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RAIL TRANSIT SEMINAR



August 26-28,
2025

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voestalpine Rail Technology GmbH



WRI2025RT

SEATTLE, WA



Reducing Wear in the Wheel-Rail-Interface of an Underground Line

Thomas Hammer – Wiener Linien
Ronald Durstmüller – Wiener Linien
Lorenz Pietsch – PJM
Daniel Risse – PJM
Francesco Marangon – RID
Ferdinand Pospischil – RID
Timna Gschwandl - voestalpine Rail Technology
Lukas Prettner – voestalpine Rail Technology

Confidentiality: Public

voestalpine Rail Technology GmbH
www.voestalpine.com/railway-systems

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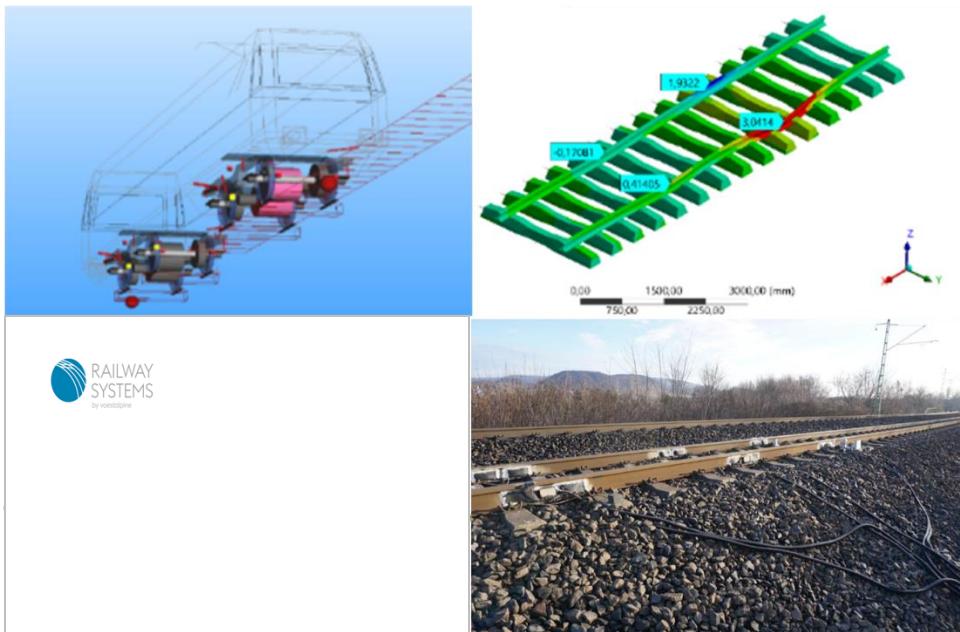
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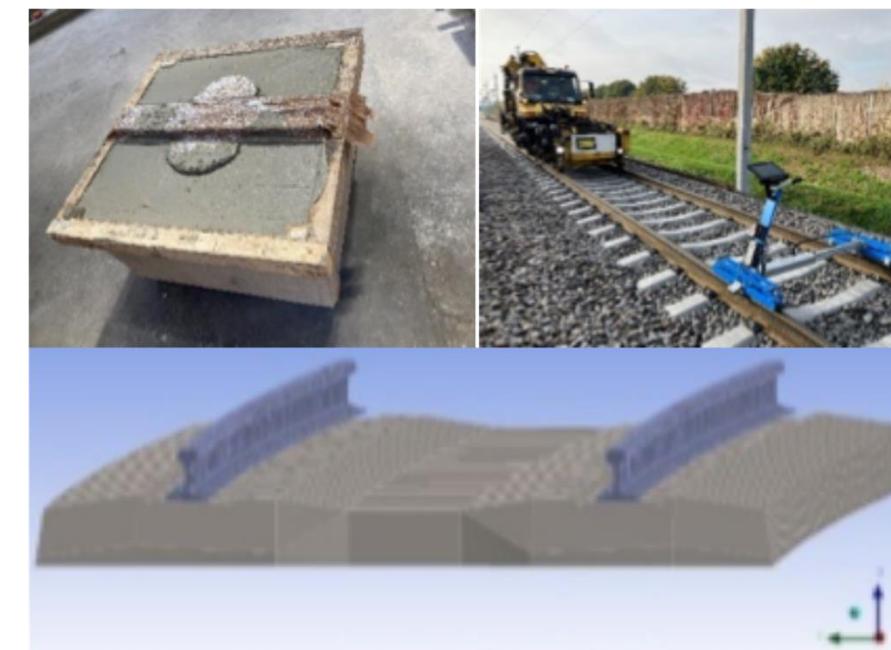


Track Systems – Areas of Activity

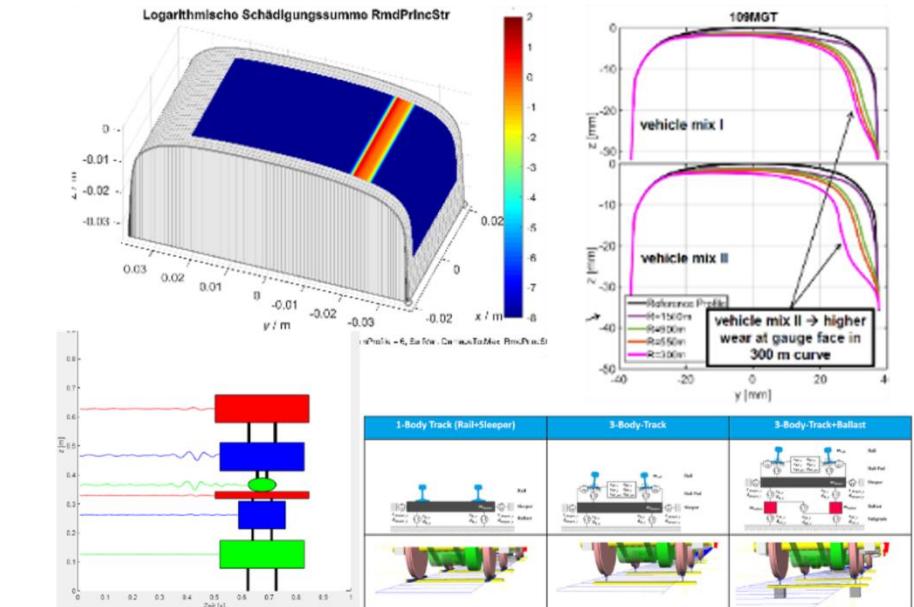
Physical & economic understanding of track systems:
Description and prediction of track behaviour with sufficient precision for performance guarantees and system design.



System Design
Development of highly available super structure systems including the suitability for digital asset management.



System Consulting
Support our customers in the areas of wheel-rail-interaction and Track System Performance Optimisation.





Executive Summary

Initial situation

- » Wheel wear problems

Wheel Rail Contact - improvement process

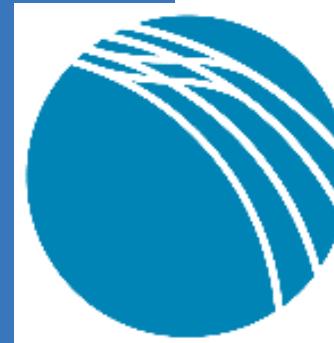
- » Re-design of wheel profile and grinding/milling pattern
- » Multi-Body Simulation for vehicle track interaction
- » Validation by track side measuring sites
- » Rail profile prognosis

Results

- » Reduction of wear number by factor 3
- » Significant reduction of wheel and rail wear expected

Key takeaways

- » Best performance is reached by combining the right material with the optimum interface design
- » Combination of simulation tools can be used to predict the impact of modifications on component wear



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RID
TU Graz

Joint Approach



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Network Wiener Linien

- Subway: 253 km track
- Tramway: 419 km track
- Passengers: 792 Mio p.a.

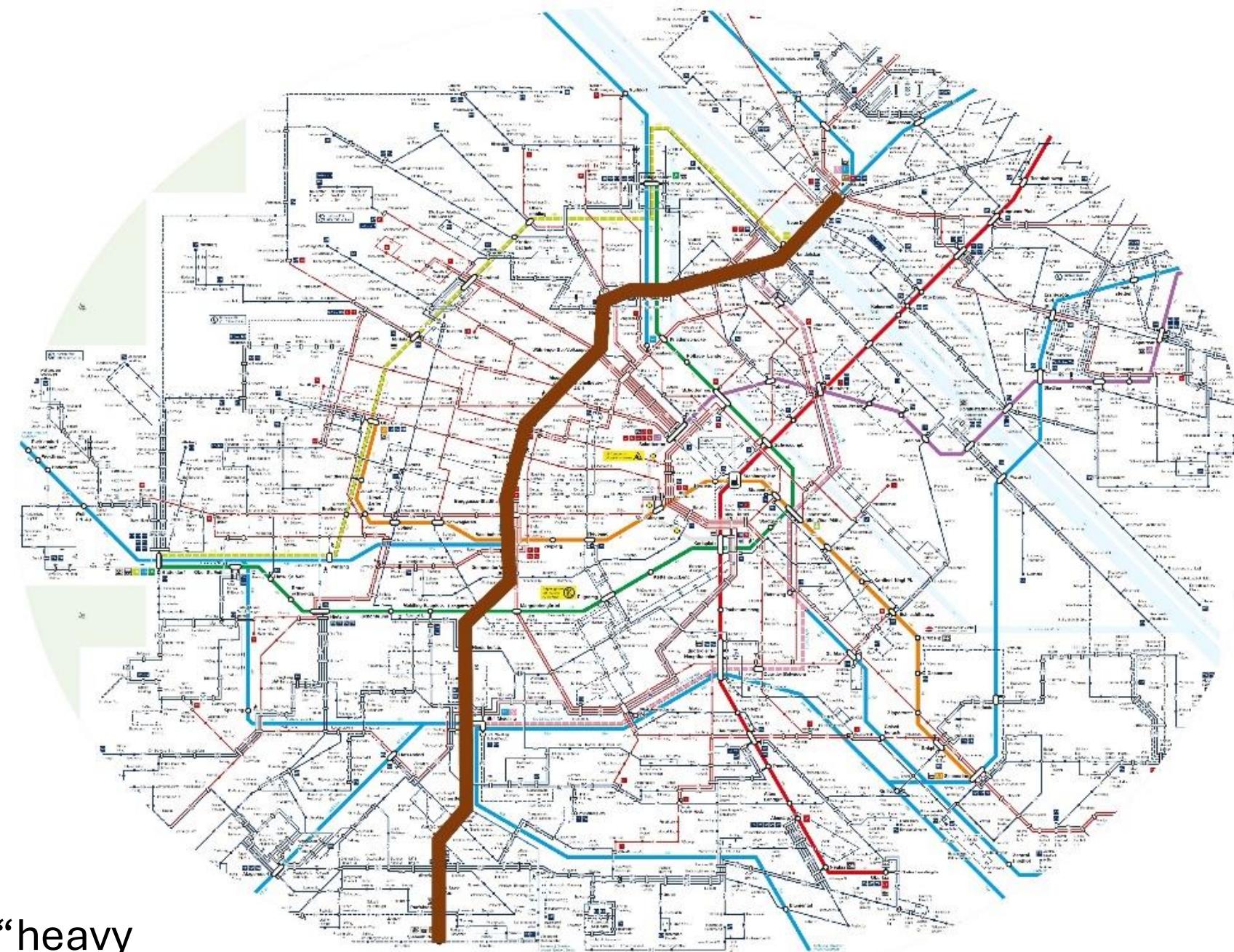
Underground Line U6

- 35 km Track
- 24 stations
- Electrification: Catenary
- Annual Load: 19 MGT/y
- Vehicle Type: Bombardier Type T & T1
- Max speed: 80 kph
- Max axle load: 12.8 to

Additional Info U6

- Designed by famous Otto Wagner in 1890 for “heavy steam locomotives” Tramway-like service after WW1
- Semi-metro mass transit with light rail vehicles today
- Trains use tramway network for transfer to workshop

