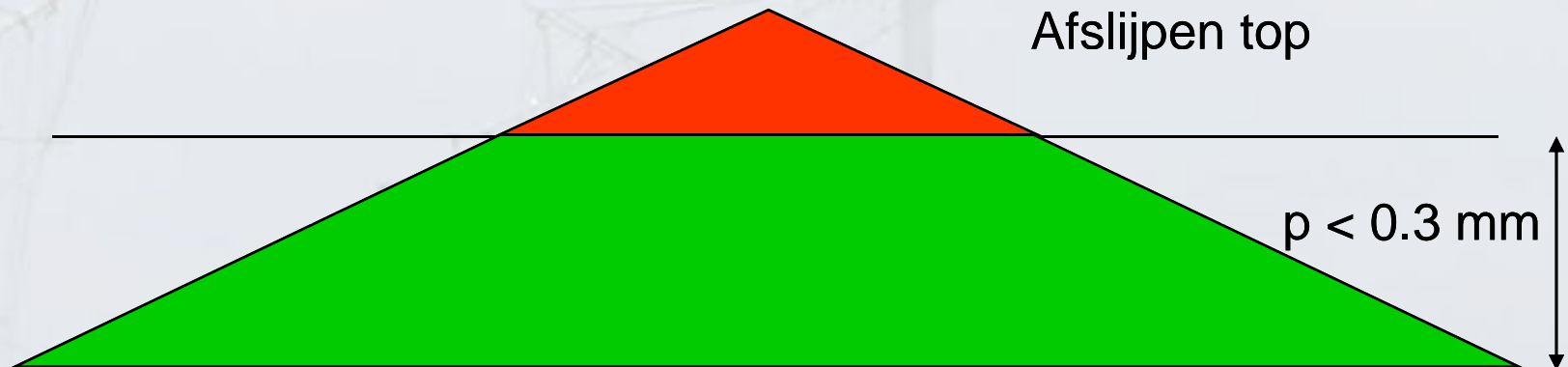


Roy Allen,
Chairman, Organizing Committee



Semih Kalay
Chairman, Executive Committee

HUIDIGE LASGEOMETRIE NORMEN

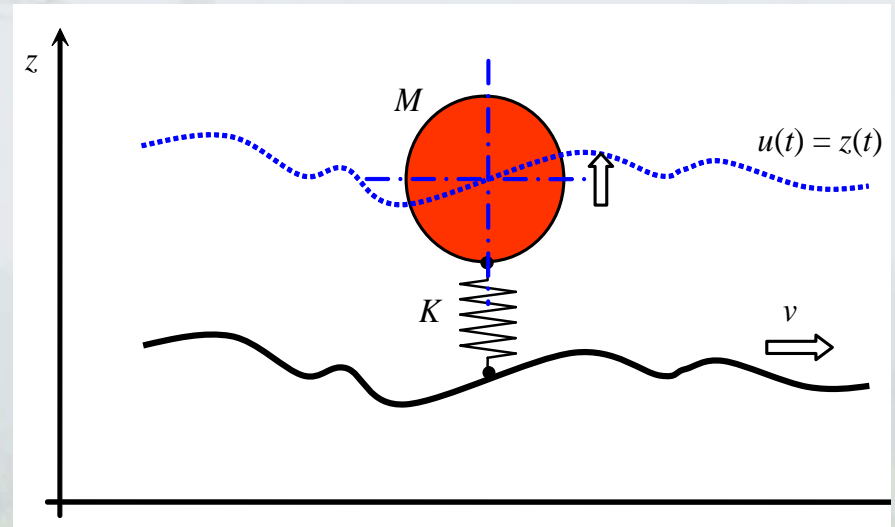


Bijvoorbeeld pijlwaarde: $0 < p < 0.3 \text{ mm}$

AANPAK VIA 1^{STE} AFGELEIDE

De dynamische contactkracht is een functie van de 1ste afgeleide:

