Under Sleeper Pads for Turnouts

Getzner Werkstoffe GmbH, Austria

2024-11-26

Introduction

- Turnouts ‚make‘ the network
- They define the operating efficiency and service capability of the whole system (e.g. availability / speed)
- The investment cost of a turnout is on average 4 times higher compared to the regular track
- Turnouts cause much higher maintenance expenses (11-13 times higher per meter of track, TUG)

→ For investment 1% of the total costs arise for turnouts, but …

For maintenance >25% of total costs arise for turnouts

Indroduction

Why Elasticity? → To reduce dynamic forces and therefore prevent damages

Rail Corrugation

Broken Clips

Deterioration of Sleeper and Ballast

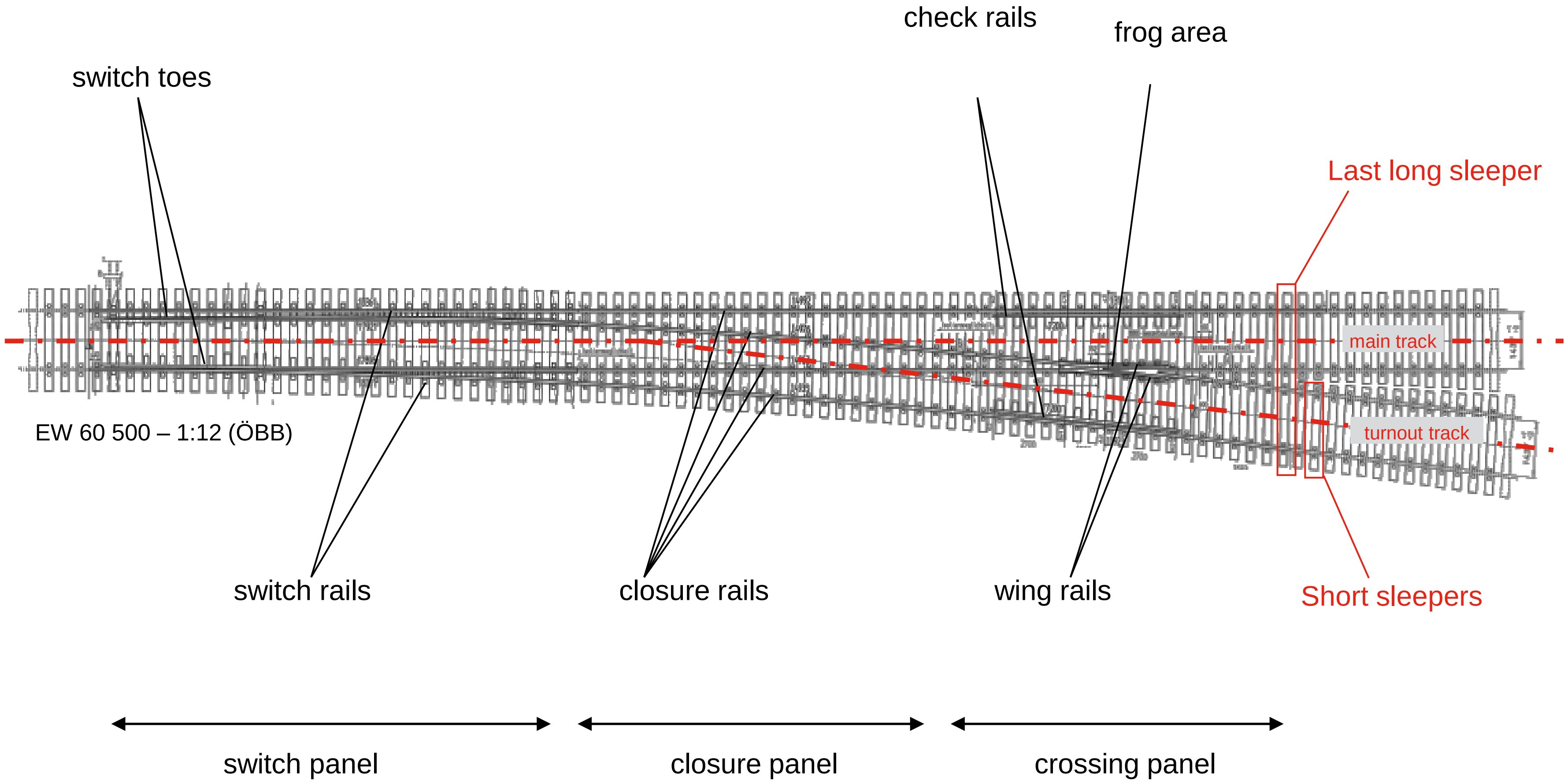
Deterioration/Settling Crossing Nose

Hanging Sleepers

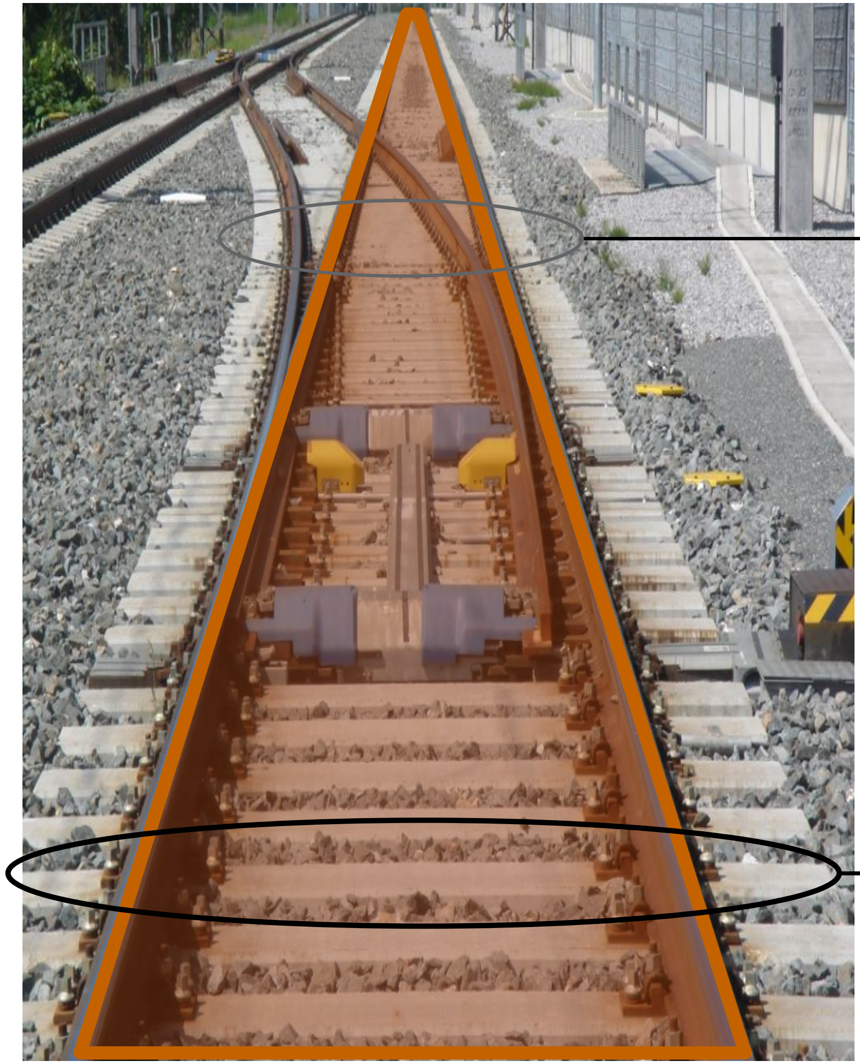
Cracks in Concrete Bearers

High potential for elastic elements (rail pads, base plate pads, ballast mats, etc.)
→ Getzner has a special competence in Under Sleeper Pads …

