

**Band-wegdek interactie:
stil, schoon, zuinig?**





Band-wegdek interactie: stil, schoon, zuinig?

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Technische Universiteit Eindhoven

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Onderzoek TU Eindhoven

VEILIG
(Stuurgedrag, comfort)



SCHOON
(Rolweerstand,
band en wegdekslijtage)

STIL
(Geluid binnen en
buiten het voertuig)

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Inhoud

- Wat is rolweerstand?
- Rolweerstand & Milieu
- Invloedsfactoren
- Rolweerstand-Grip-Geluid

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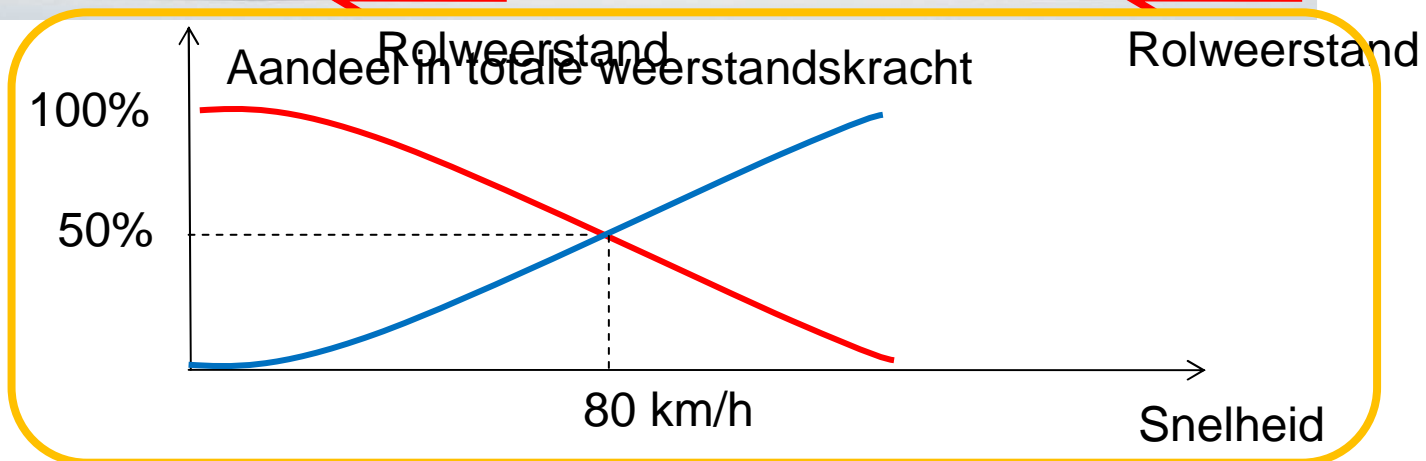
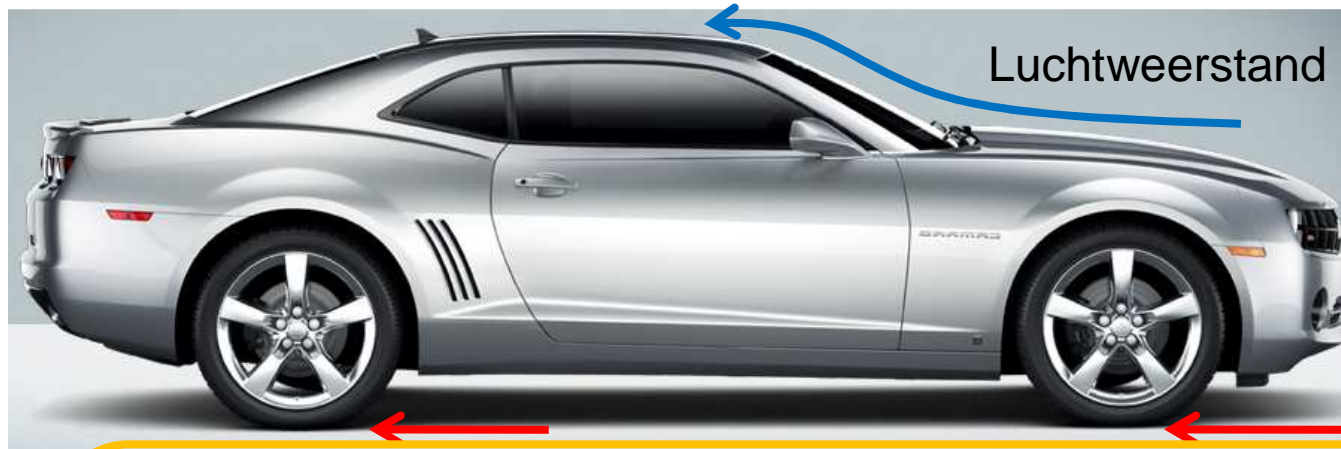
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Weerstand leidt tot brandstofverbruik

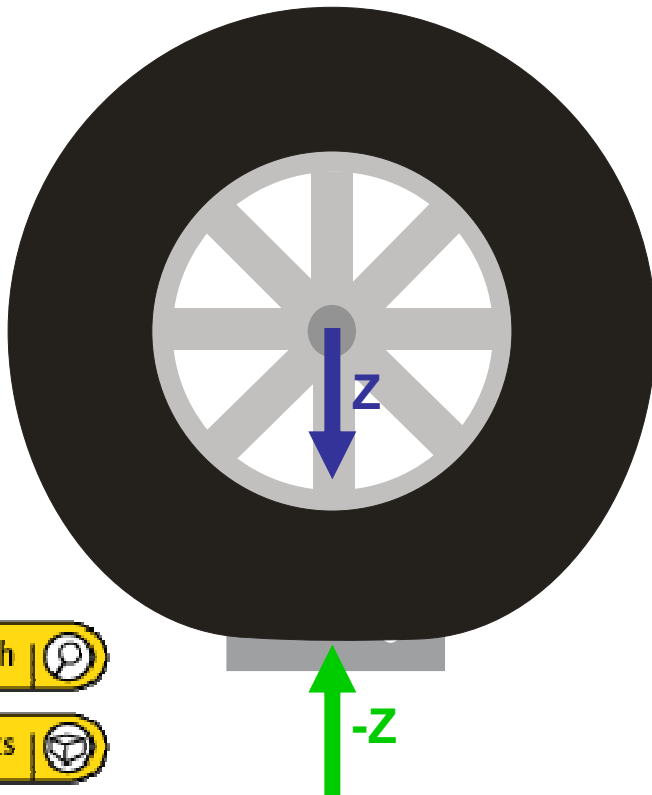


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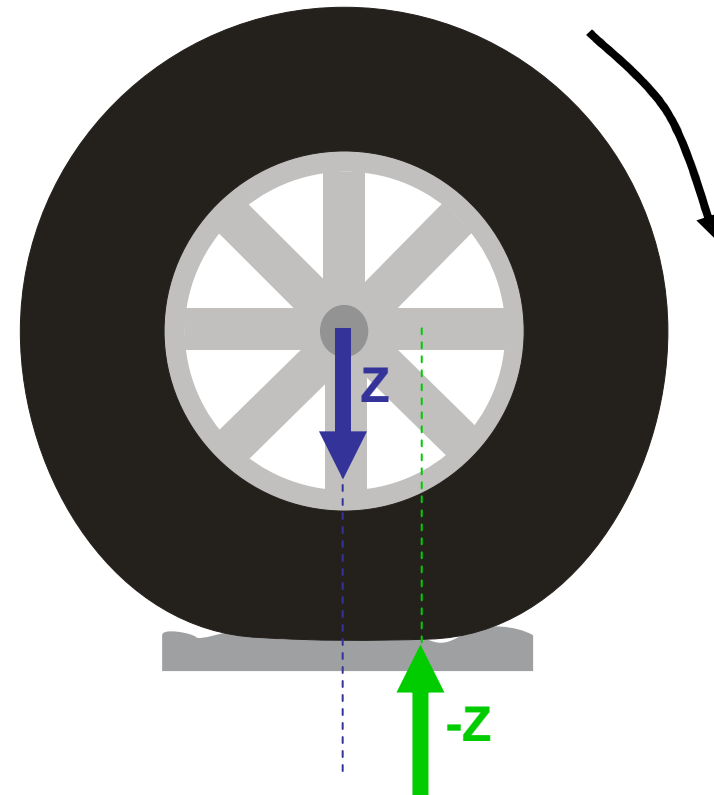


Wat is rolweerstand?