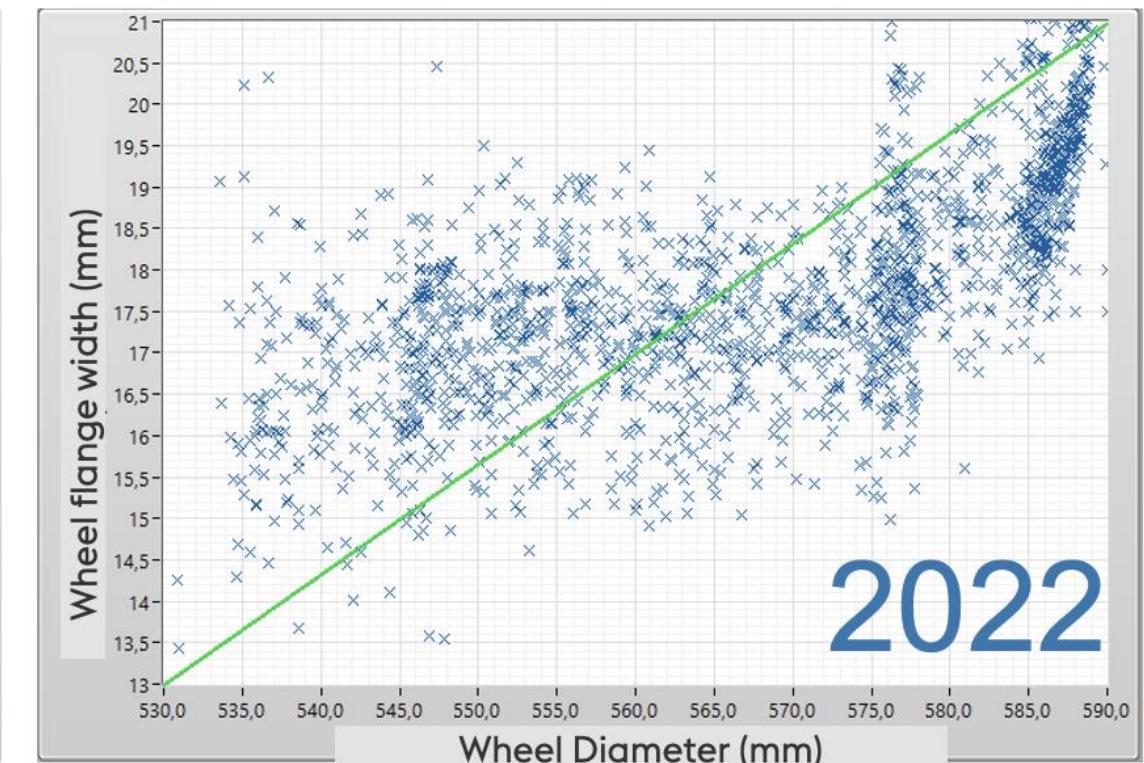
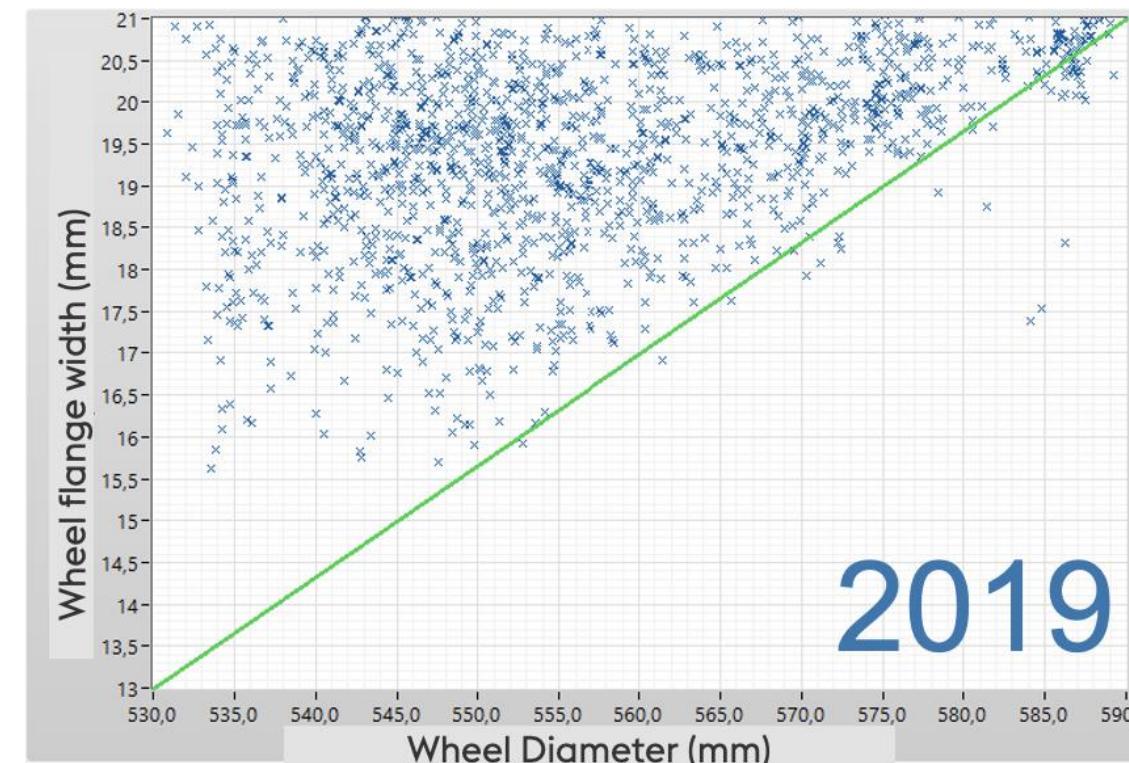
Vienna Underground Line U6

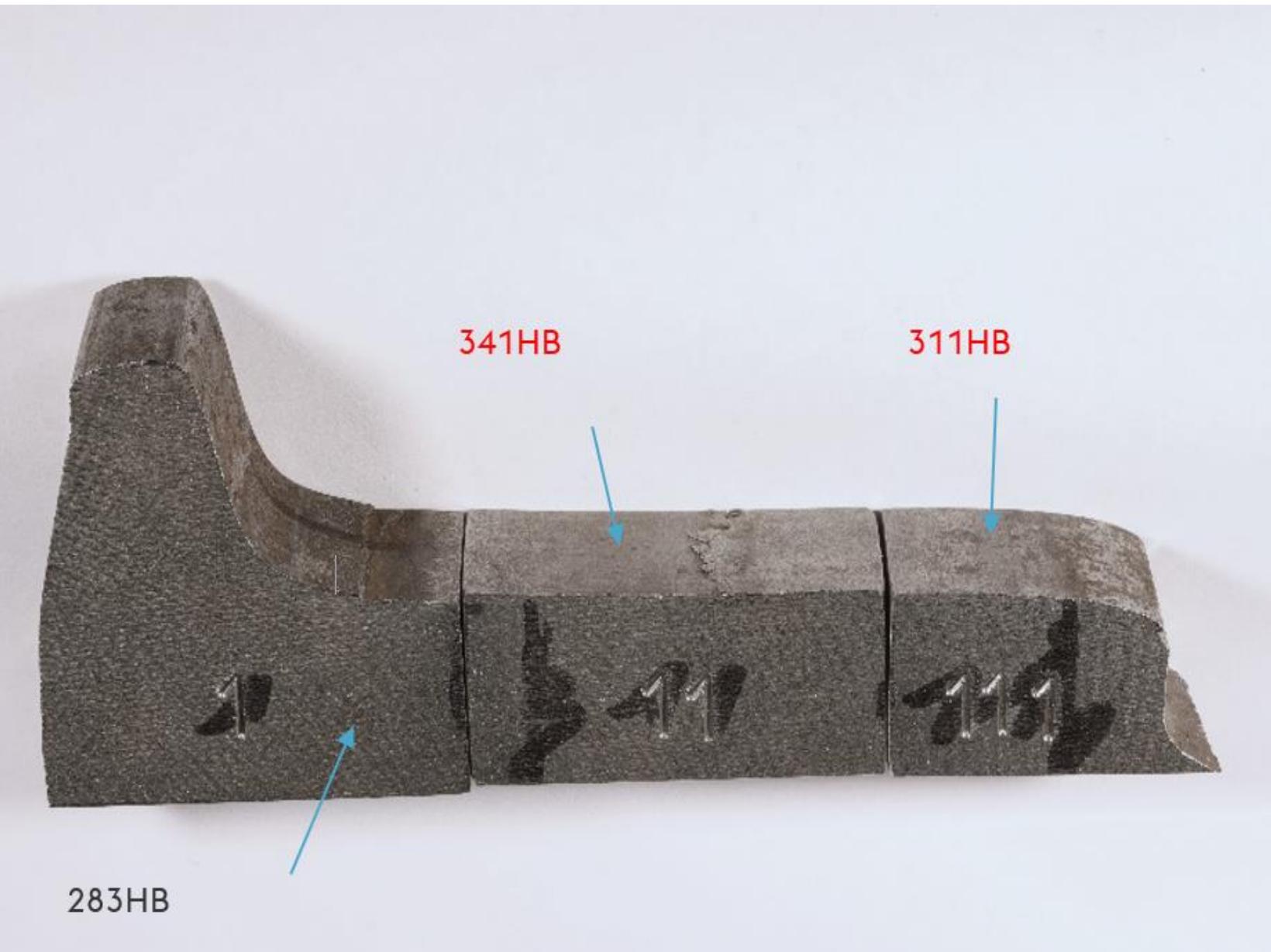
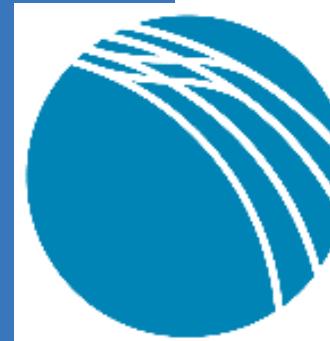