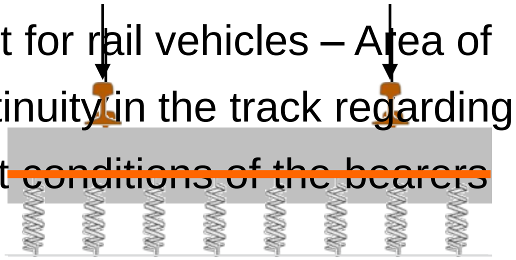
Configuration turnout



Introduction

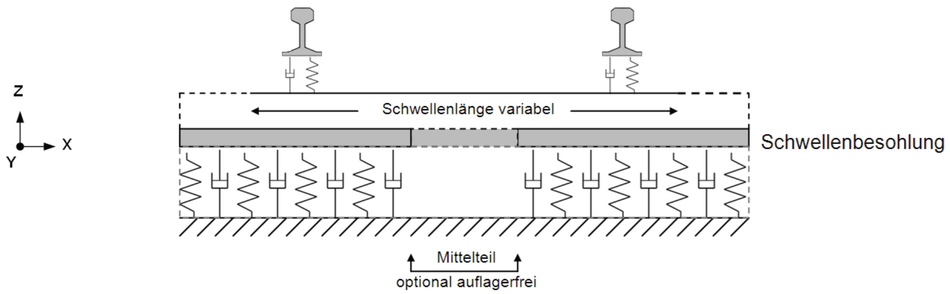


Turnout for rail vehicles – Area of discontinuity in the track regarding support conditions of the bearers