$$F_{dyn} = C * v^2 \frac{dz}{dx}$$



NIEUWE NORMEN VERTICAAL

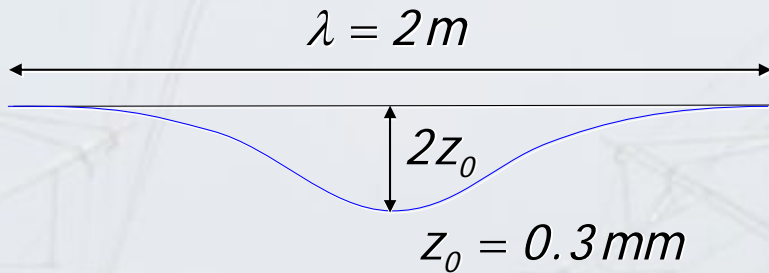
		Snelheid	F_{Dyn}	Helling
HH HSL	Conventioneel	40 km/h	5 kN	3.2 mrad
		60 km/h		2.8 km/h
		80 km/h	15 kN	2.4 mrad
		100 km/h		2.2 mrad
		140 km/h	35 kN	1.8 mrad
		200 km/h	65 kN	1.3 mrad
		300 km/h	140 kN	1.0 mrad
		100 km/h	50 kN	1.4 mrad

Implementatie in RAILPROF

Totale kracht in principe 225 kN

↑ $QI=1$

NIEUWE NORM VERSUS OUDE NORM



$$z = z_0 \sin \frac{2\pi x}{\lambda}$$

$$\begin{aligned} \frac{dz}{dx} &= \frac{2\pi}{\lambda} z_0 \\ &= \frac{2\pi}{2} 0.3 \approx 1.0 \text{ mrad} \end{aligned}$$

Snelheid	Pijl [mm]	Helling [mrad]
40 km/h	1.02	3.2
80 km/h	0.76	2.4
140 km/h	0.57	1.8
200 km/h	0.41	1.3
300 km/h	0.29	1.0
Oude Norm	0.30	1.0

Voor 80 km/h is nieuwe norm 2.5 maal gunstiger dan oude norm, mits korte golven zijn weggeslepen