STILSTAAND



ROLLEND



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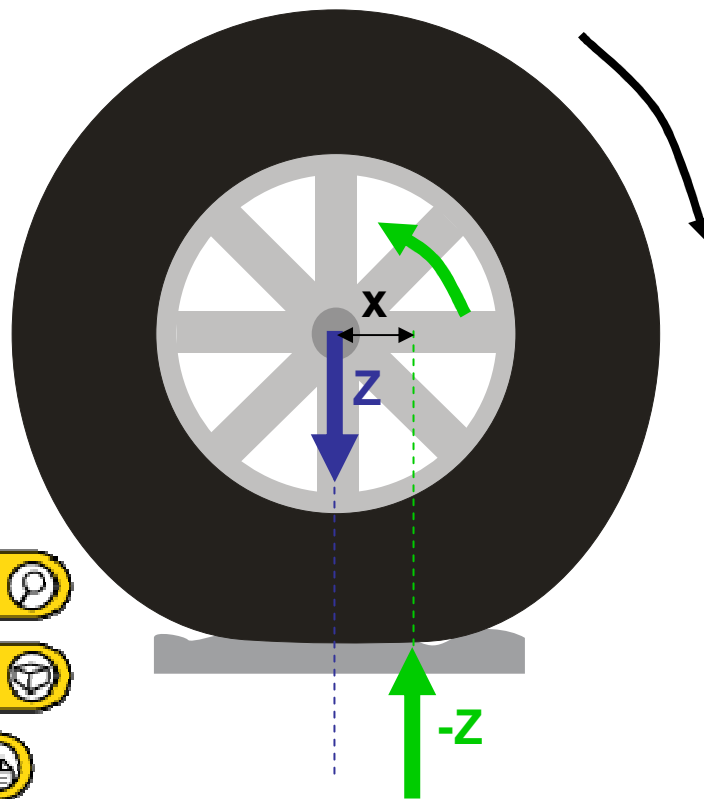
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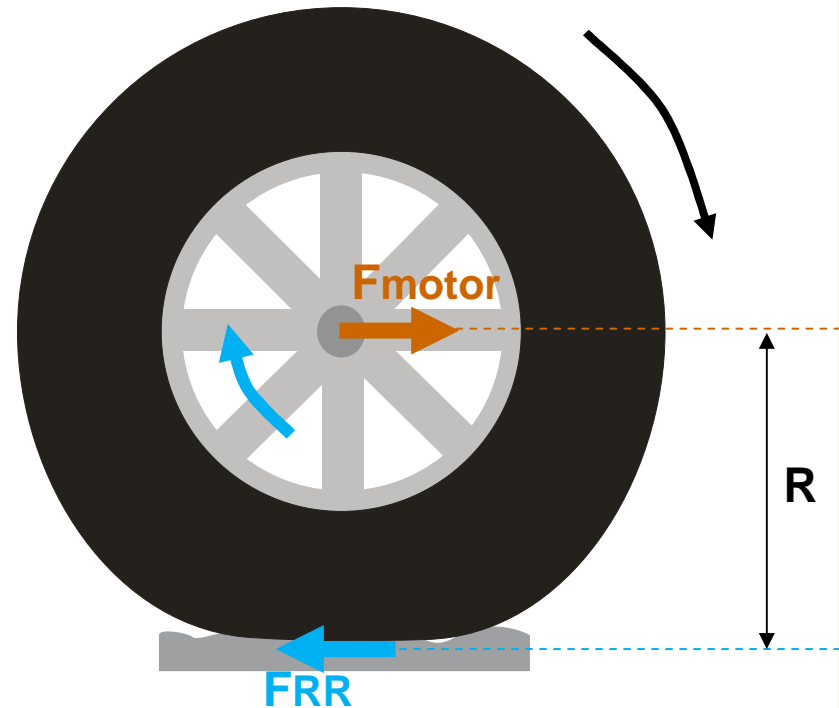


Wat is rolweerstand?

MOMENT



TEGENMOMENT

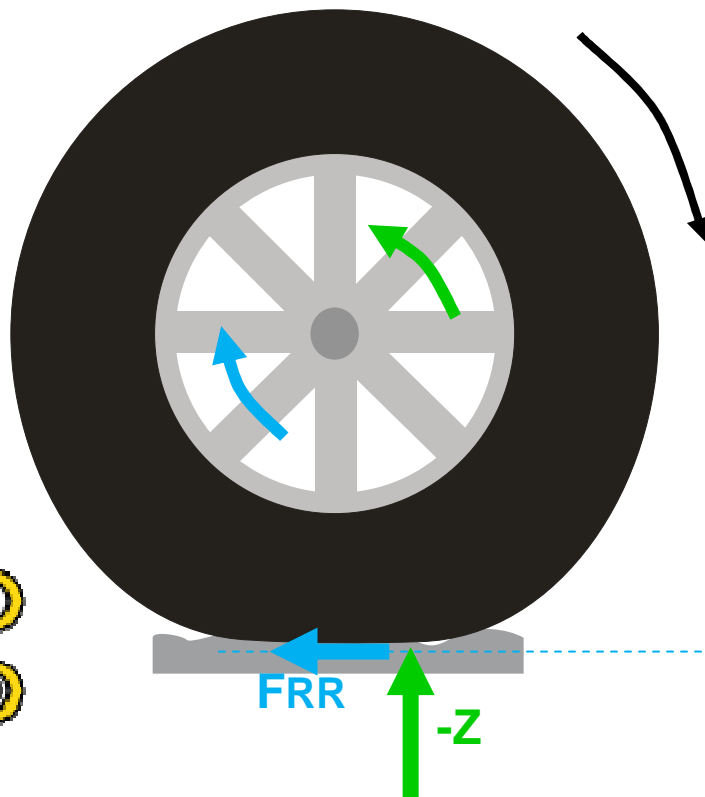


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Wat is rolweerstand?

EVENWICHT



- Rolweerstandscoefficient

$$C_{RR} = F_{RR}/Z$$

- Autobanden 0.8 - 1.2%
 - Vrachtwagenbanden 0.4 - 1%
- Oorzaak: Energie verlies door herhaalde deformatie

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Rolweerstand & Milieu

- 10% minder rolweerstand betekent:
 - Auto's: 0.5 tot 1.5 % minder brandstof
 - Vrachtwagens: 1.5 tot 3 % minder brandstof
- Minder brandstofverbruik → minder CO₂ uitstoot en minder NO_x, PM₁₀ uitstoot
- PM₁₀ door uitlaatemissie is 70% van het totaal.

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Invloedsfactoren

- Band
 - Viscoelastische eigenschappen van rubber
 - Afmetingen, opblaasdruk, belasting
- Wegdek
 - Textuur
 - Impedantie
- Voertuig
 - Snelheid
 - Wielophanging

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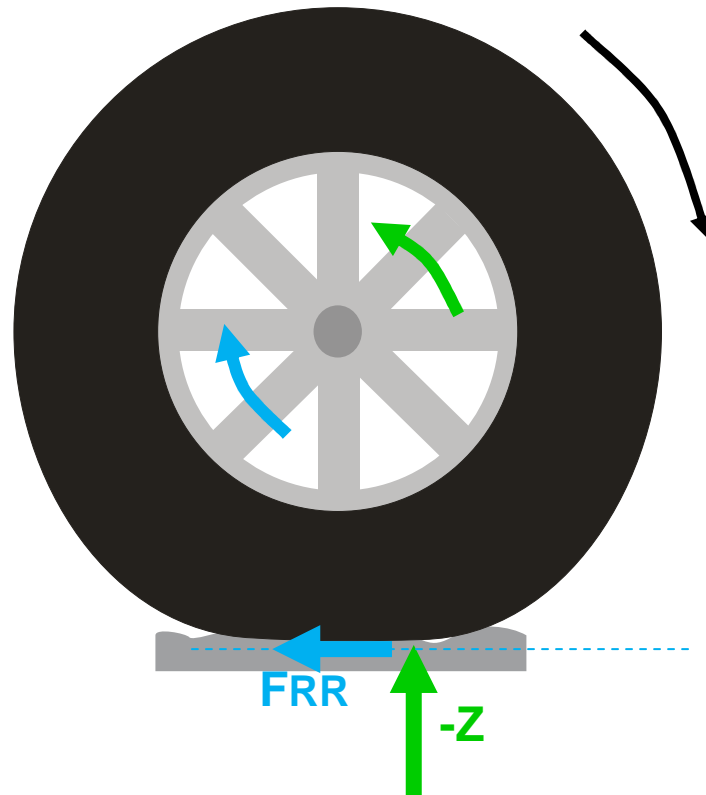
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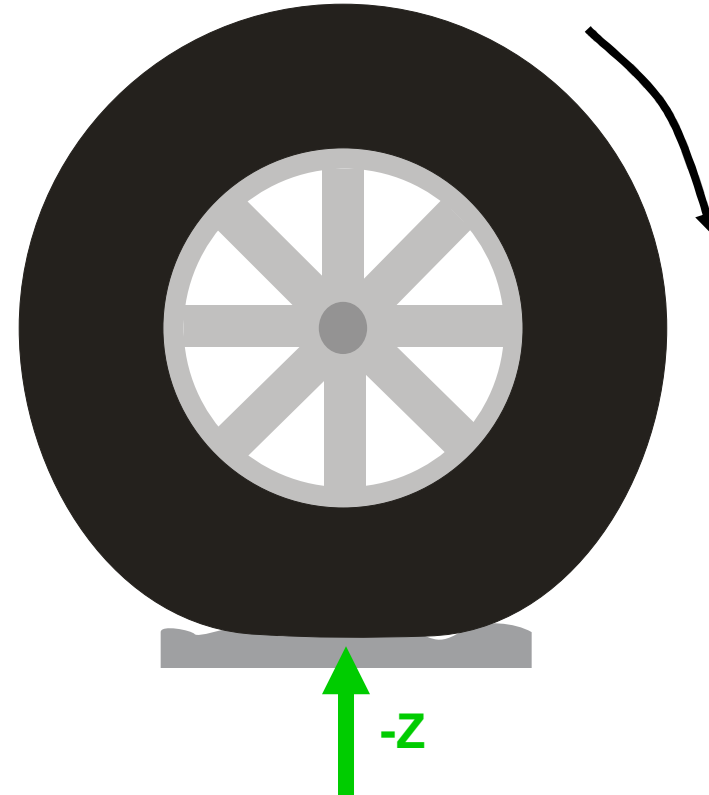


Rolweerstand & Rubbereigenschappen

Demping



Geen demping



Oplossing: Zuiver elastische rubber maken?