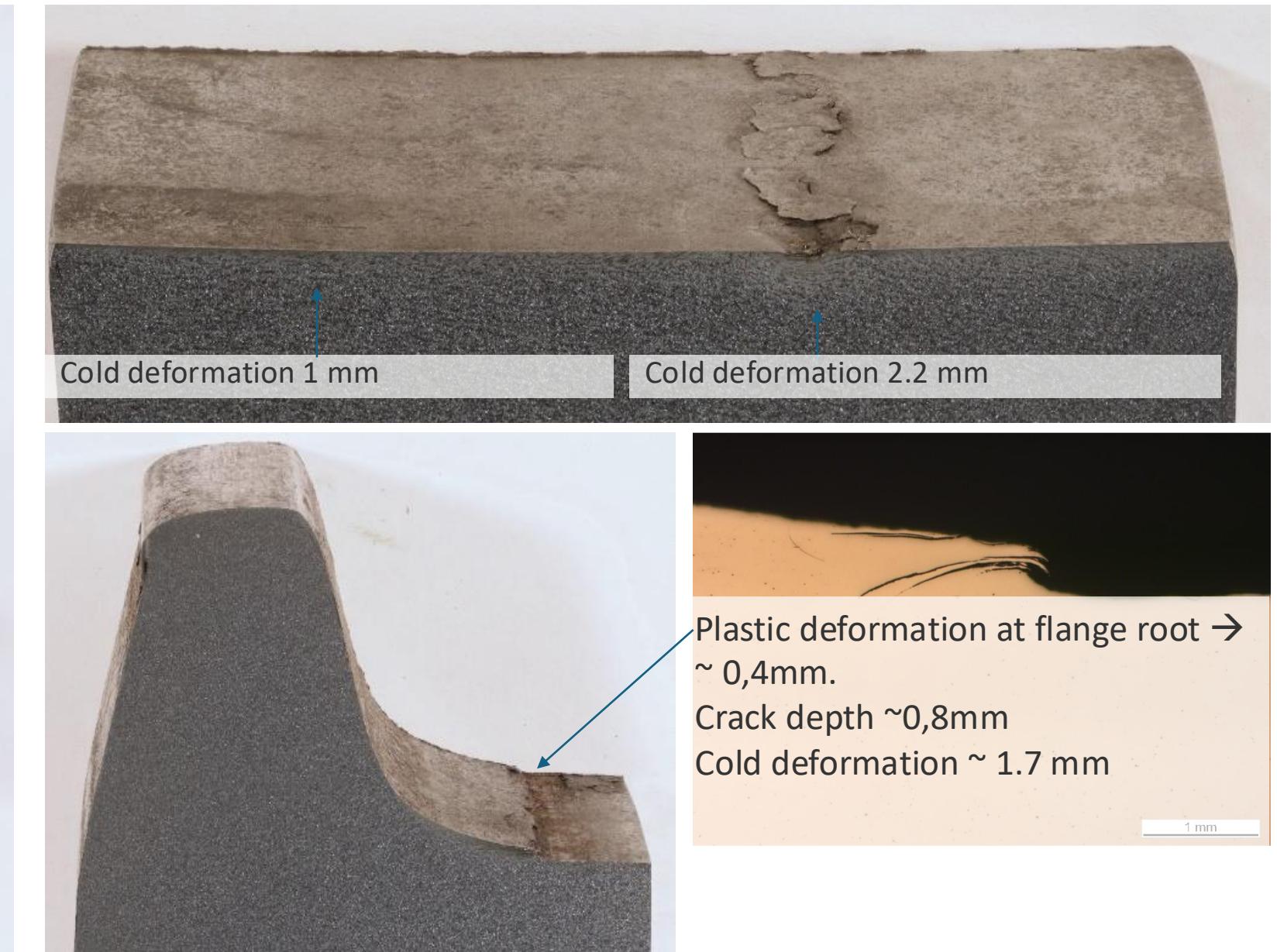
Challenges U6 – Wheel Side

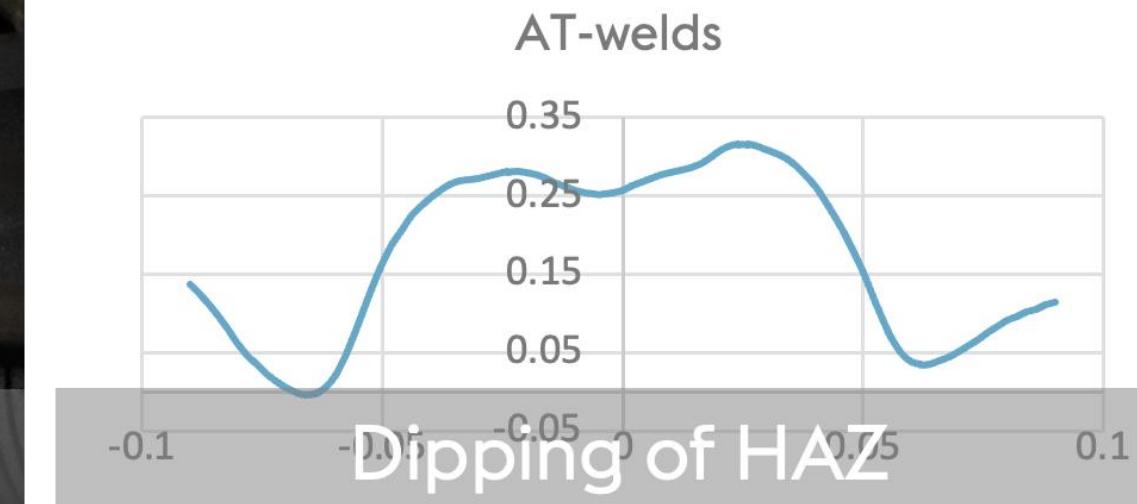
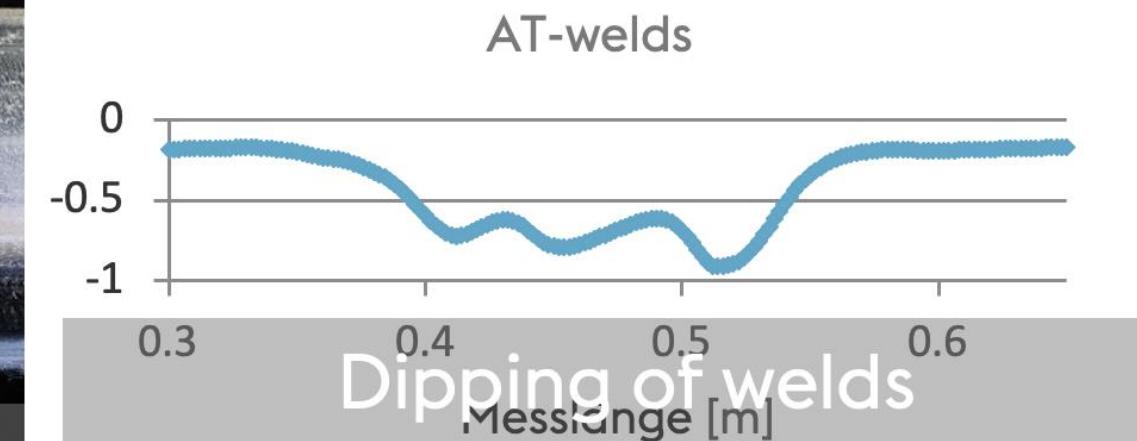
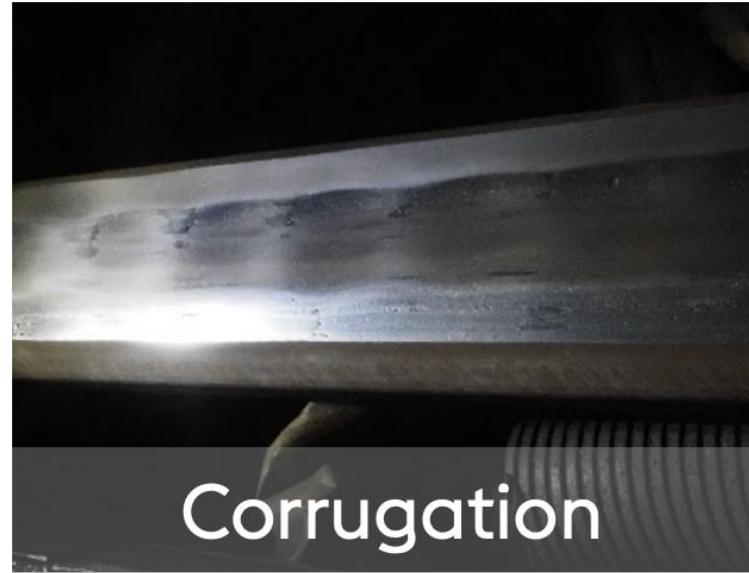
- » Massive wheel wear starting from mid 2022 after renewal/grinding/milling of track.
- » Wheel flange wear increased drastically.
- » High workload for workshop - could only be achieved by extra shifts.



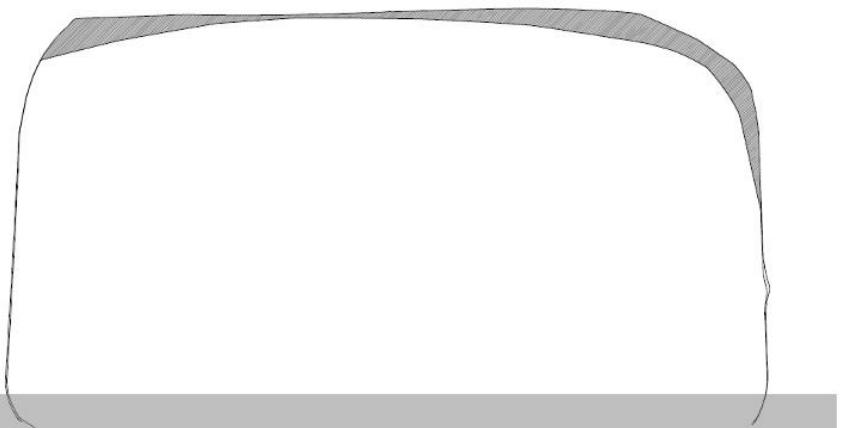


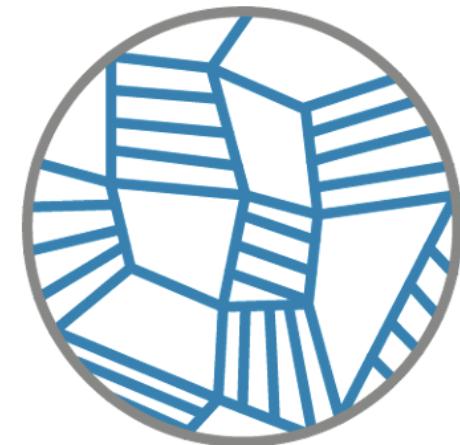
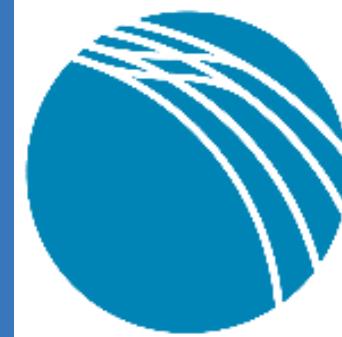
Challenges U6 – Wheel Side Destructive Testing of Wheels



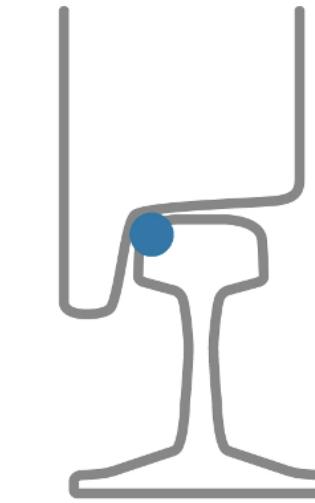
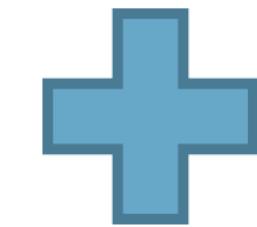