NIEUWE NORMEN ZIJDELINGS

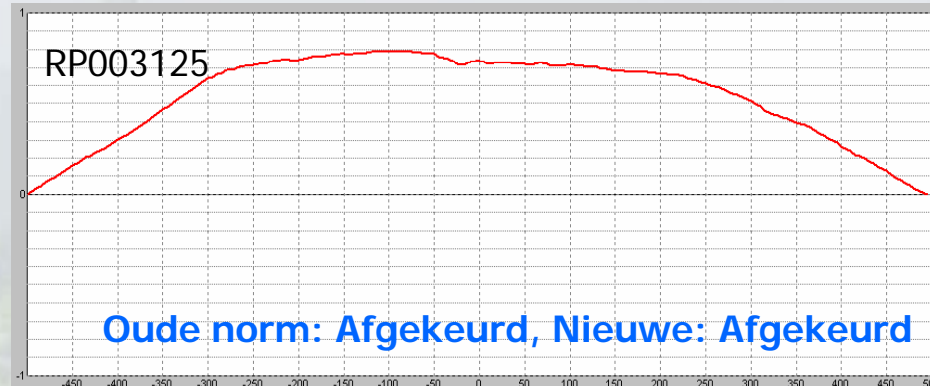
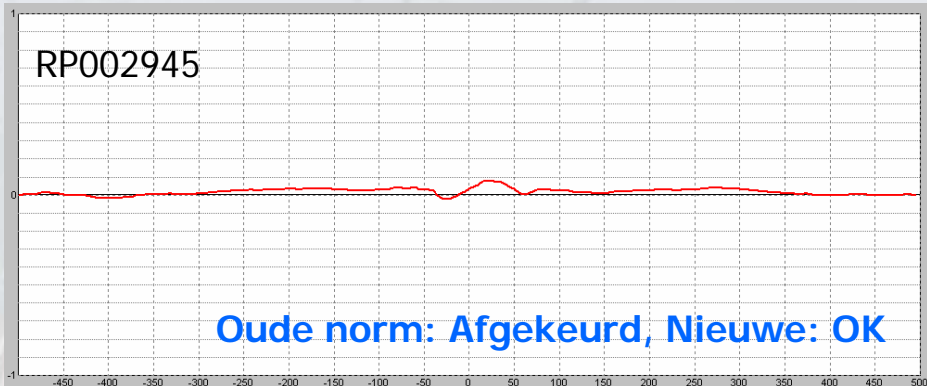
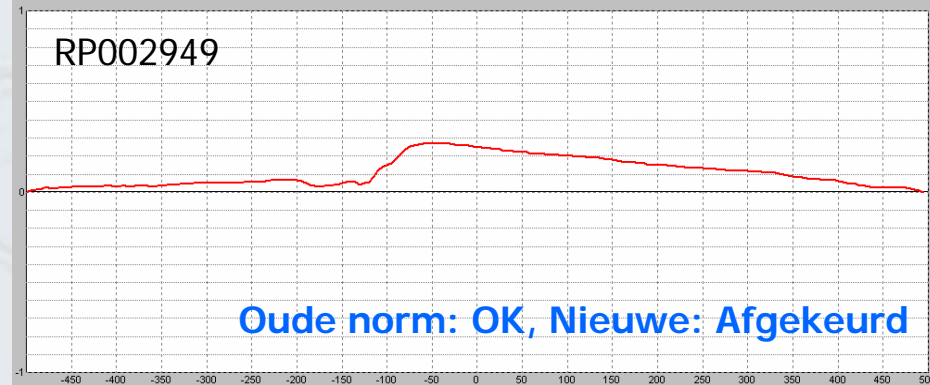
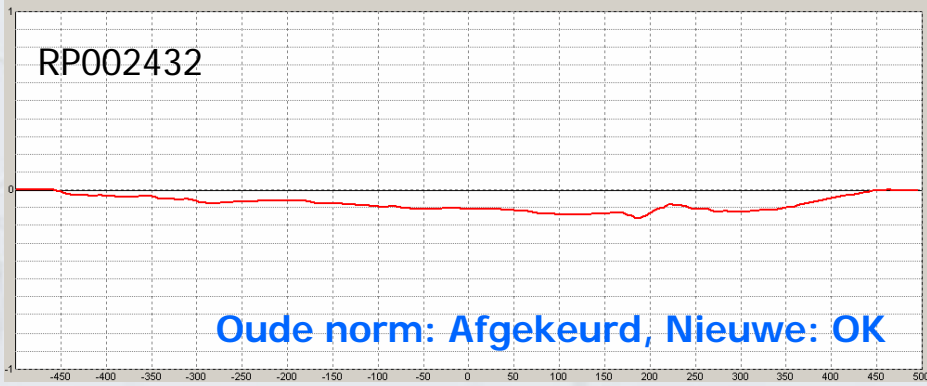
Snelheid	Pijlwaarde
40 km/h	1.0 mm
80 km/h	0.7 mm
140 km/h	0.5 mm
200 km/h	0.5 mm
300 km/h	0.5 mm