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Geen rolweerstand ...

GEEN GRIP!



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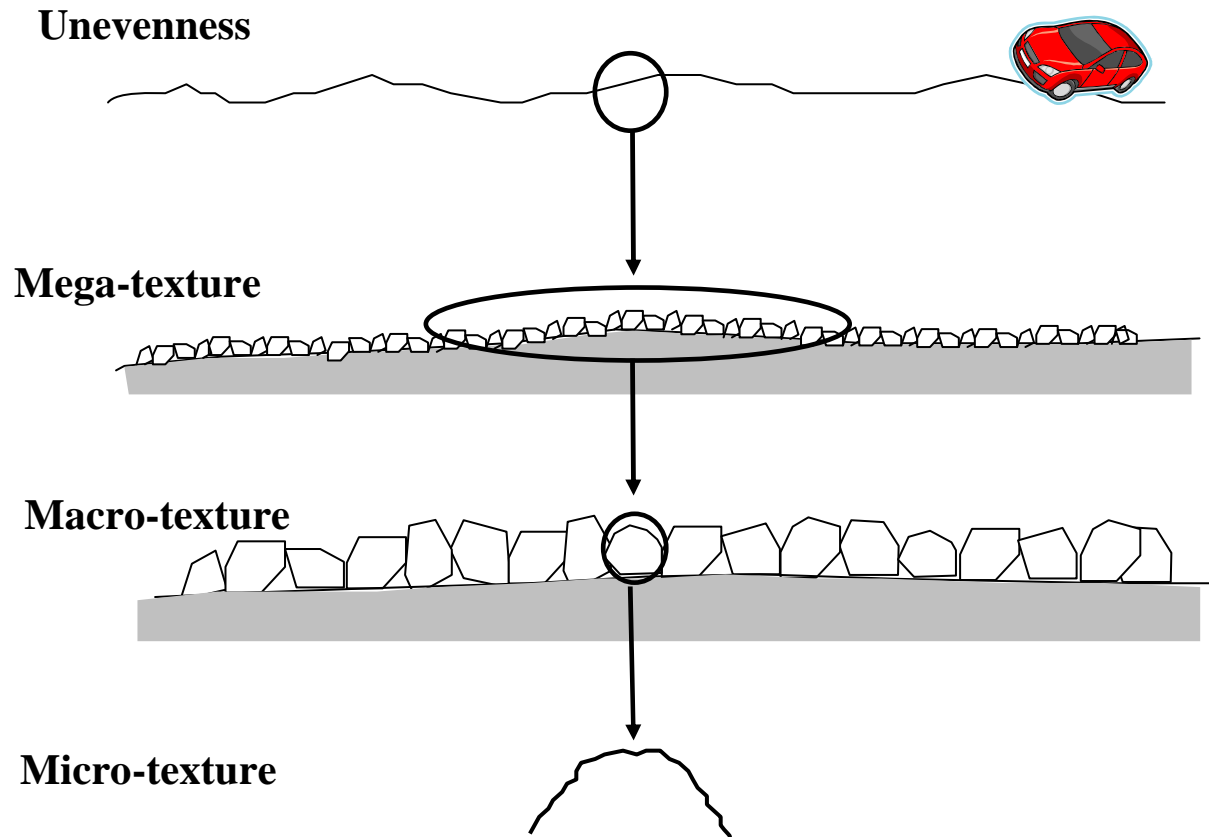
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Rolweerstand & Textuur



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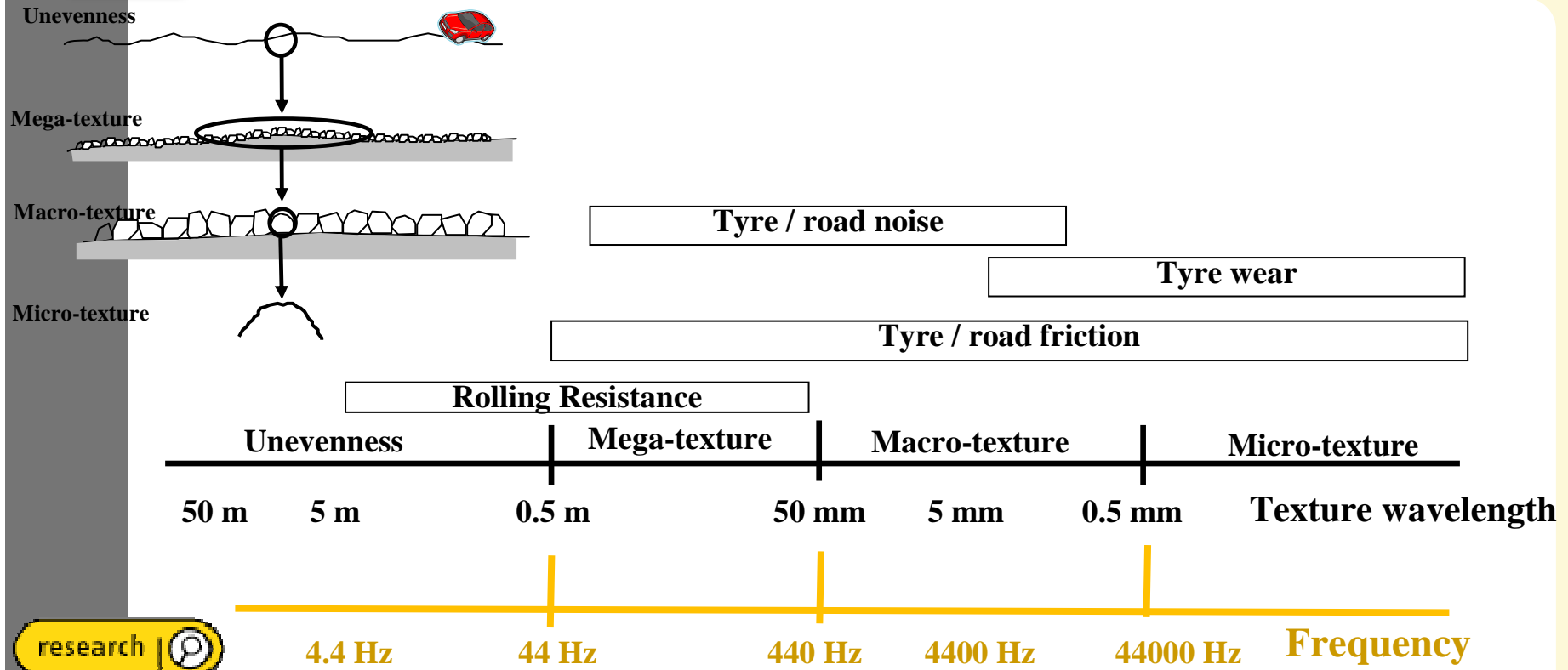
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Rolweerstand & Textuur



Frequenties bij 80 km/h

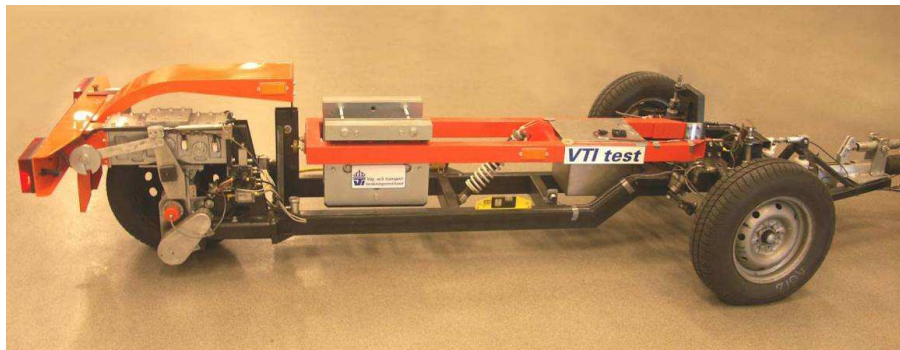
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Rolweerstand metingen