Rail
Milling by
MG11





Innovative
Material Design



Well designed
Wheel-Rail-Interface

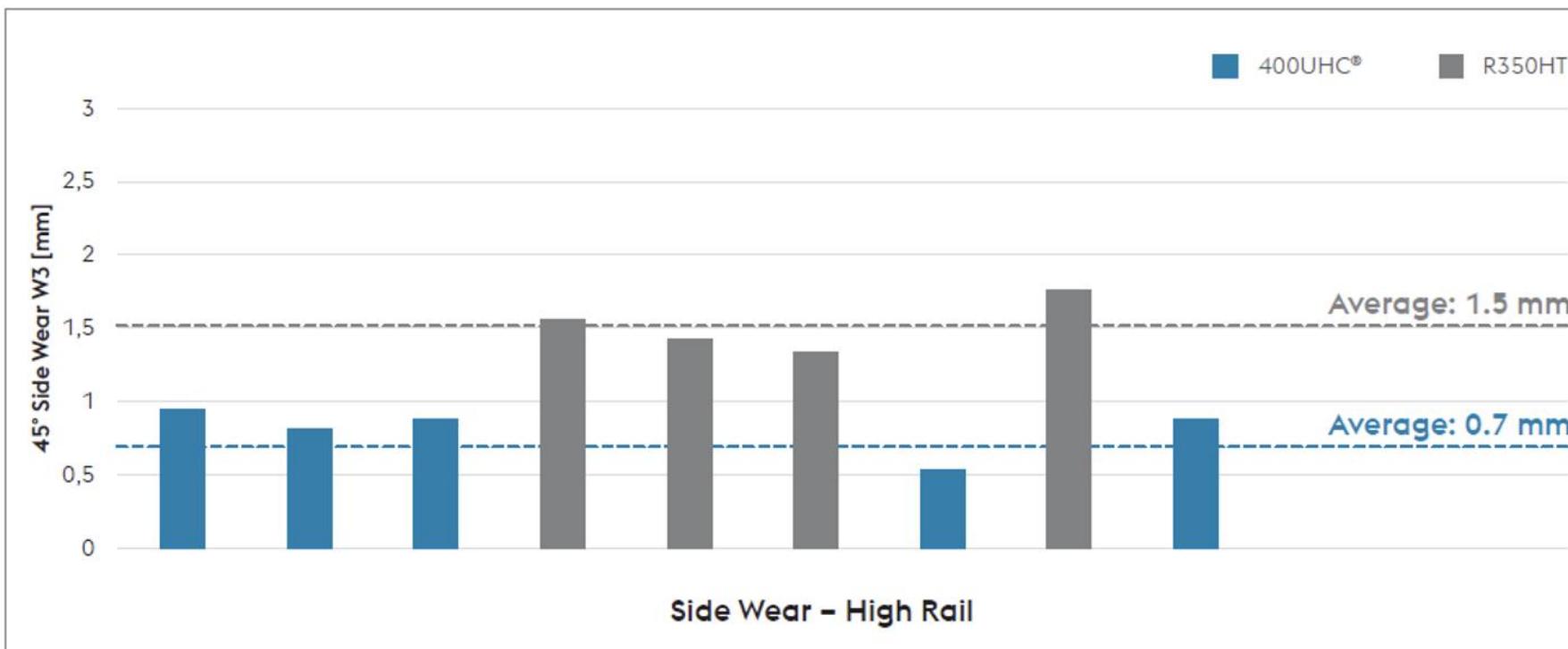


Performance on
Track

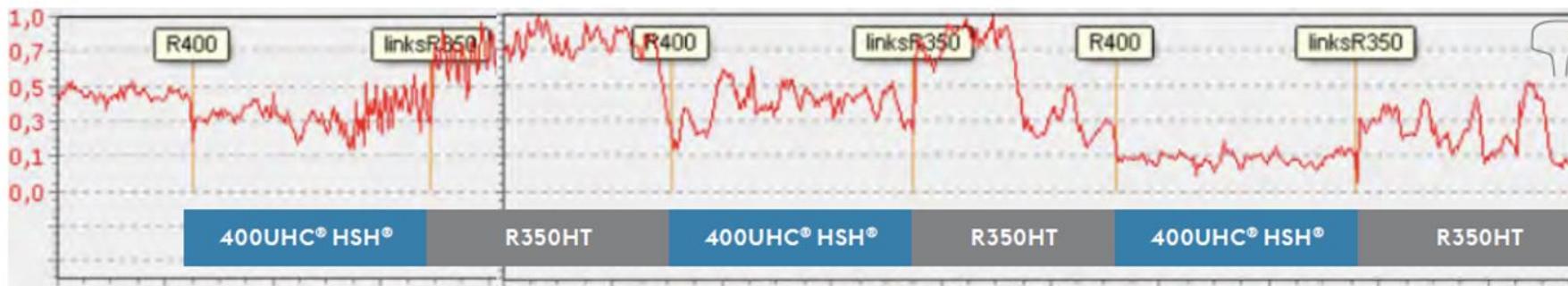


Material Behaviour – Field Tests U6

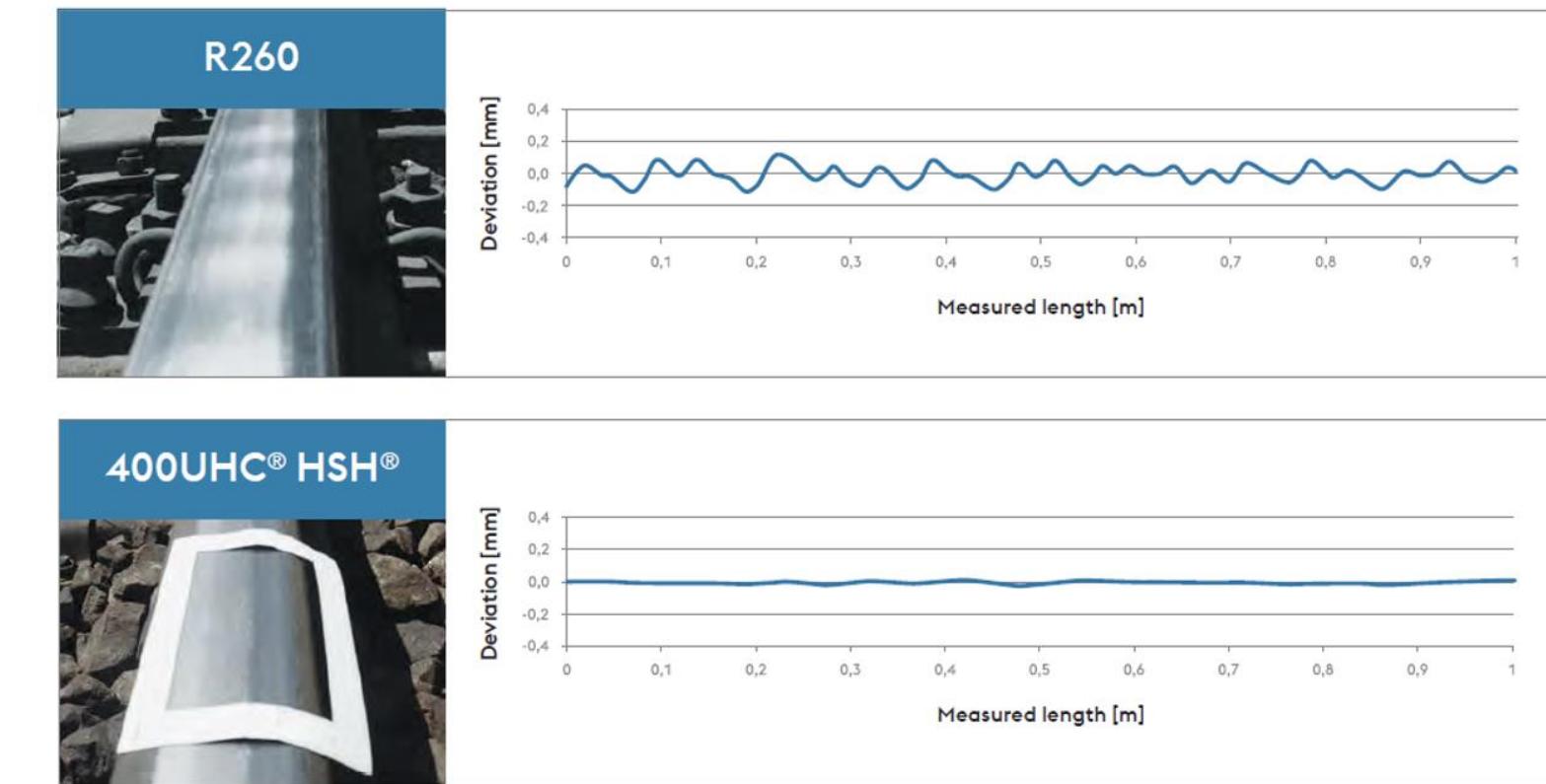
Wear behaviour - High Rail



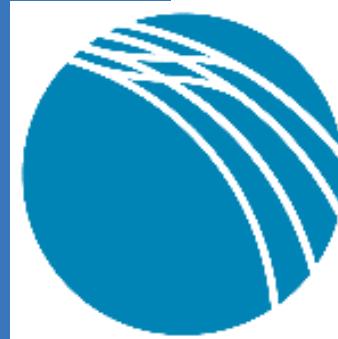
Head Checks - Eddy Current - High Rail



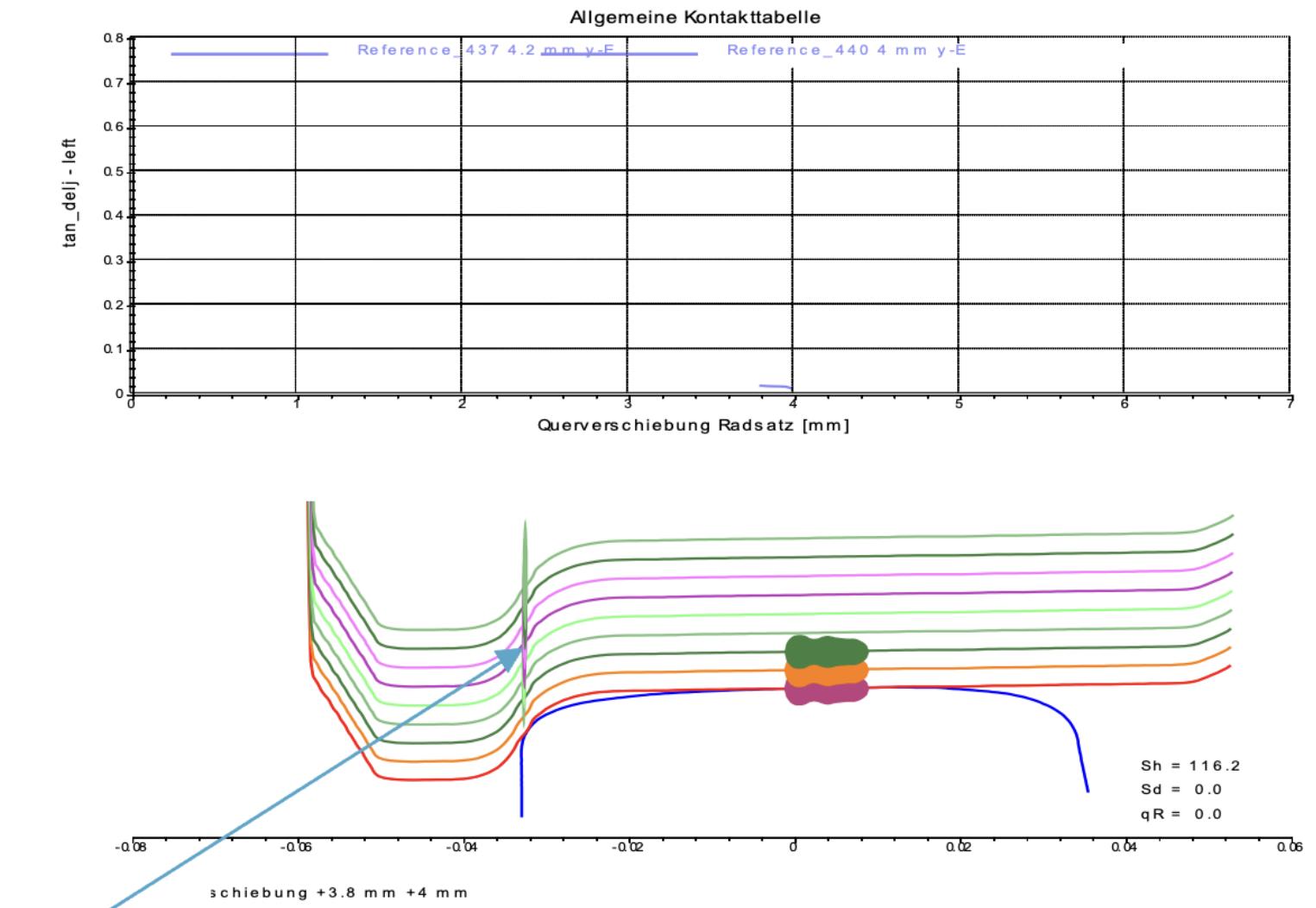
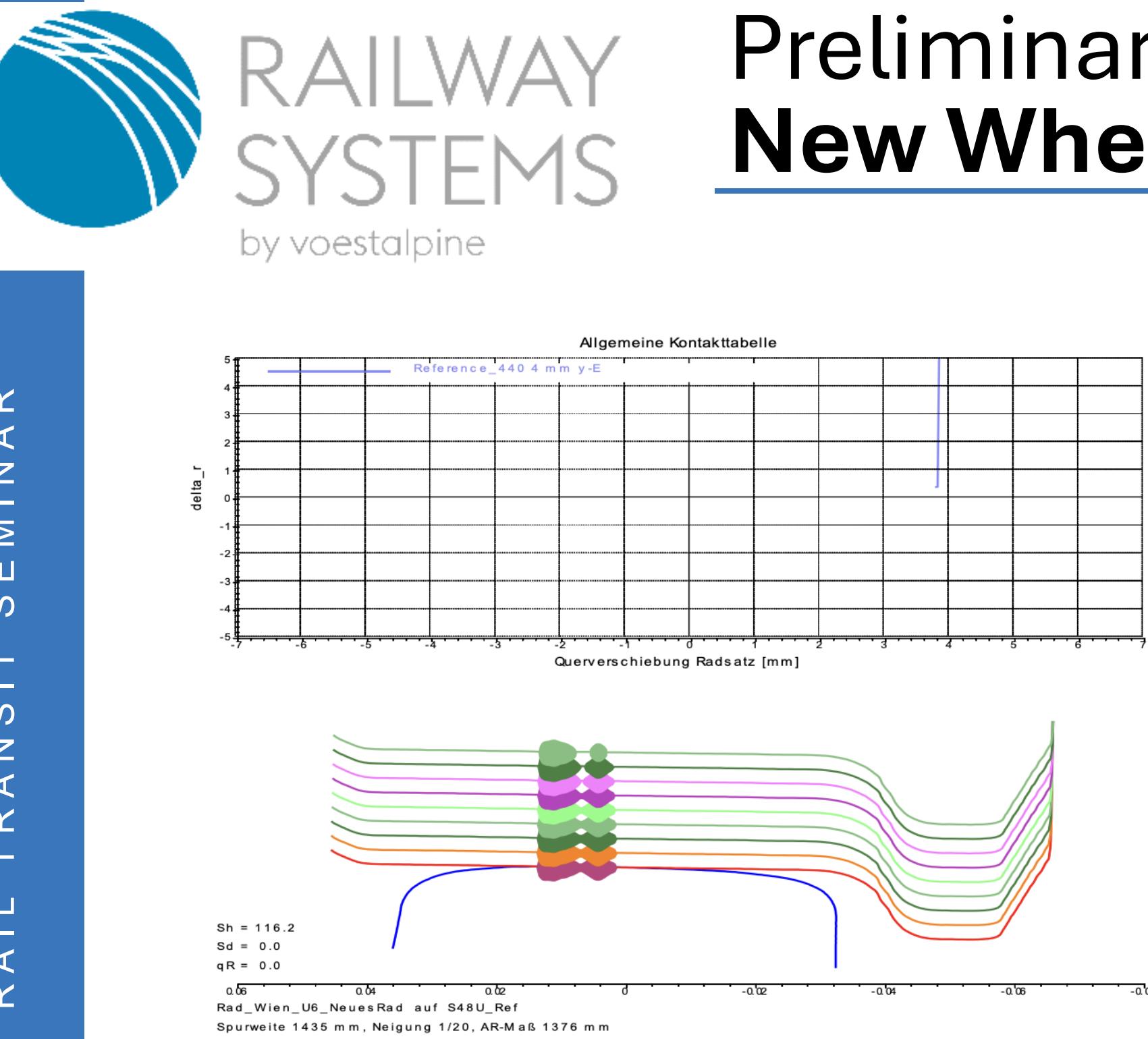
Corrugation – Low Rail



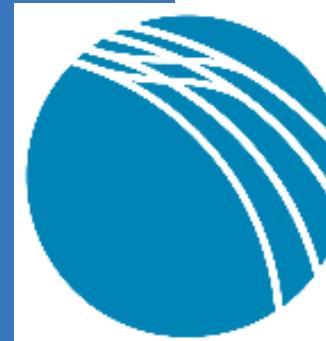
400 UHC® HSH® as new standard for curves.