Implementatie in RAILPROF

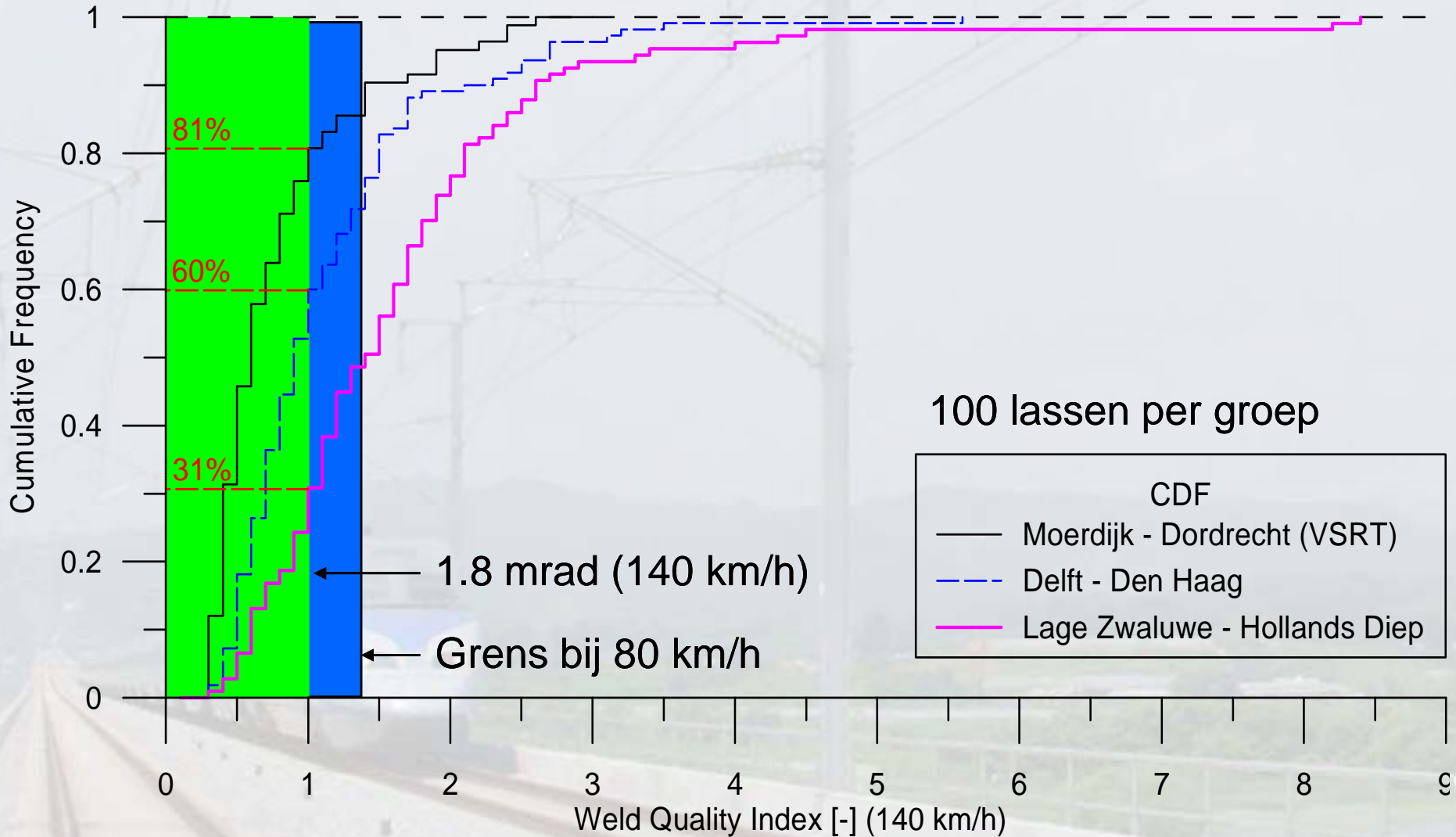


QI=1

BEOORDELING OUD EN NIEUW PRORAIL



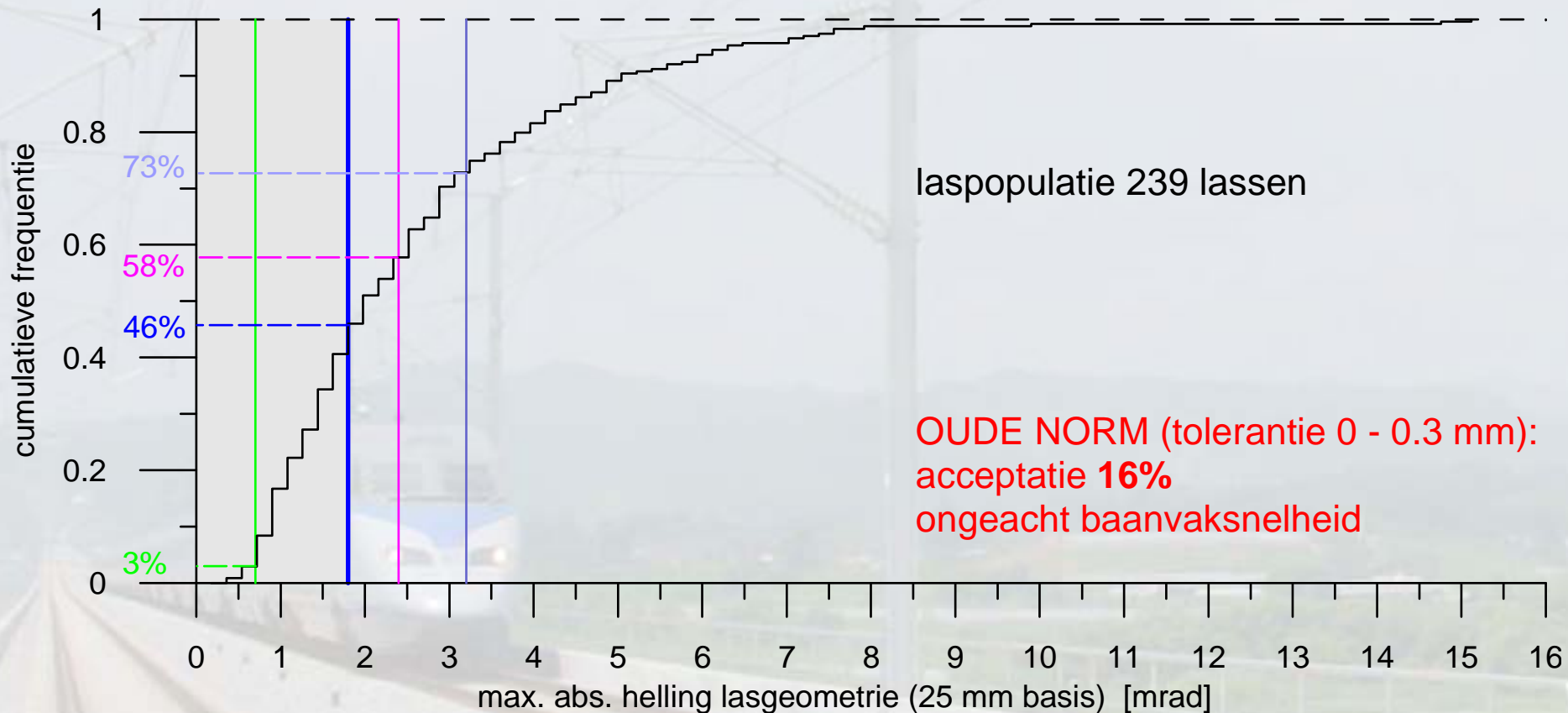
STEEKPROEF PRORAIL LASSEN



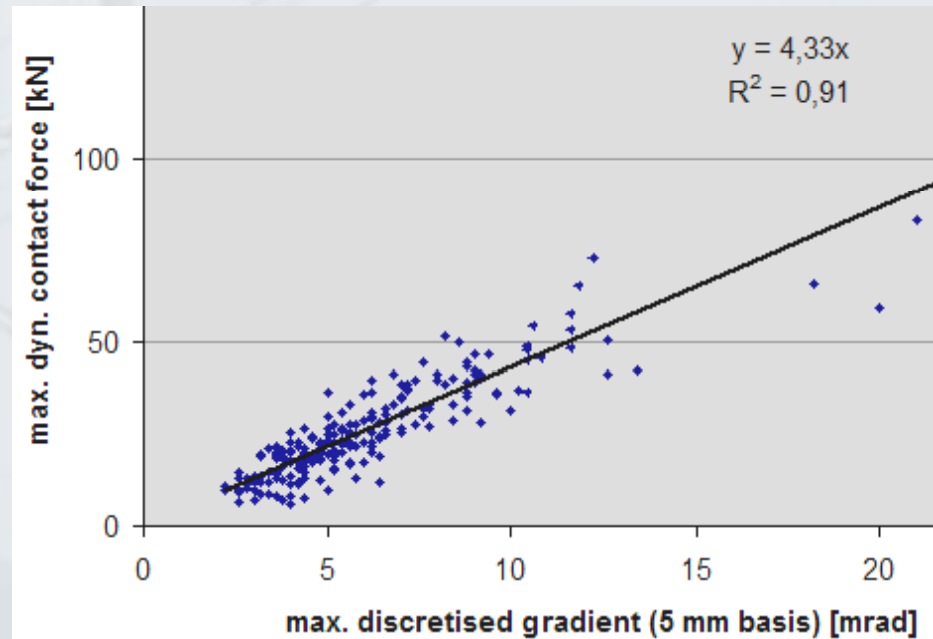