Meetsysteem TU Gdansk



Proefvakken Kloosterzande



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Wegdek types



ISO



SMA



DAC



Thin layered asphalt



PAC



Double layer PAC



Rubberized surfaces



Surface dressings

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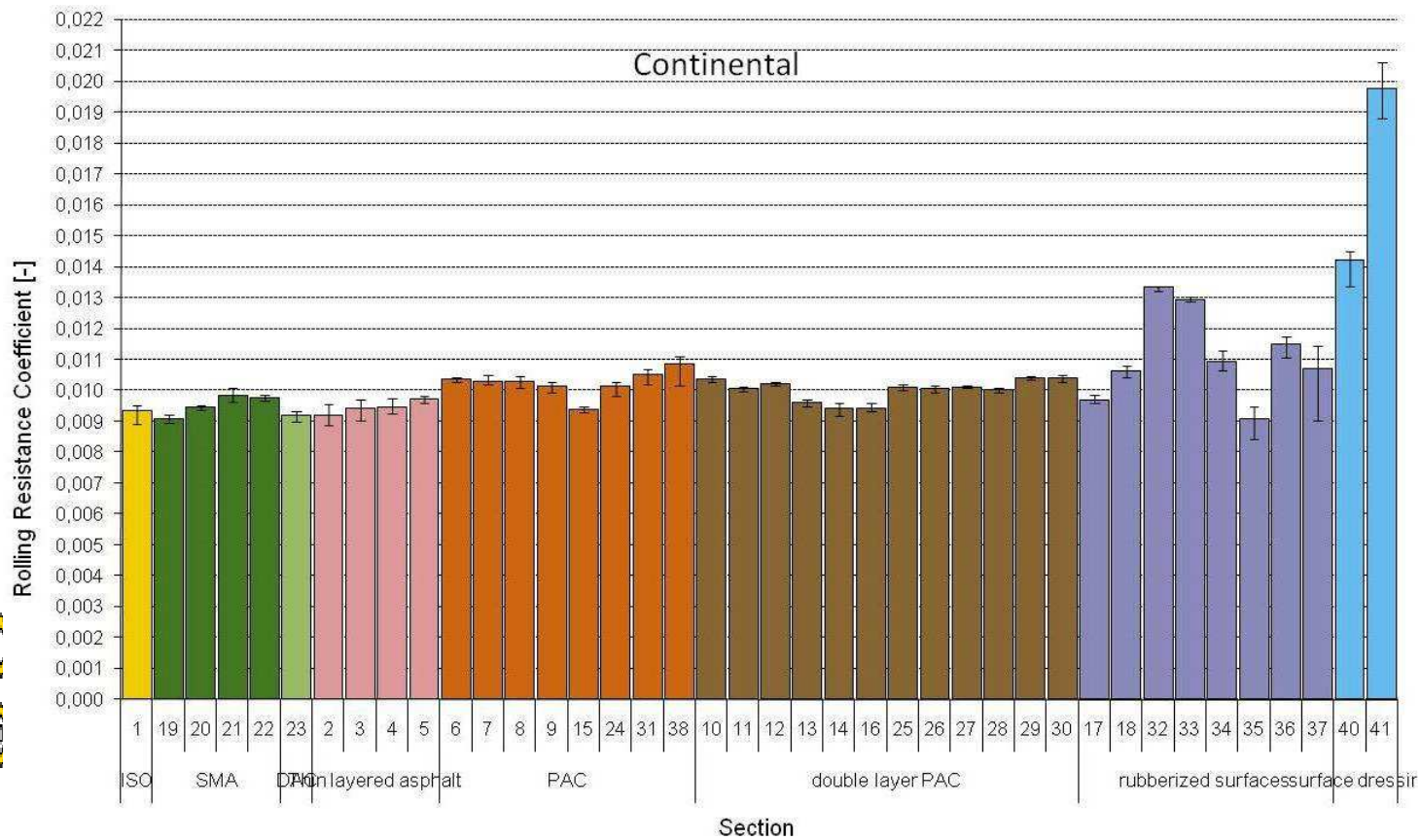


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Rolweerstand voor alle proefvakken



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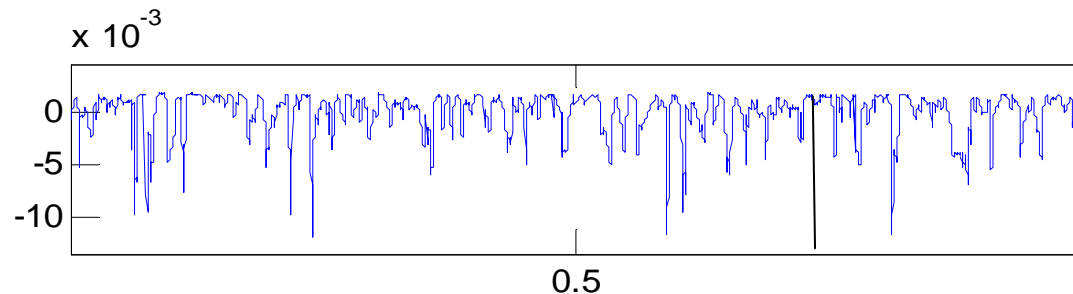
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Textuur metingen



Root Mean Square Profile Depth (RMS)

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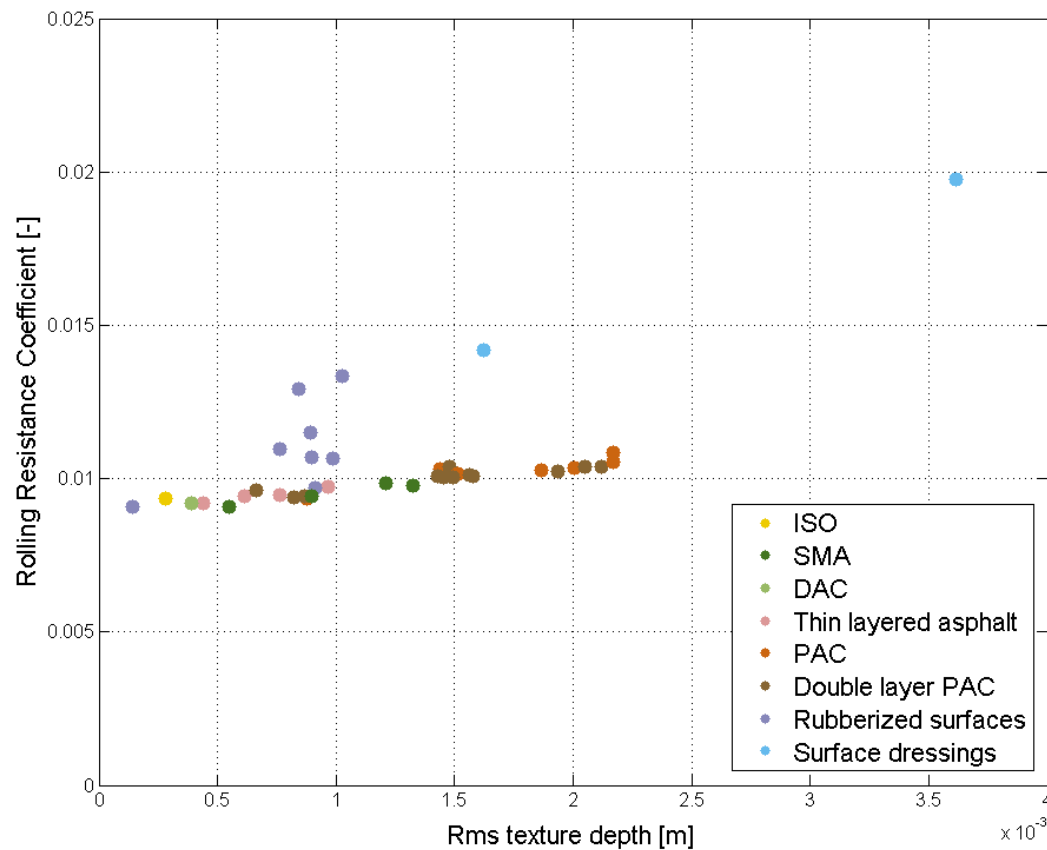
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Rolweerstand vs. RMS Texture Depth



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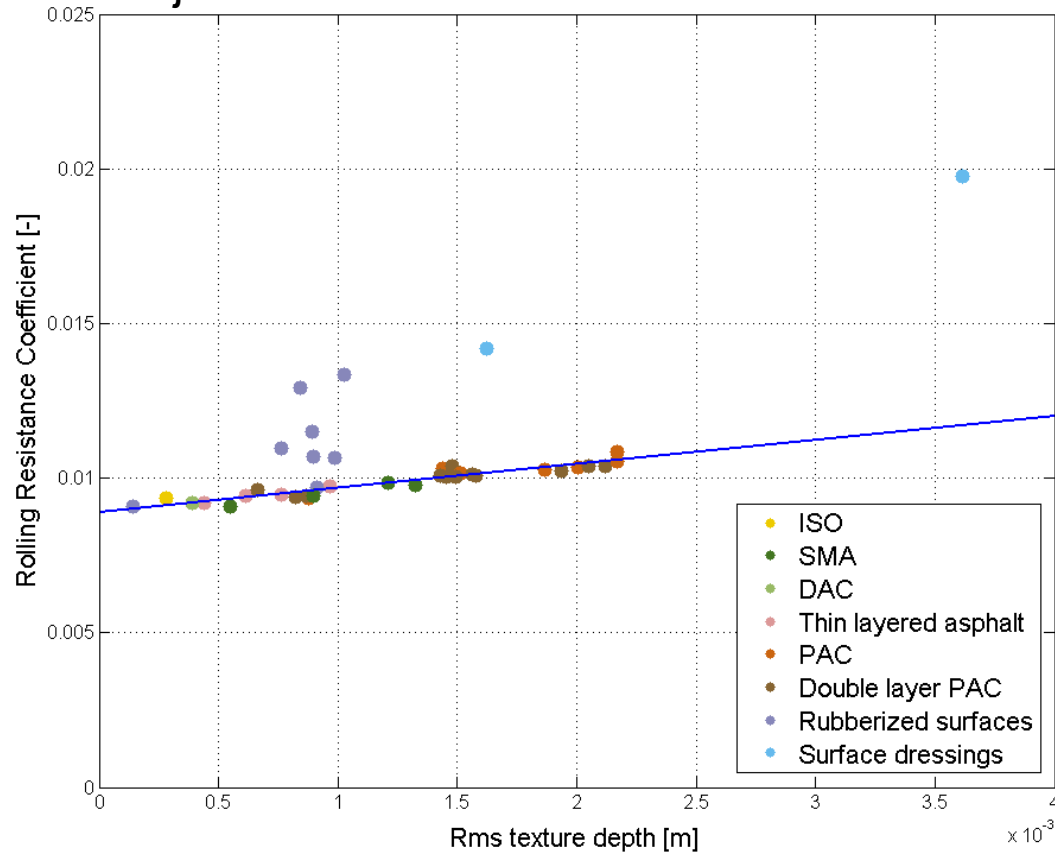
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Rolweerstand vs. RMS Texture Depth