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2 point contact (HR)
High frictional forces and contact pressures at wheel flange expected

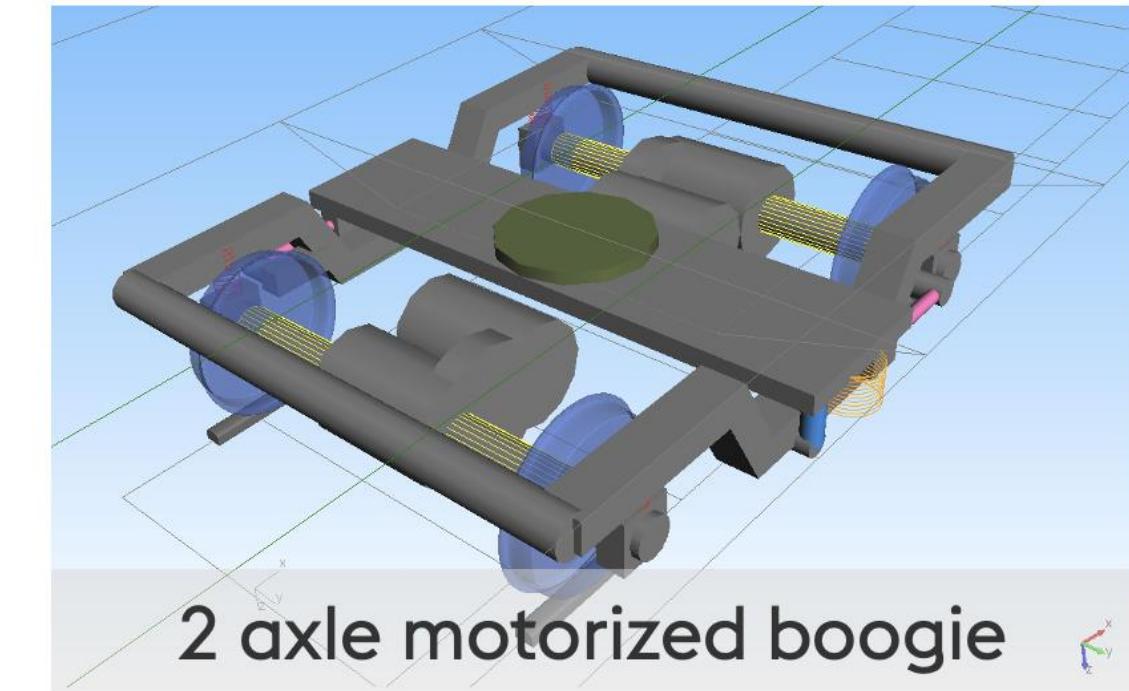
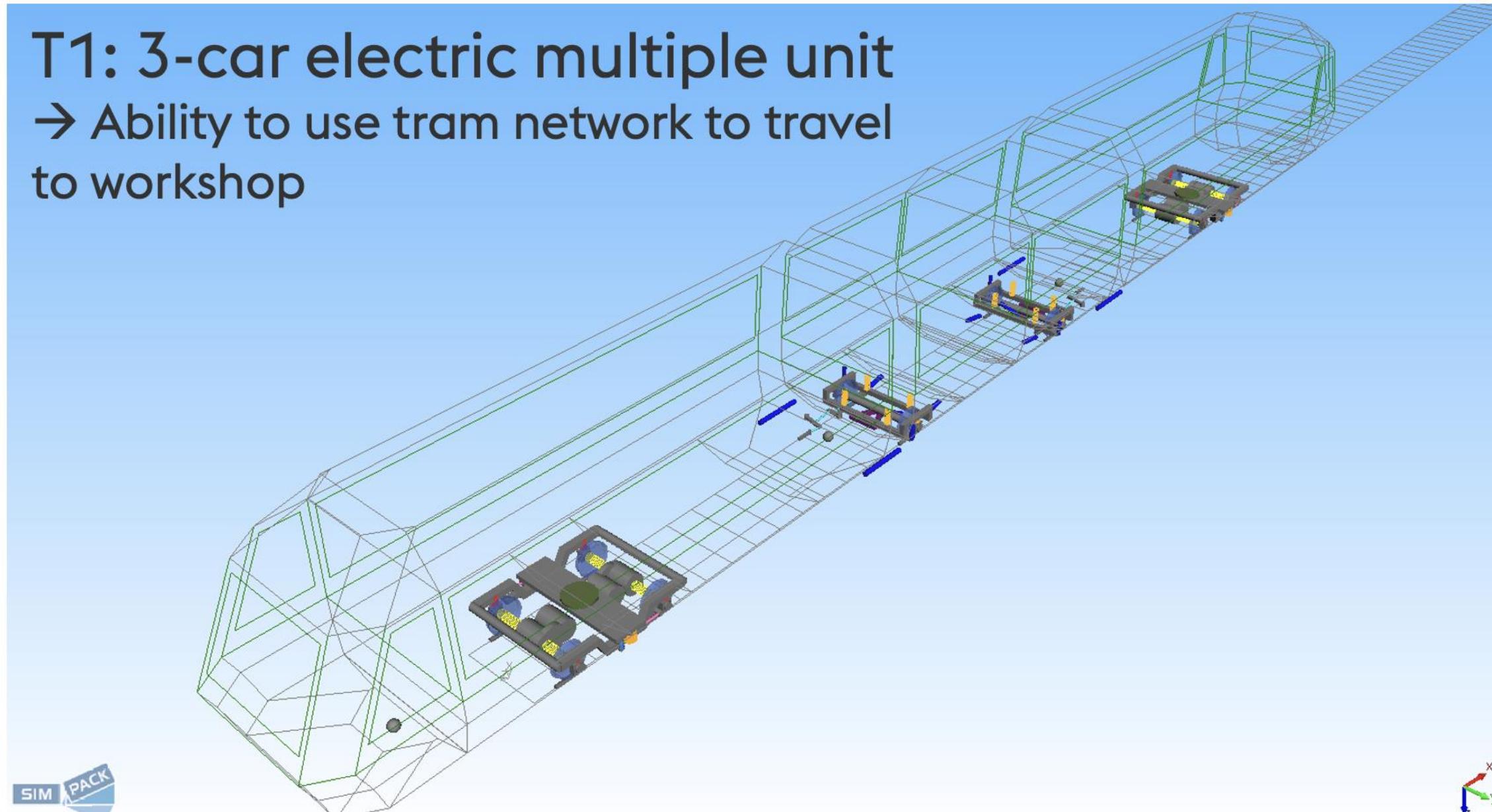


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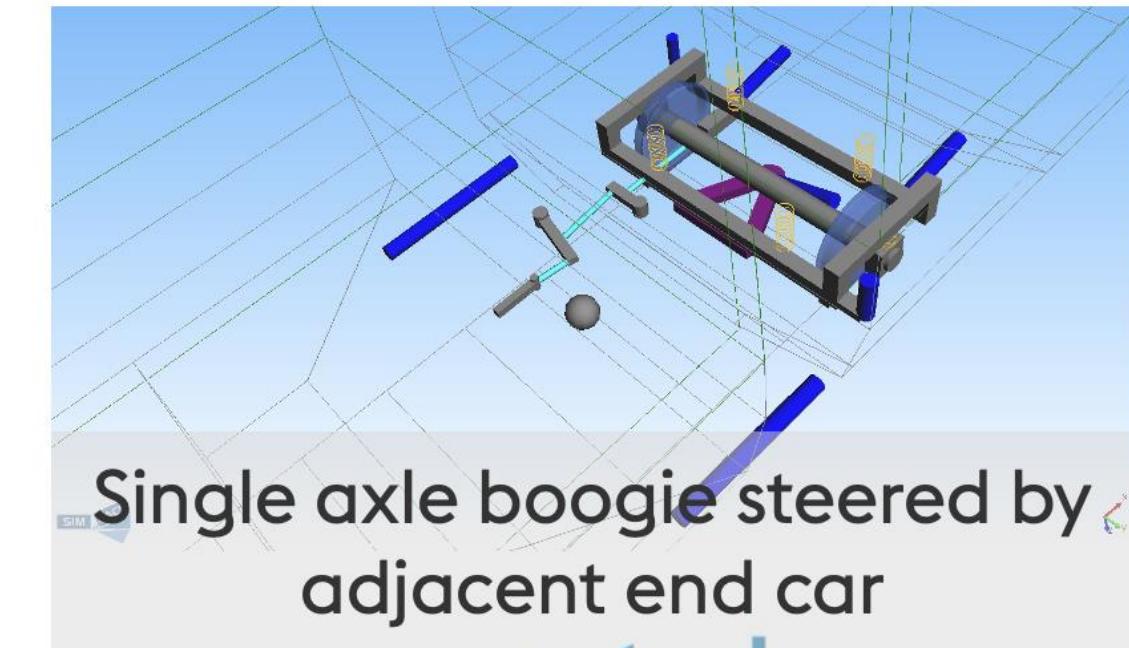
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T1: 3-car electric multiple unit
→ Ability to use tram network to travel
to workshop



2 axle motorized bogie



Single axle bogie steered by
adjacent end car

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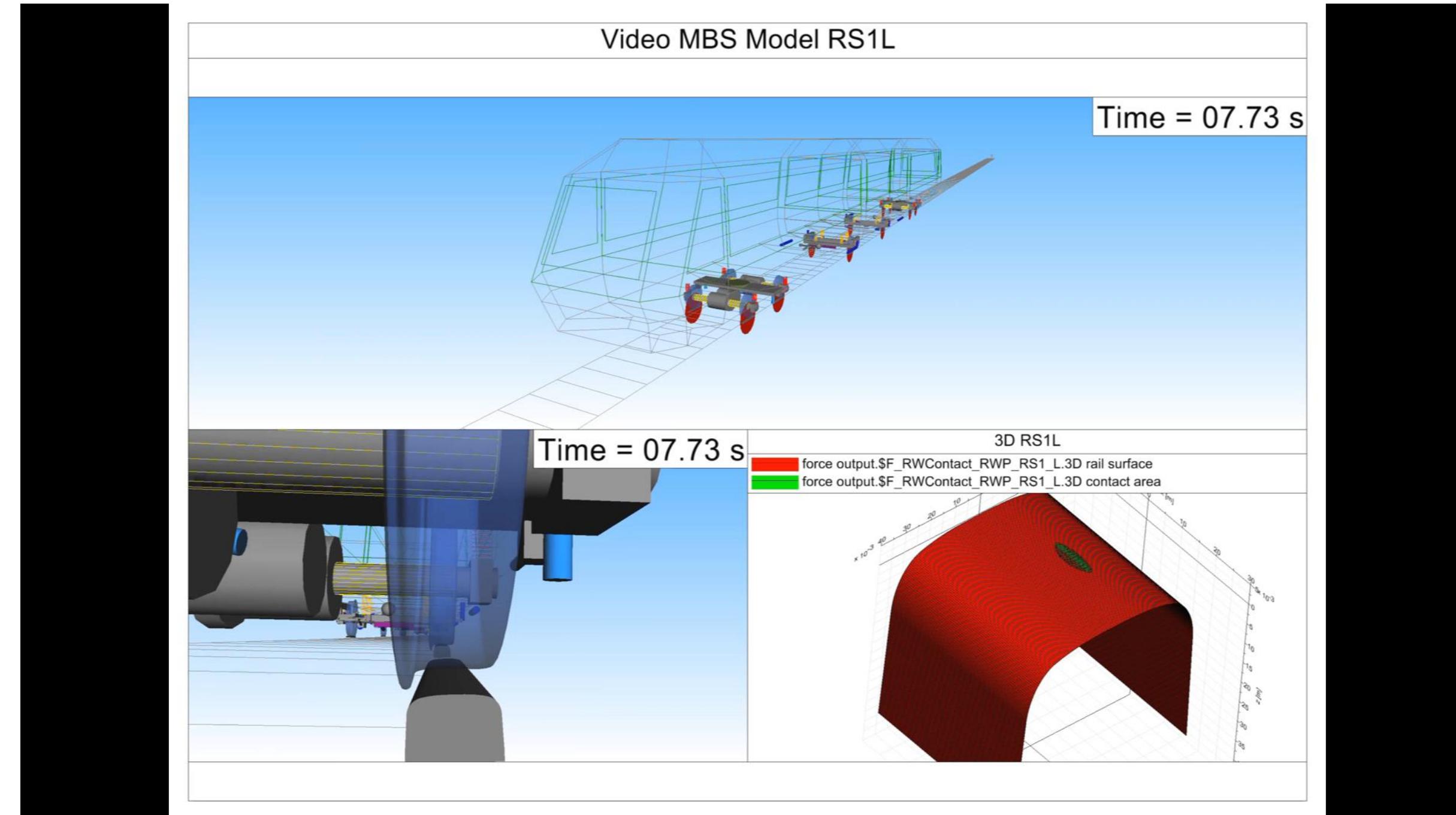
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Vehicle – Track Interaction