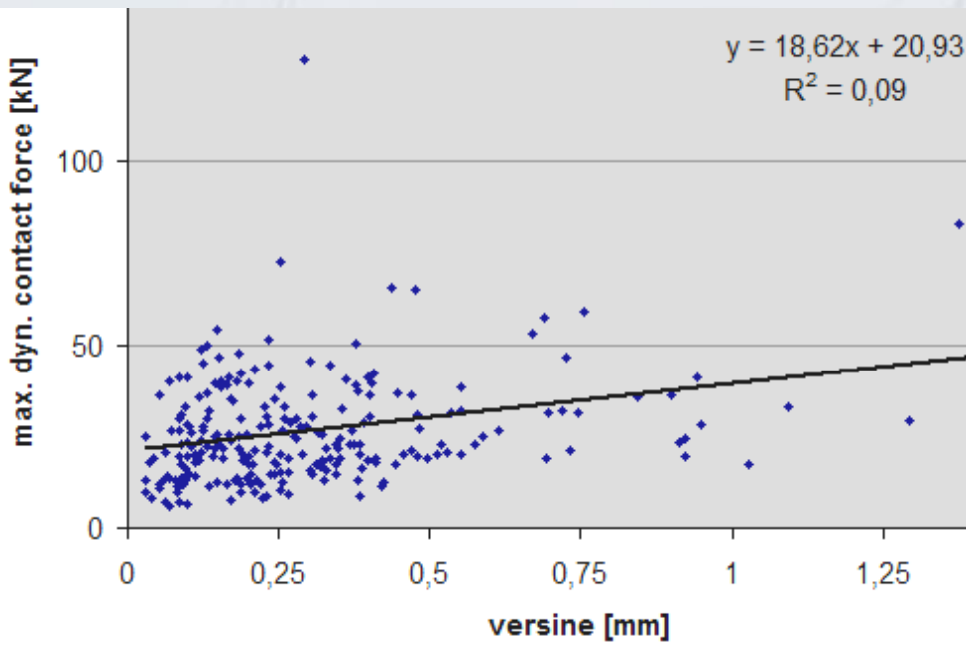
OUDE VERSUS NIEUWE NORM

NIEUWE NORM

300 140 80 40 km/h



BEREKENDE DYNAMISCHE KRACHTEN



Lage correlatie
kracht en pijlwaarde

Hoge correlatie
kracht en QI

PRACTISCHE IMPLEMENTATIE

Procedure:

- Sample lasgeometrie met digital meetrei;
- Filter gemeten signaal;
- Bepaal 1st afgeleide (helling);
- Normeer met interventiewaarde voor baanvaksnelheid;
- Bereken QI;
- $QI < 1$: OK, anders: slijpen.