Duidelijke correlatie tussen textuur en rolweerstand



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Rolweerstand vs. RMS Texture Depth

- Rolweerstand neemt toe met RMS Texture Depth
- 1 mm minder RMS Texture Depth betekent 10% minder rolweerstand
- Dus gemiddeld 2% minder brandstof verbruik

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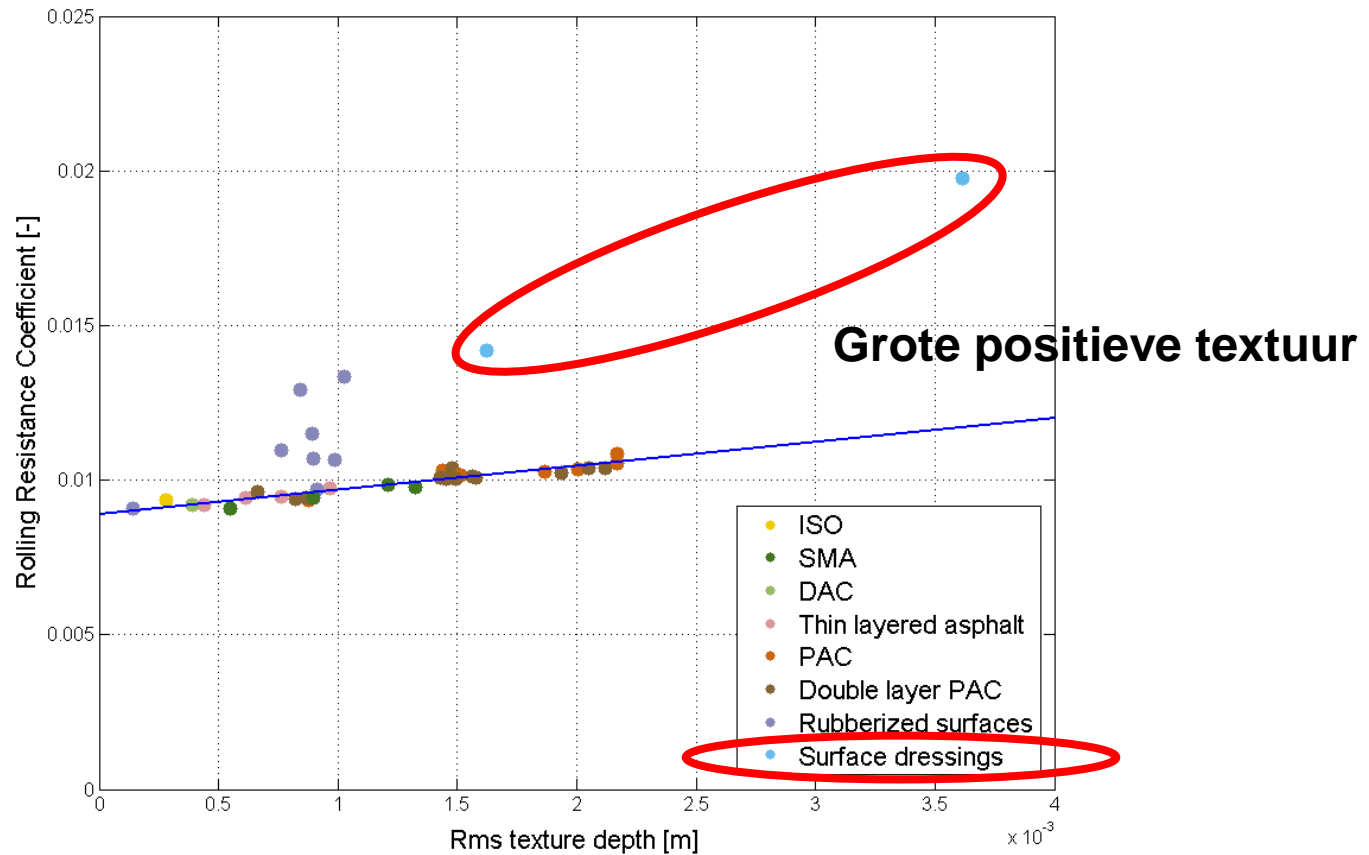
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Rolweerstand vs. RMS Texture Depth



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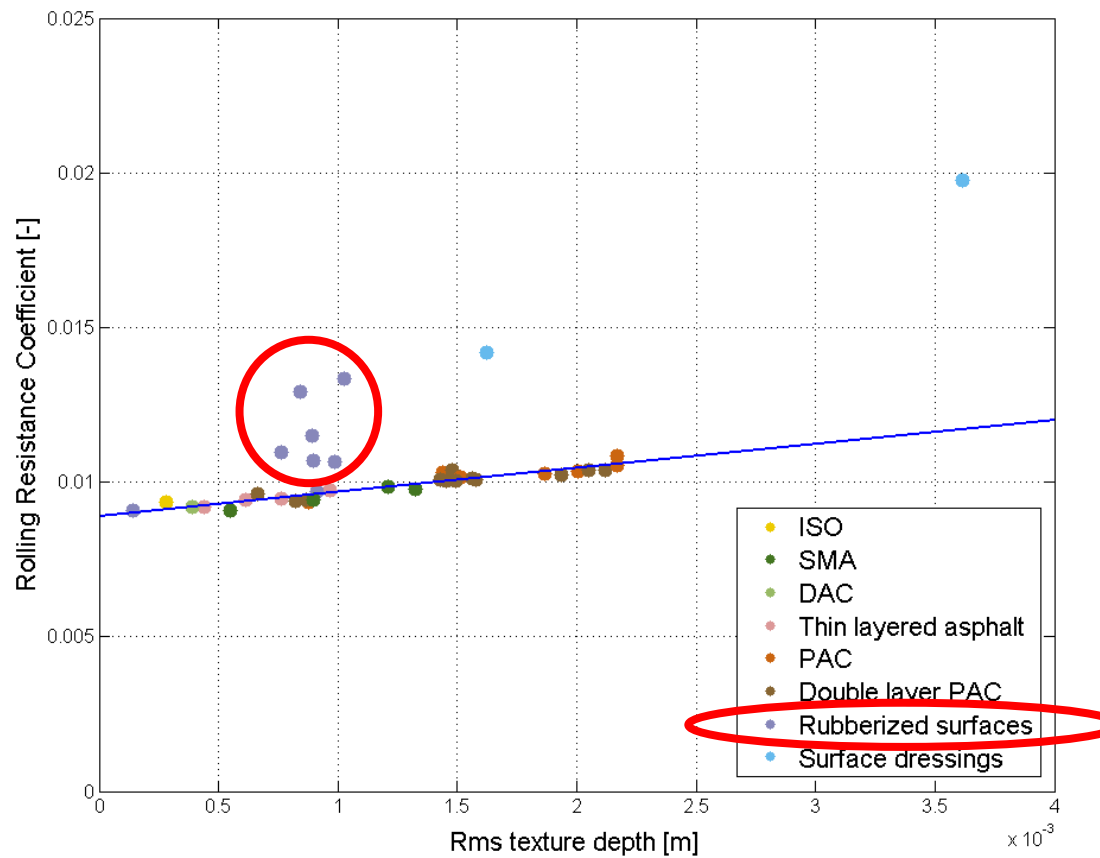
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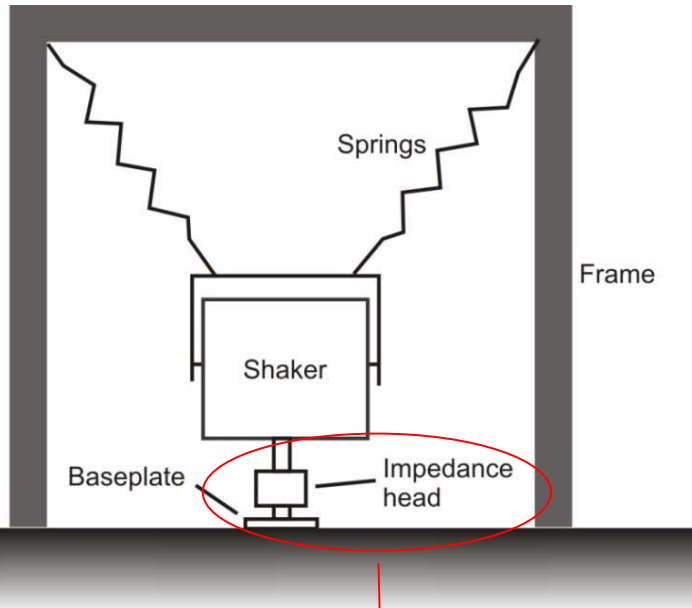
Rolweerstand vs. RMS Texture Depth



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Dynamischgedrag wegdek



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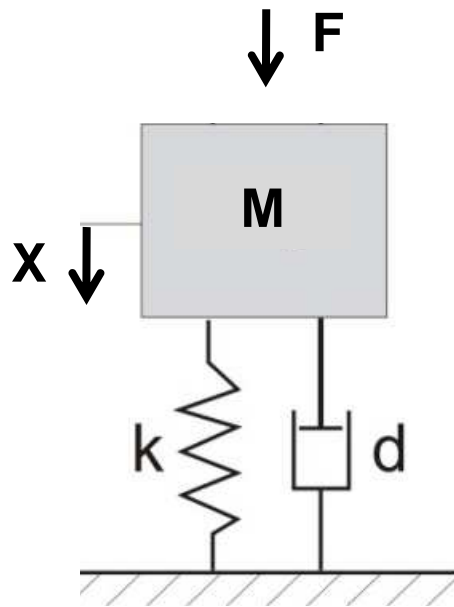
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Dynamischgedrag wegdek