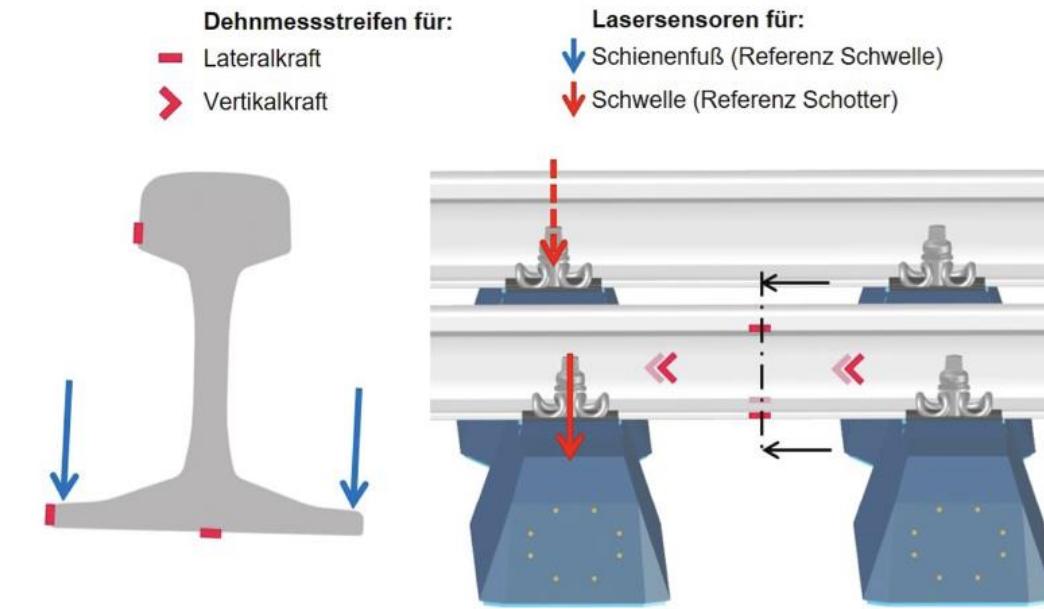


Example – Westbahnhof

R = 315 m

Cant = 80 mm

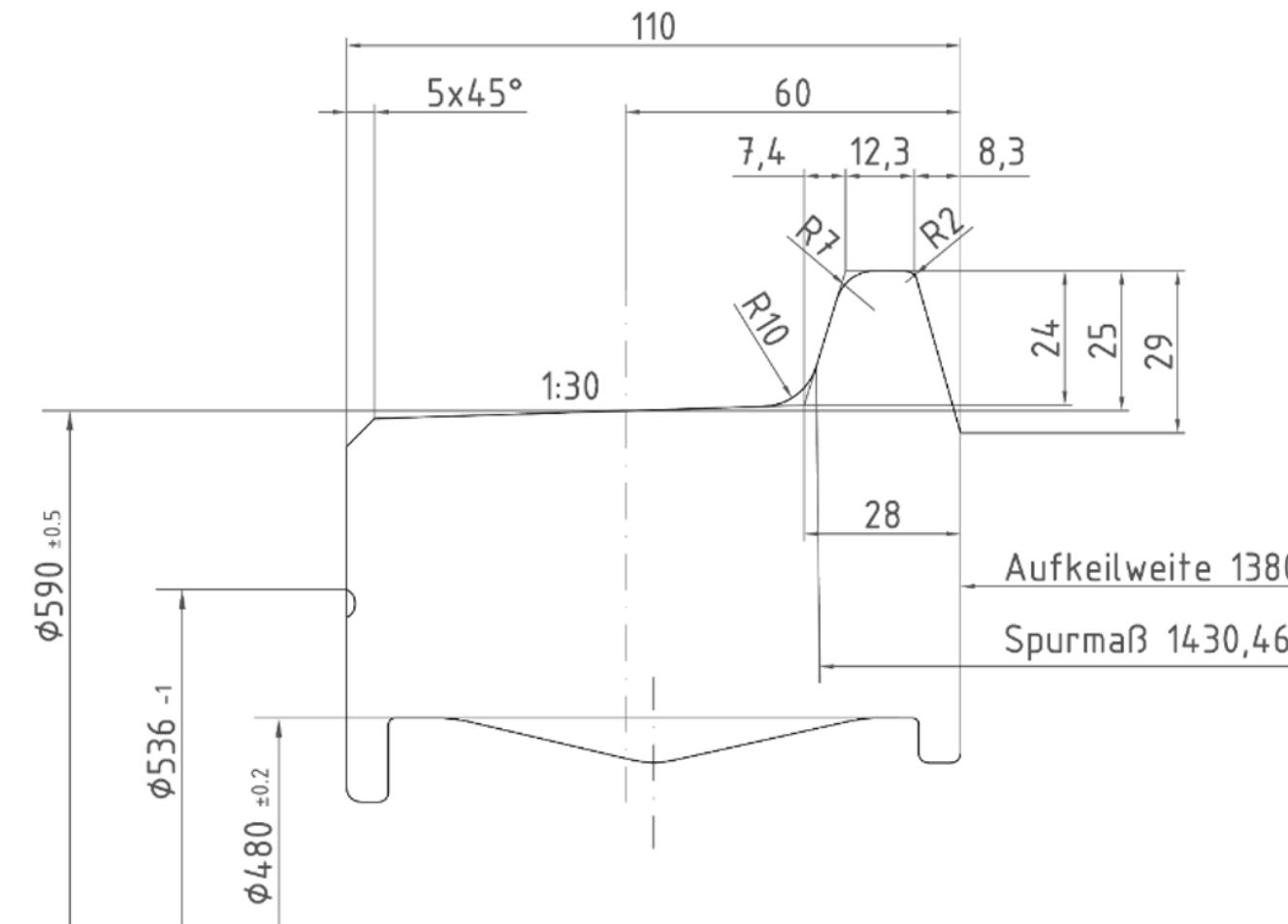
Speed = 16 m/s



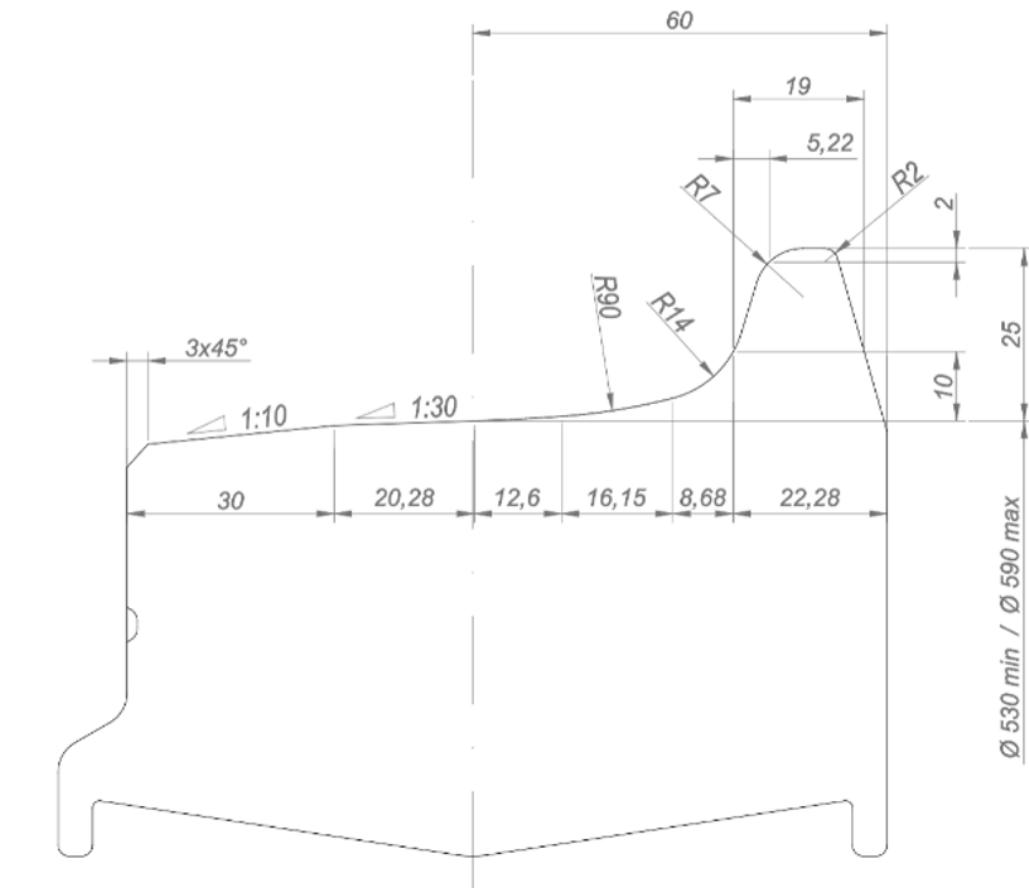
	Simulation	Measurement
Max. Lateral Force Y [kN]	9.8	11.2
Max. Vertical Force Q [kN]	42.8	42.5

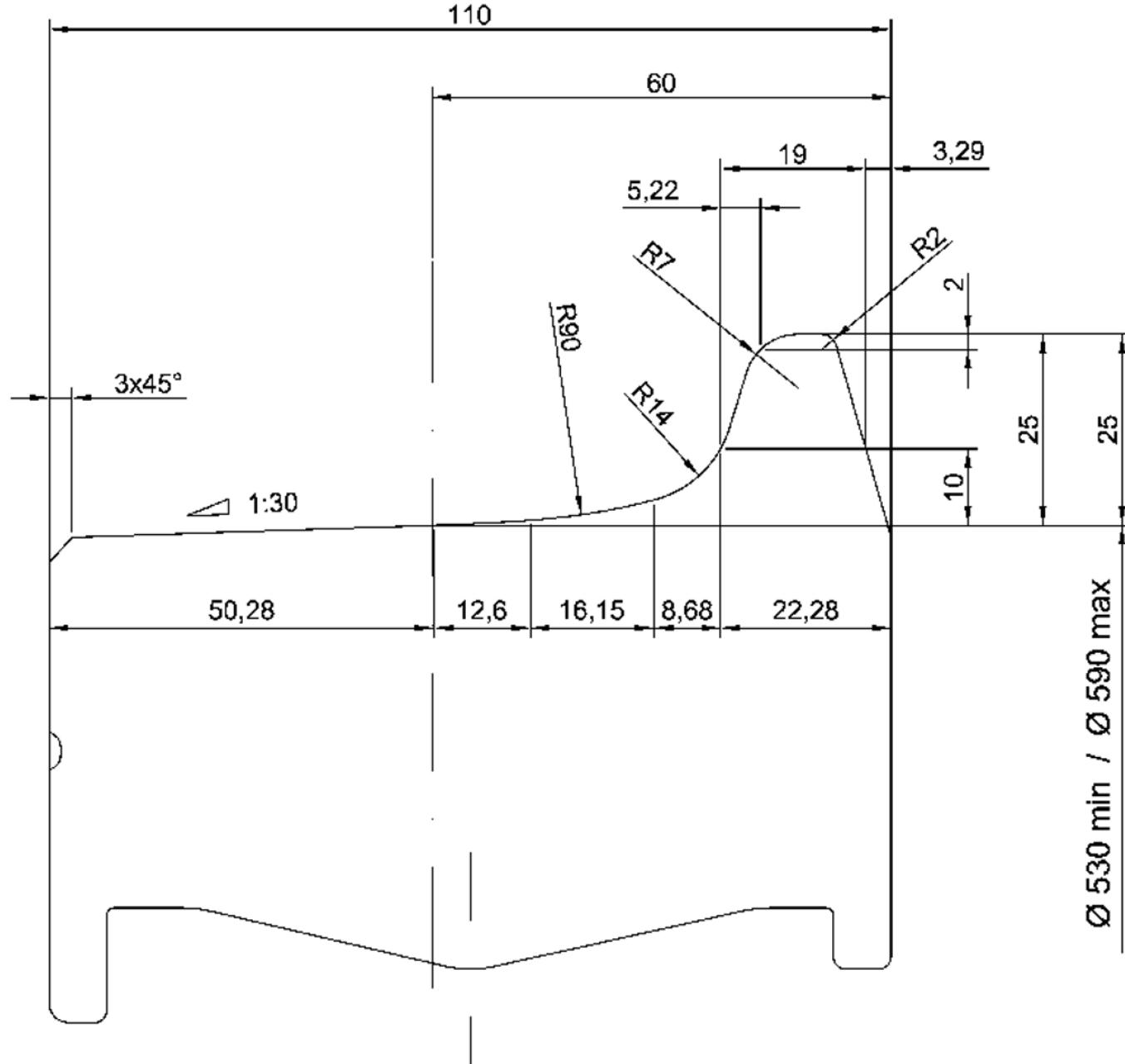
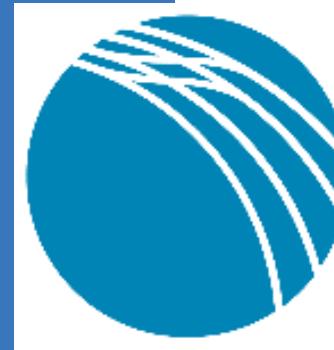