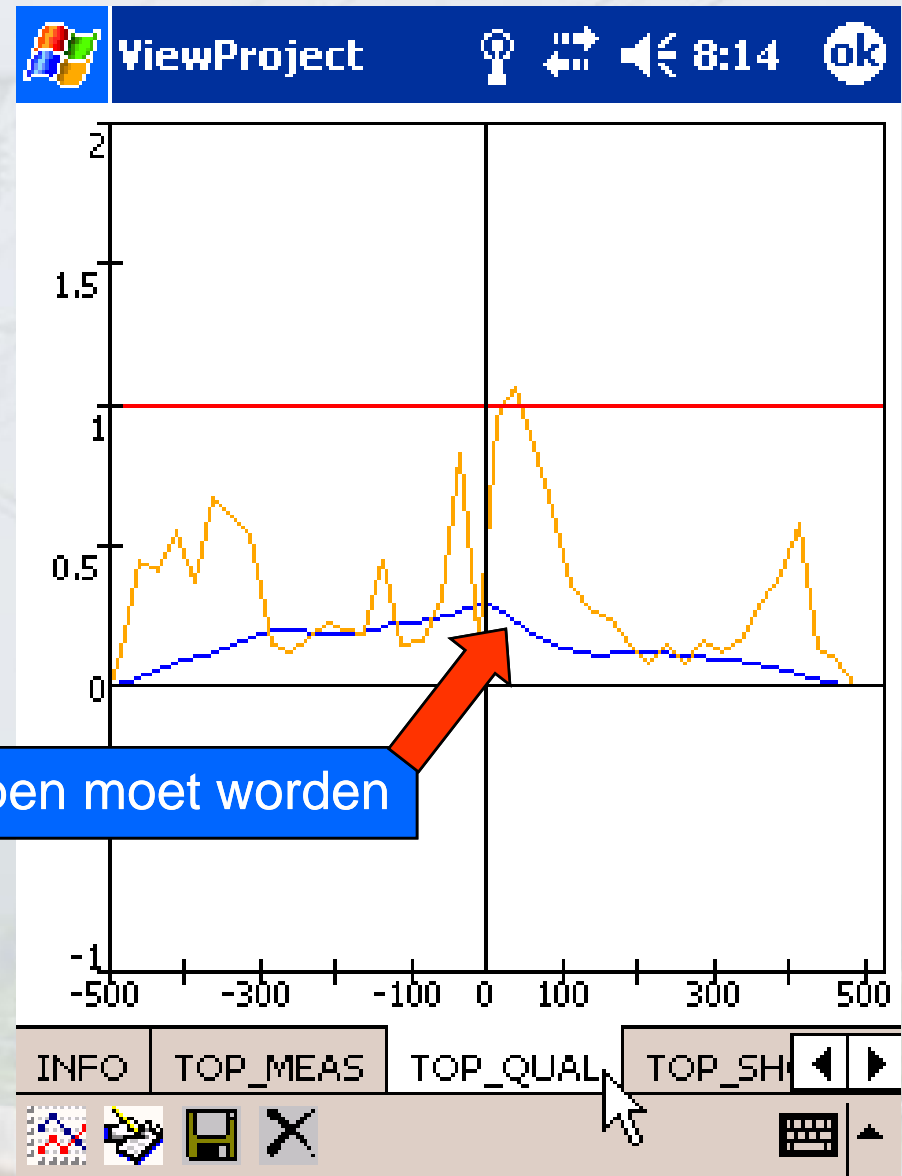
PRACTISCHE IMPLEMENTATIE



PDA SCHERM

V = 140 km/h
 QI = 1.06

QI toont eenduidig waar geslepen moet worden



Railprof GUI 2.1 - [D:\ECS_data\ECS\Ecs_files\Tdc\PDAPDA_metingen\]

Project Edit Tools Windows Help

Top Measurement Top Assessment Top Corrugation Top Trend Hor. Measurement Hor. Assessment

Legend: Norm (red), Measurement (blue), 1-st derivative (orange)

- Alle gegevens en grafieken kunnen op PC getoond worden;
- Resultaten direct in pdf-formaat naar opdrachtgever sturen.

Report Name: [List of reports]

Weld Number: 1234567890

Serial No: 4175

Report: RP4175200504021755.xml

Date: 02-04-2005

Time: 17:55

Job Number: 312000013

Operator: John

Location Code: Utrecht-C

Rail: 54E1

Rail L/R: R

Weld Type: SL

Switch/Km: 2345A

Track: UTRECHT - AMSTERDAM

Top Meas. results

Pos. versine [mm]	0.30
Neg. versine [mm]	0.00
Pos. inclination [mm/m]	0.82
Neg. inclination [mm/m]	-0.61

V [km/h] 140

Quality Top QI: 1.06

V [km/h]: 140

www.esveld.com

CONCLUSIES

1. Theorie volgens eerste afgeleide blijkt in de praktijk goed te werken;
2. Stalen meetrei absoluut ongeschikt;
3. Wel elektronische meetrei met QI-bepaling (RAILPROF);
4. Hoge correlatie van kracht met QI, lage correlatie met pijlwaarde;
5. Met QI-meting RAILPROF:
 - Je ziet wat je doet;
 - Hogere kwaliteit;
 - Minder afkeur mits lassen goed geslepen (ook negatieve lassen kunnen goed zijn);
 - Levensduurverlenging.