Dynamische stijfheid: $Z = \frac{F}{X}$

Admittance: $A = \frac{X}{F}$

Verloren energie

$$E = \text{Re}\{F^*X\} = \text{Re}\{A^*F^2\}$$

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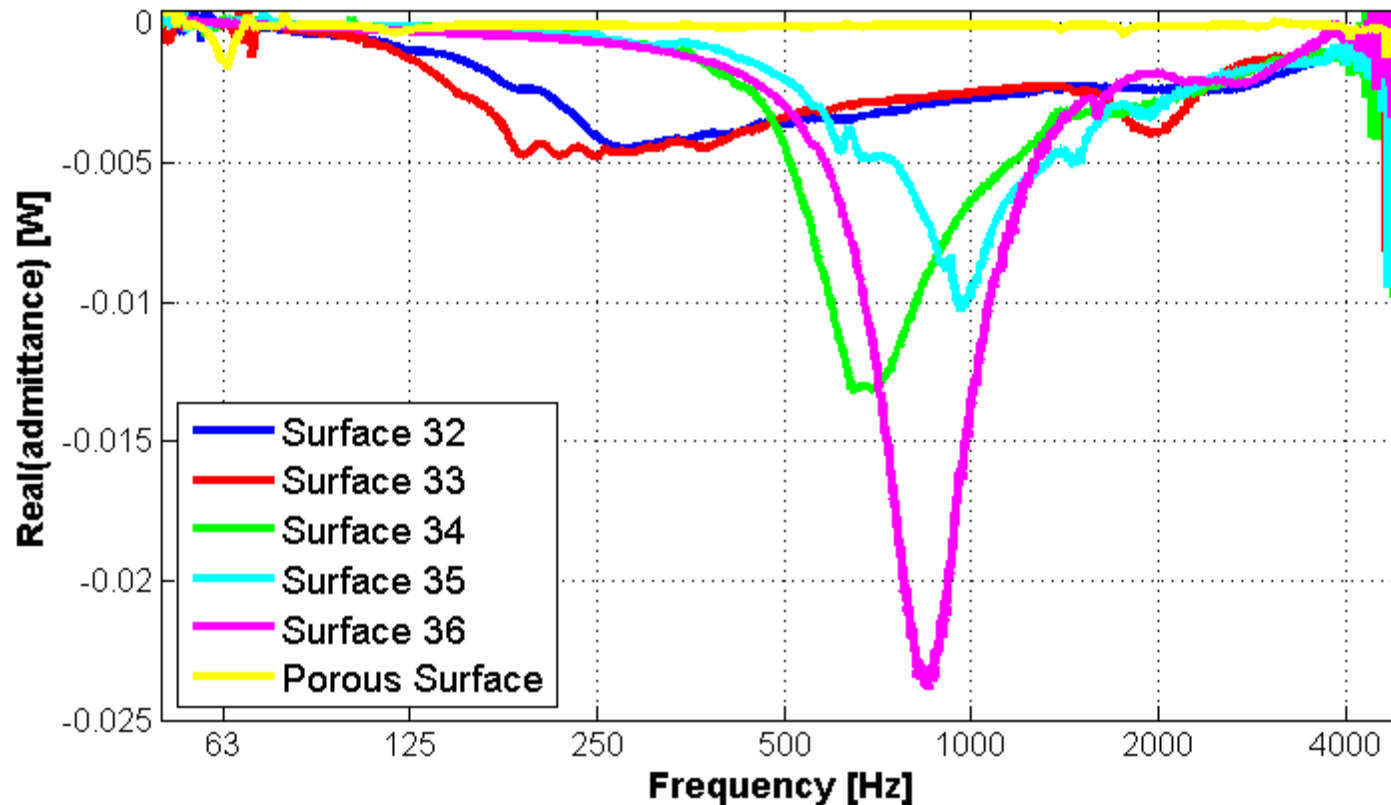
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Rolweerstand vs. Dynamisch gedrag wegdek

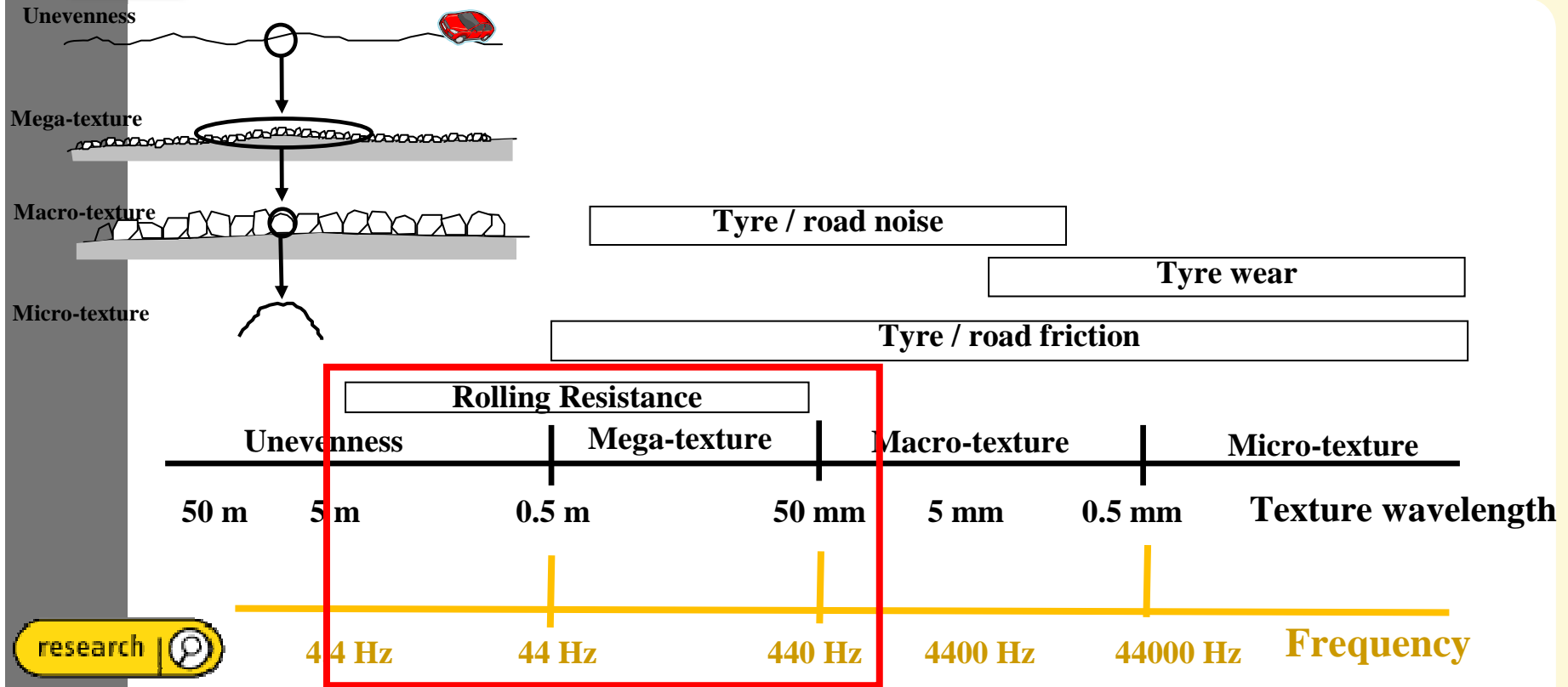
Real part of the admittance for a 1 N input force