Wheel Design



Verschleißprofil

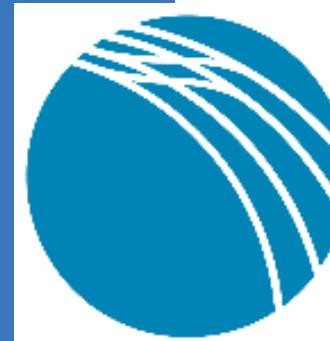




New Wheel Design

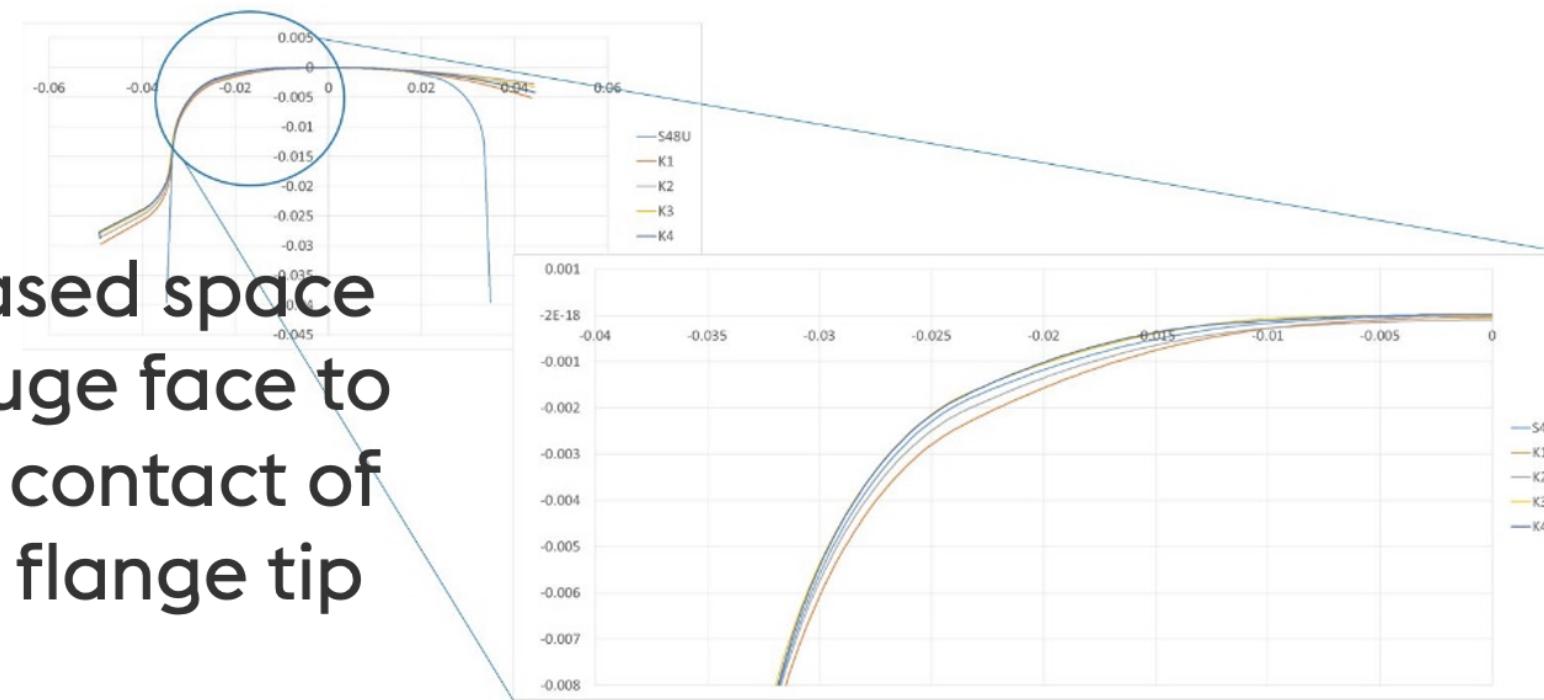
- » Single contact point,
- » increased flange to rail clearance (13 mm).



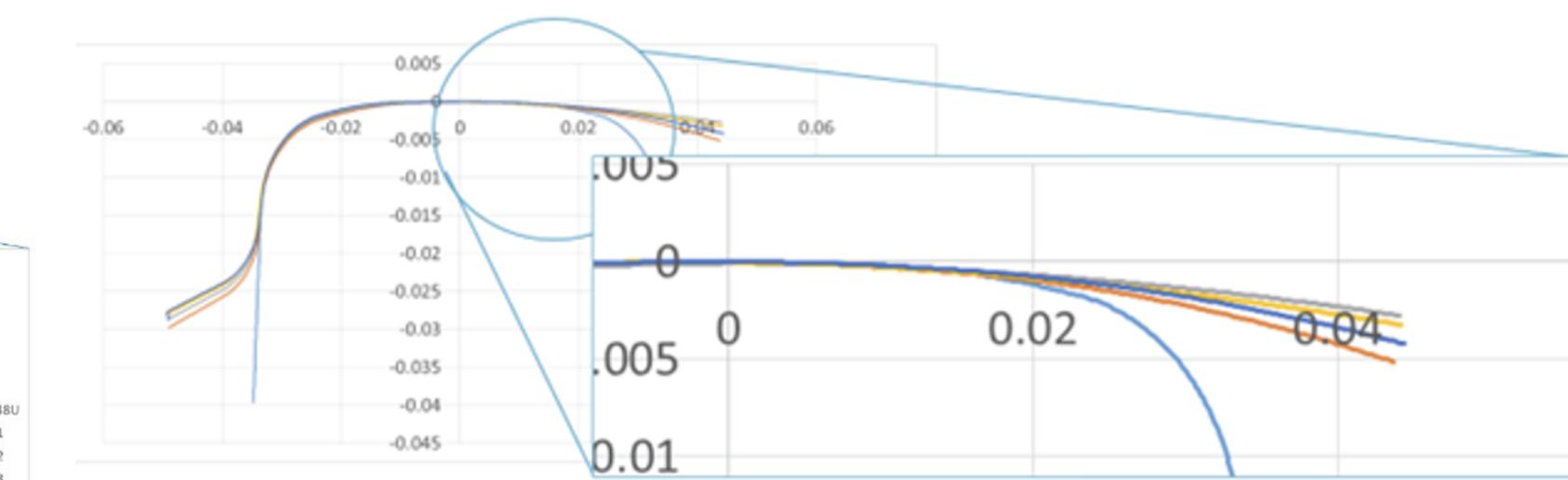


Design of Grinding/Milling Pattern

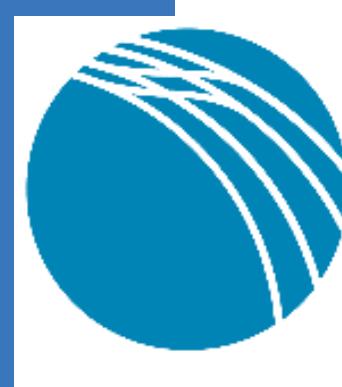
Increased space at gauge face to avoid contact of wheel flange tip



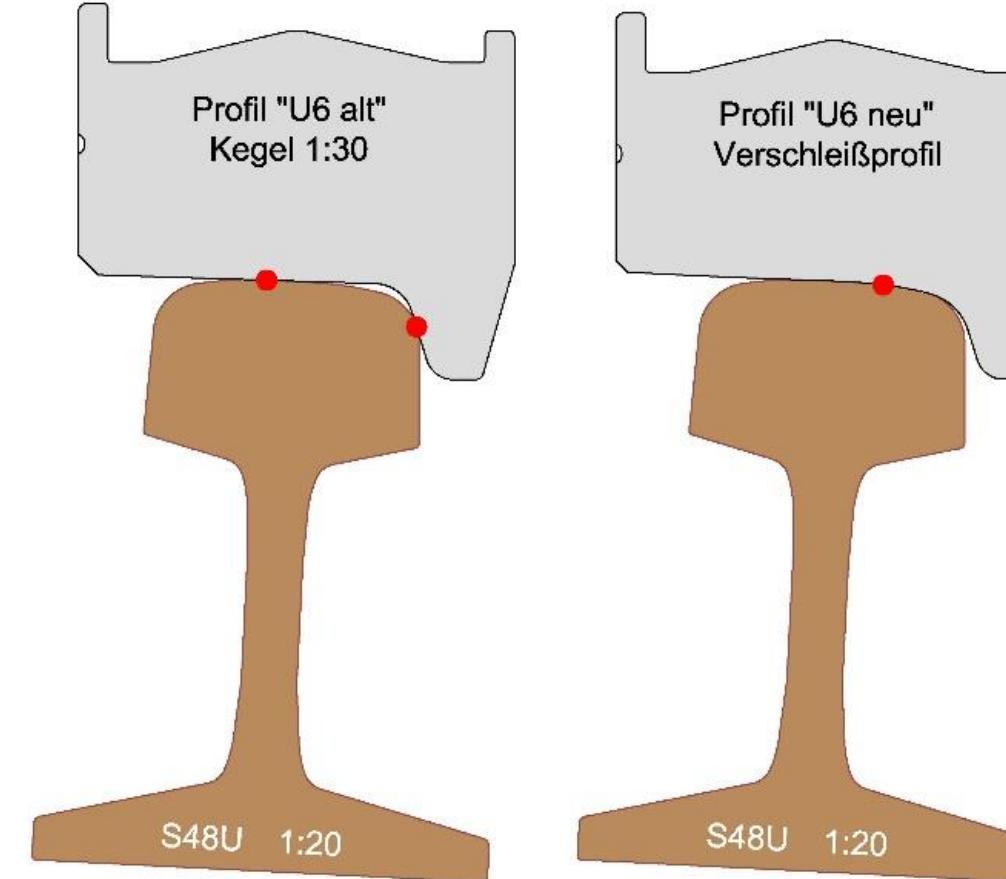
Analysis of different gauge corner variants



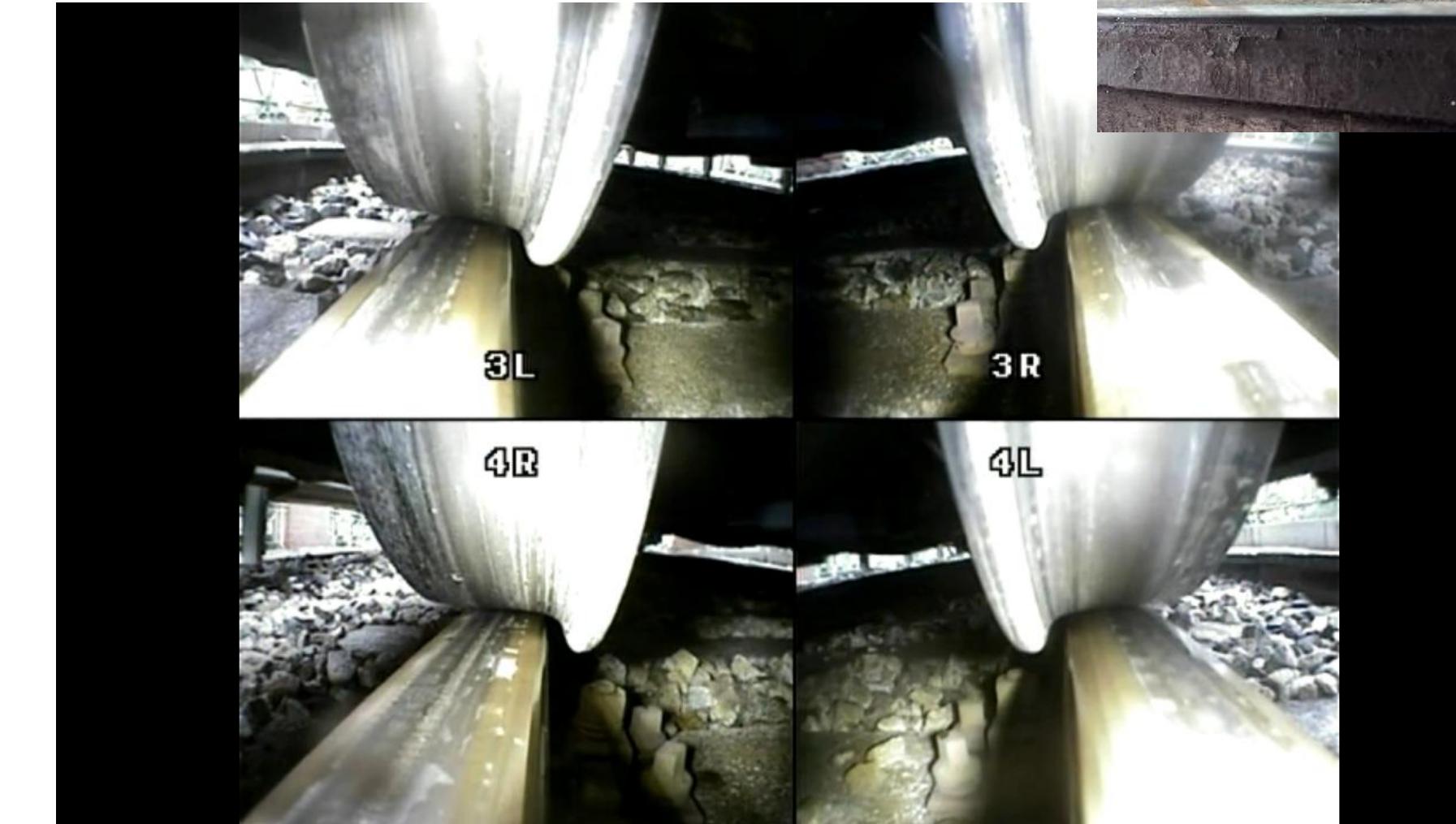
Analysis of different field side and top of rail variants to reduce contact pressure at top of rail section