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Rolweerstand & Textuur



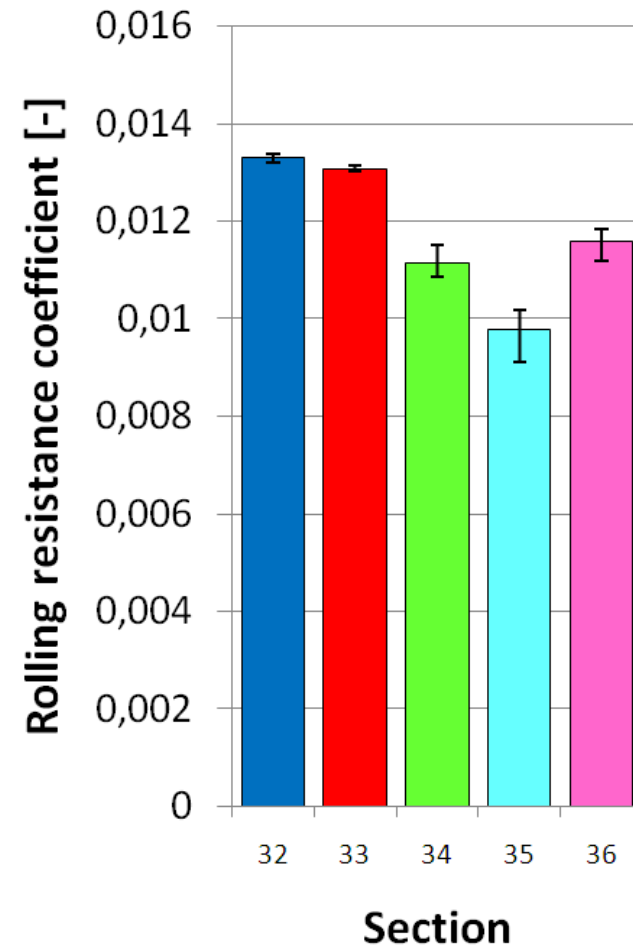
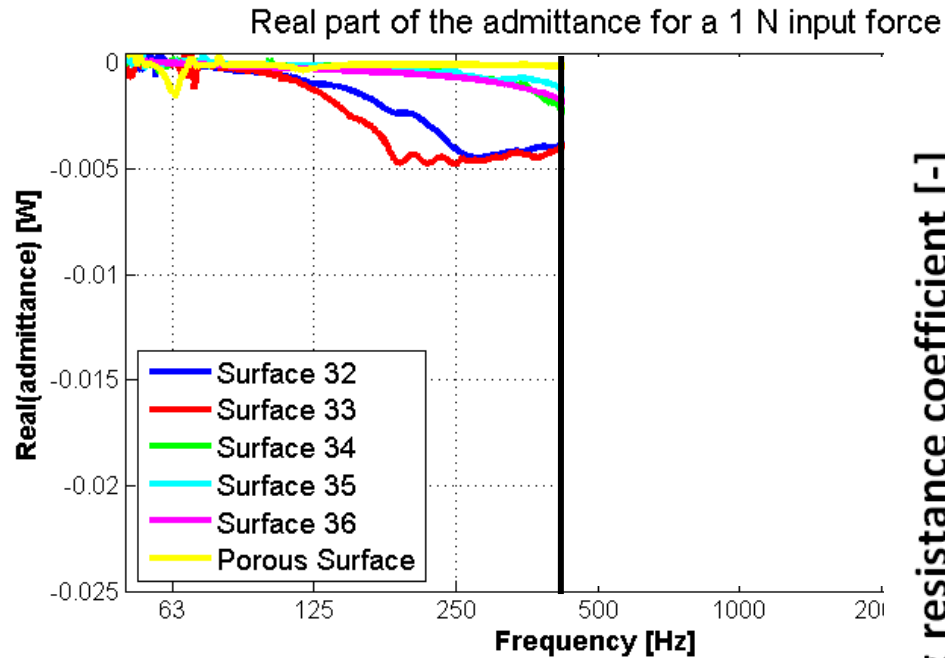
Frequenties bij 80 km/h

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Rolweerstand vs. Dynamisch gedrag wegdek



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Rolweerstand vs. Dynamische stijfheid

- Flexibele wegdekken kunnen hoge en lage rolweerstand veroorzaken.
- Meer damping op macro/megatextuur gebied = meer rolweerstand
- Invloed stijfheid??
- Onderzoek nodig om invloed van damping en stijfheid vast te stellen

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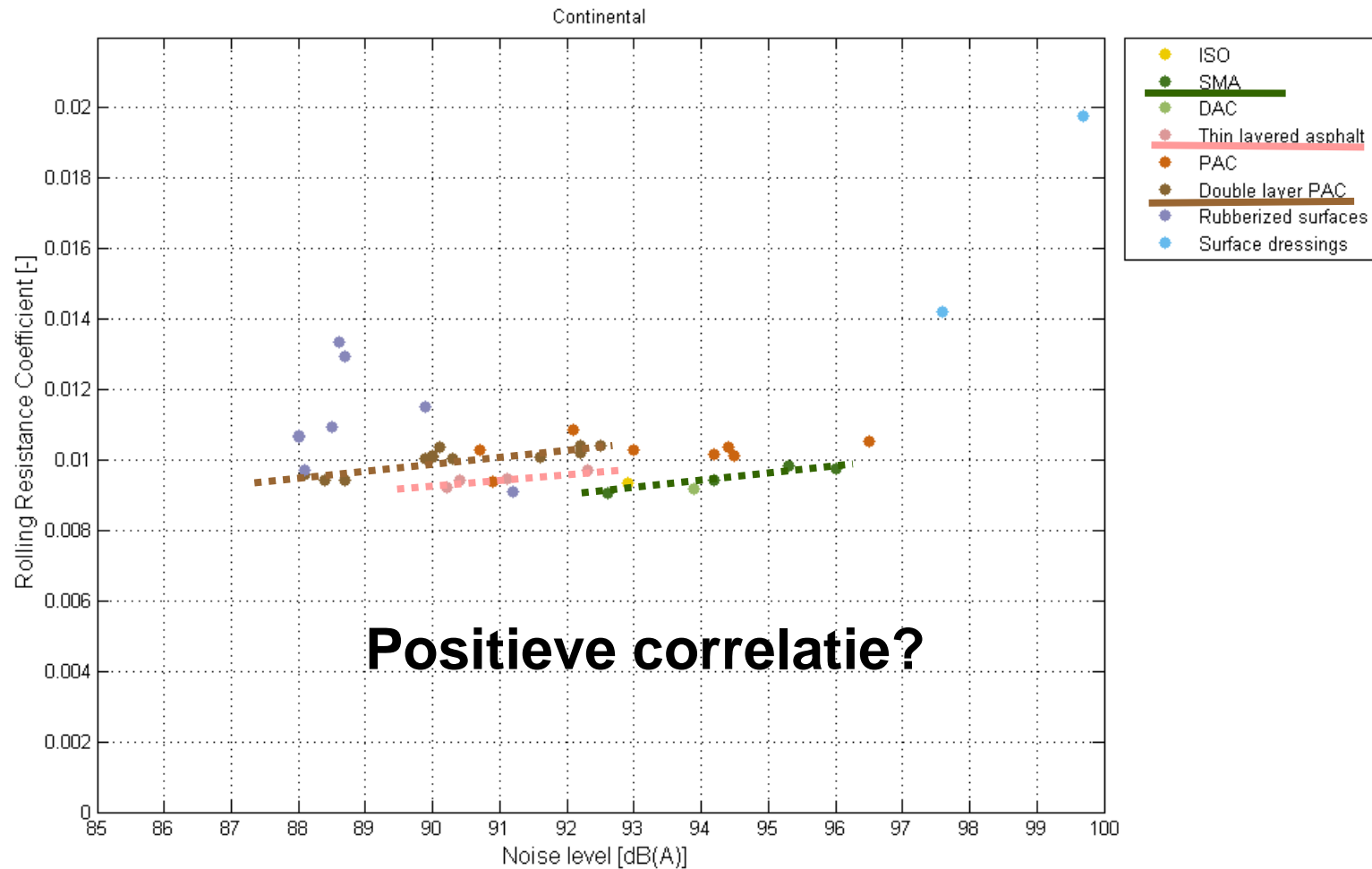


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Rolweerstand vs. Geluid



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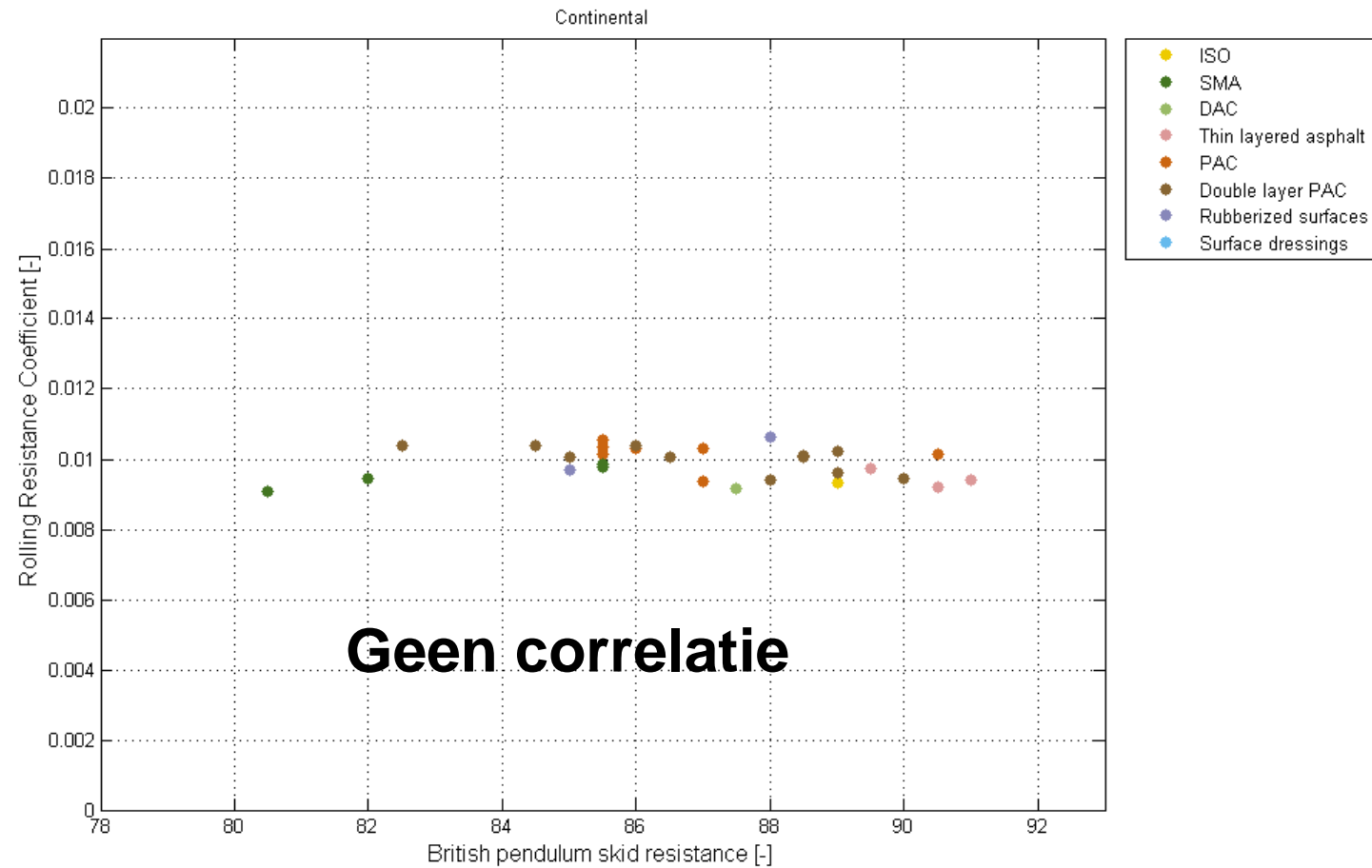


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Rolweerstand vs. Skid resistance



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Samenvattend

- 1 mm minder RMS Texture Depth, 10% minder rolweerstand, 2% minder brandstofverbruik.
- Rolweerstand van flexibele wegdekken hangt af van dynamische stijfheid → onderzoek nodig om optimaal ontwerp vast te stellen.
- Minder rolweerstand = minder geluid.
- Geen correlatie tussen rolweerstand en skid resistance.