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Impact on the Wheel-Rail-Interface



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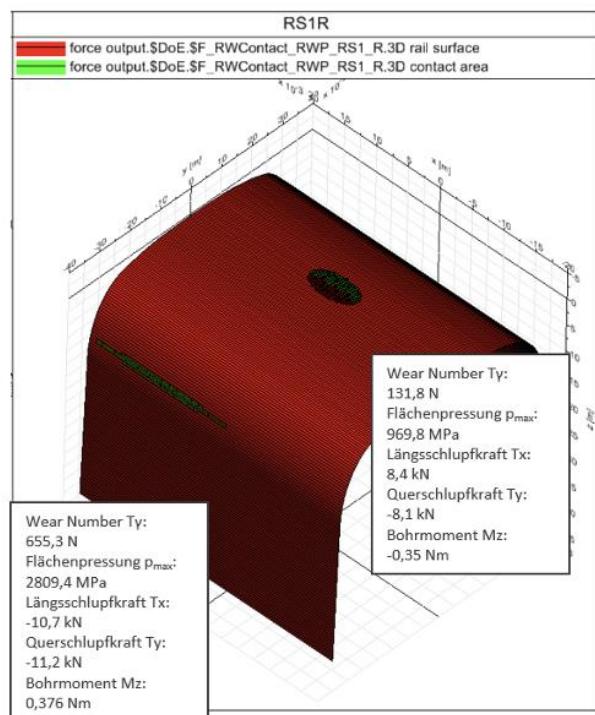
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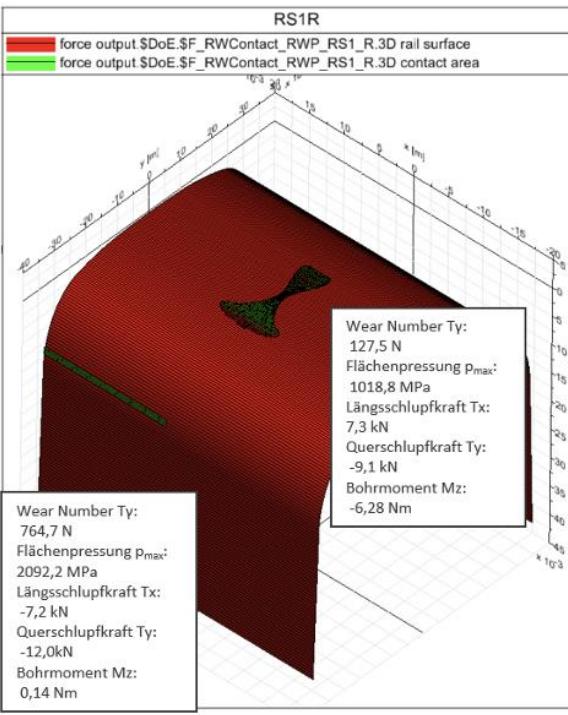
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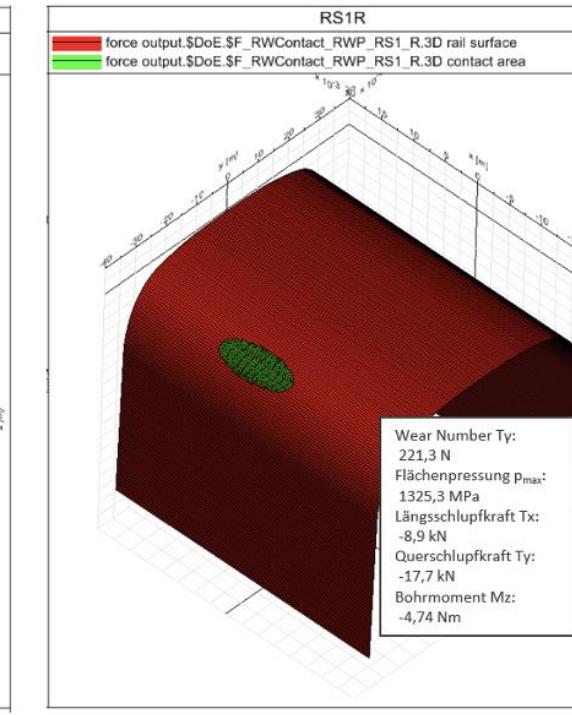
Old Wheel Profile



Worn Wheel Profile

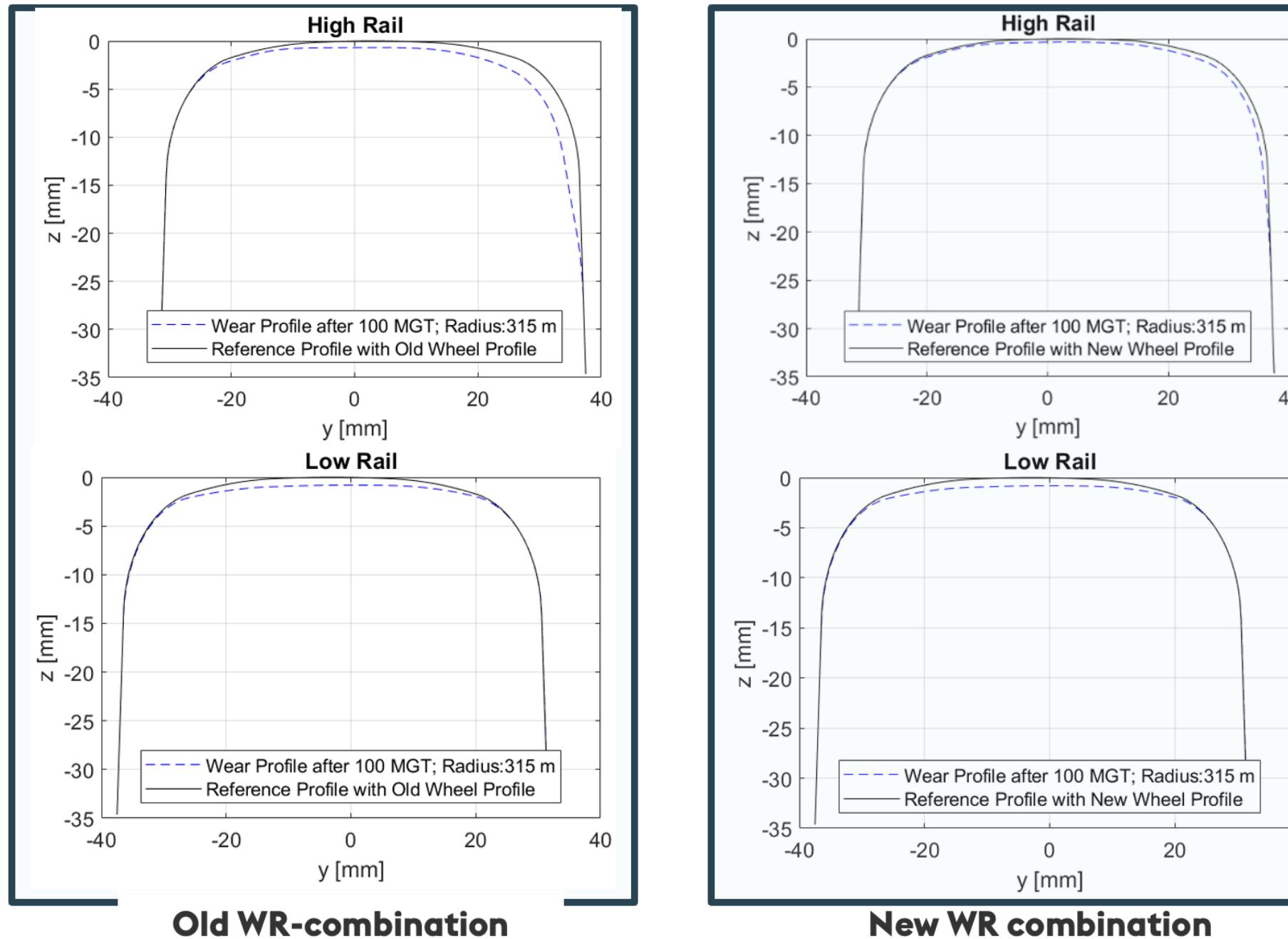
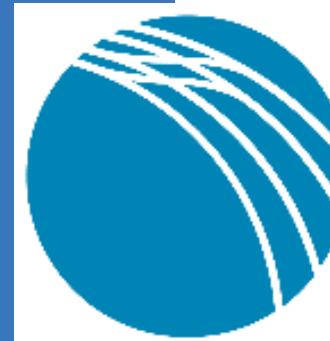


New Wheel Profile

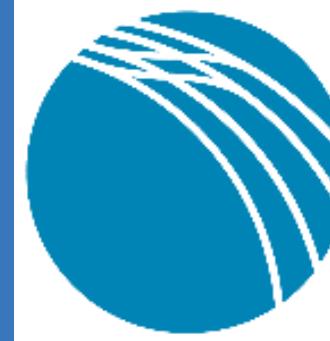


Reduction of Wear Number:
655 N → 221 N

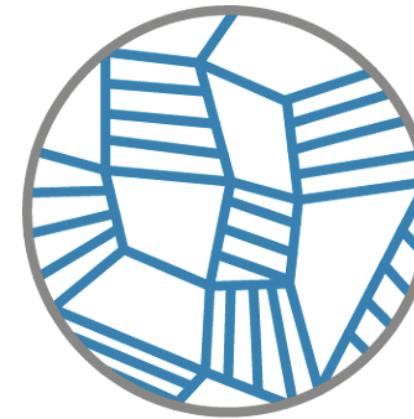
Improvement Factor
(wear number)
of
New Design:
3x



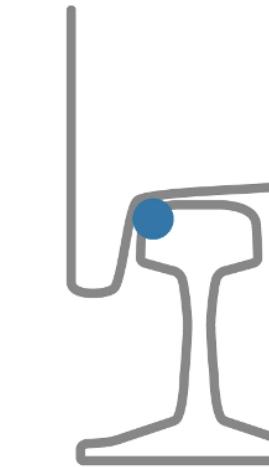
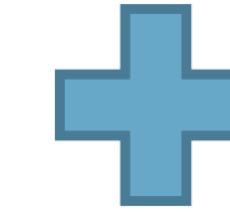
- » Application of voestalpine WEAR GURU to predict rail wear
- » Wear Prognosis for R=315 m curve
- » New wheel-rail combination shows significant wear reduction at high rail
 - » W3 Reduction-Factor = 2.8



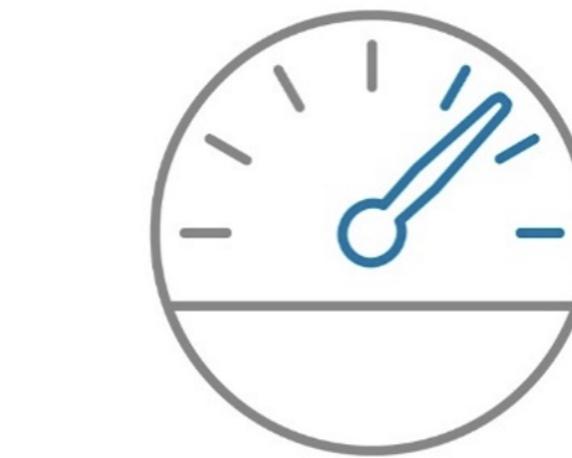
Performance Optimisation in the Wheel-Rail-System



Innovative
Material Design



Well designed
Wheel-Rail-Interface



Performance on
Track



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Thank You

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