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Cursus band/wegdek interactie



Leer meer over de invloed van band en wegdek op:

- Geluid
- Rolweerstand
- Grip/veiligheid

in Amsterdam op 11 & 12 November 2010.

Meer info op www.mp.nl/cursus2010

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Bedankt voor uw aandacht!

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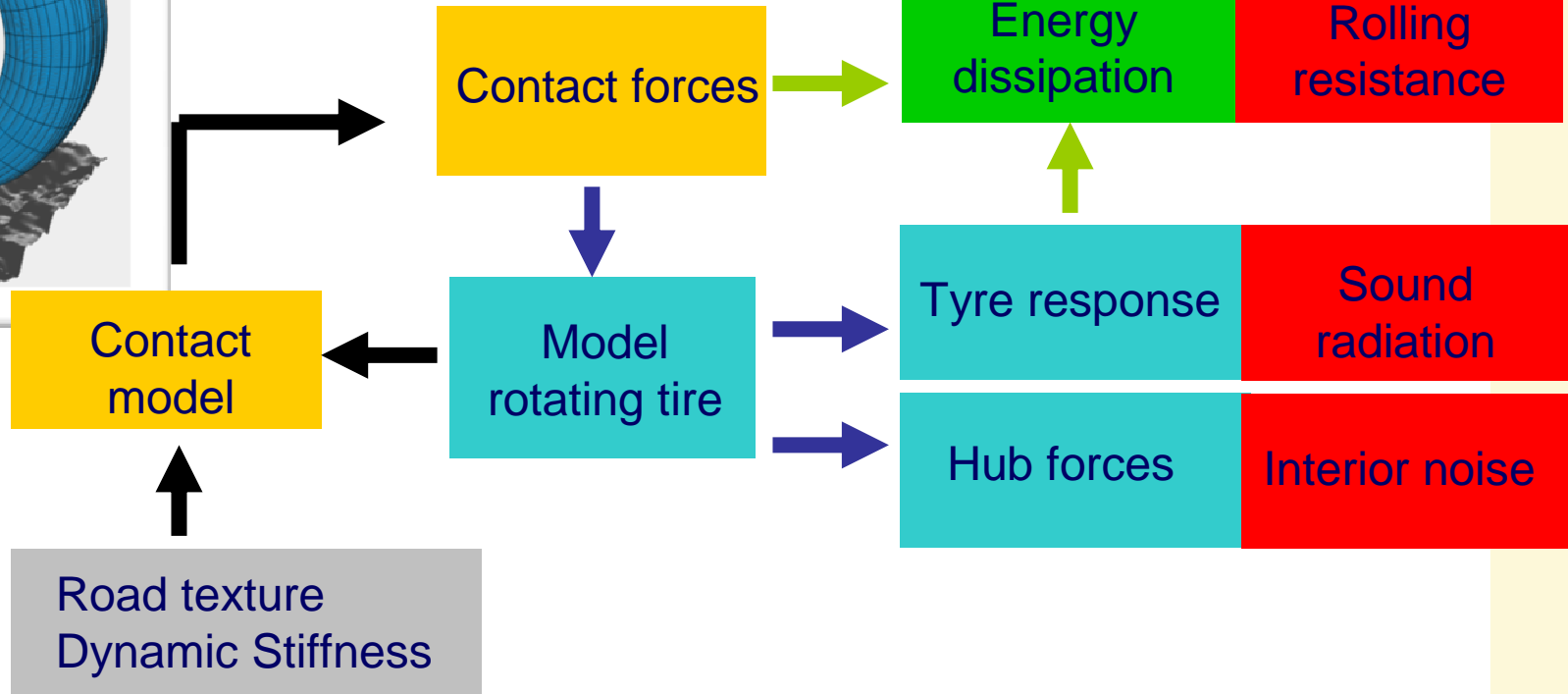
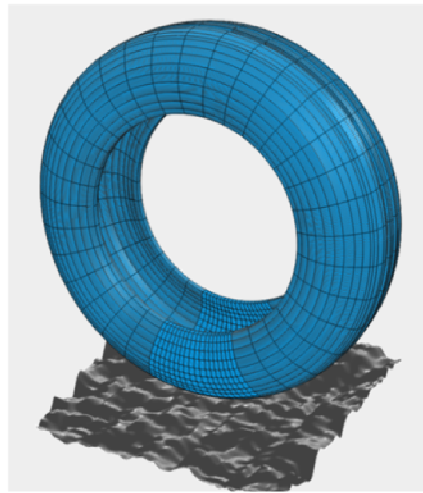
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Model geluid & rolweerstand

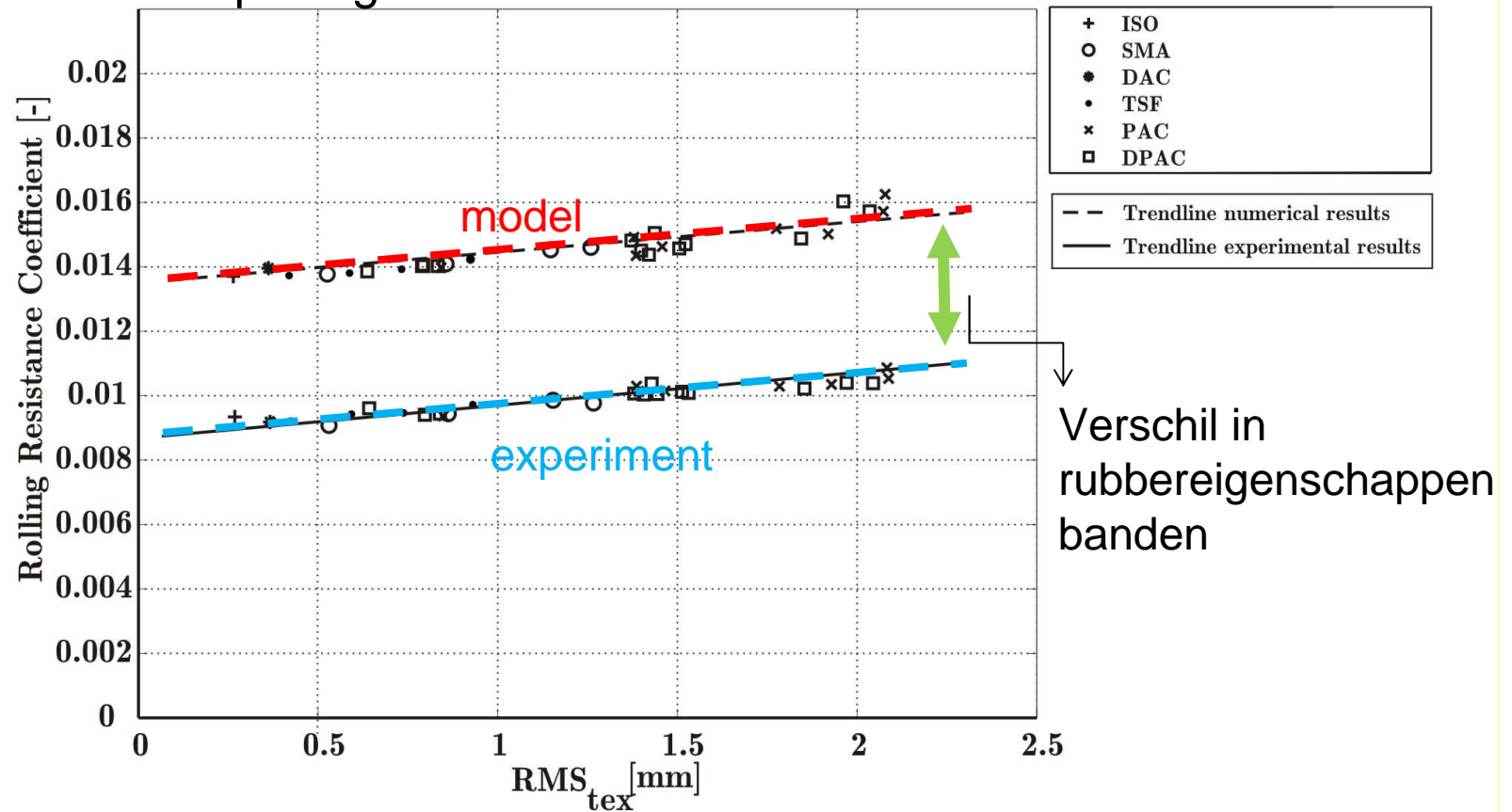


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Vergelijking model met experimenten

Goede voorspelling van de relatie tussen rolweerstand en textuur



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