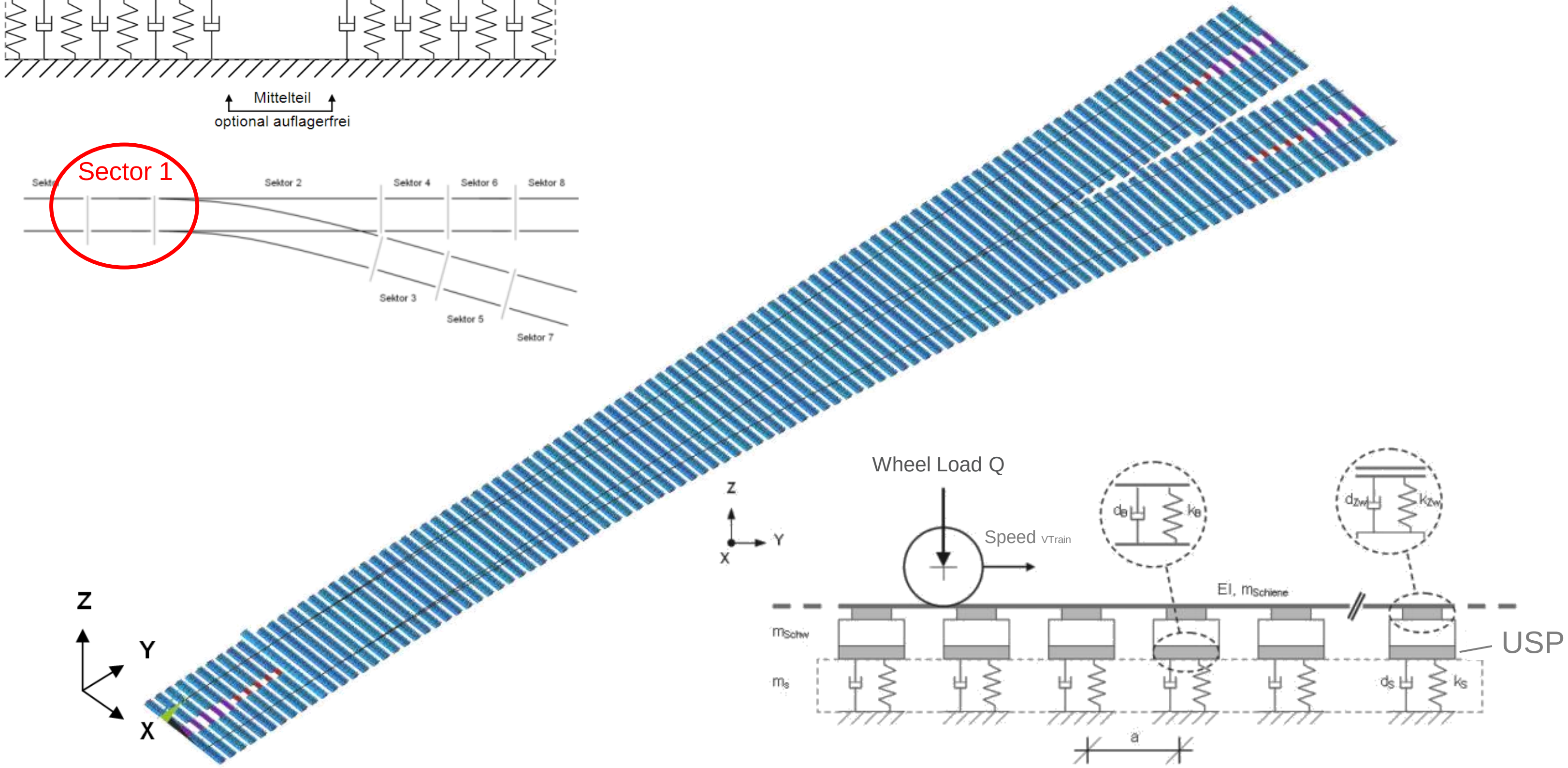


Modelling

Idealization of the system

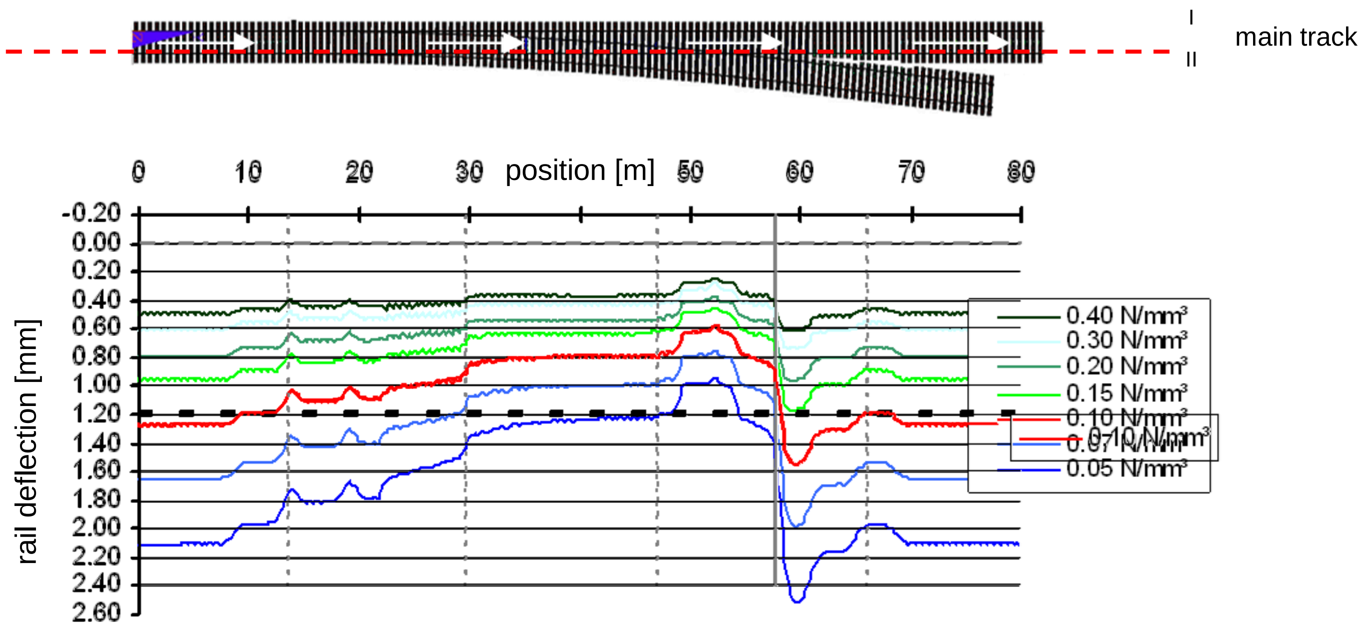


Finite Element Model (3D)



Changing the bedding

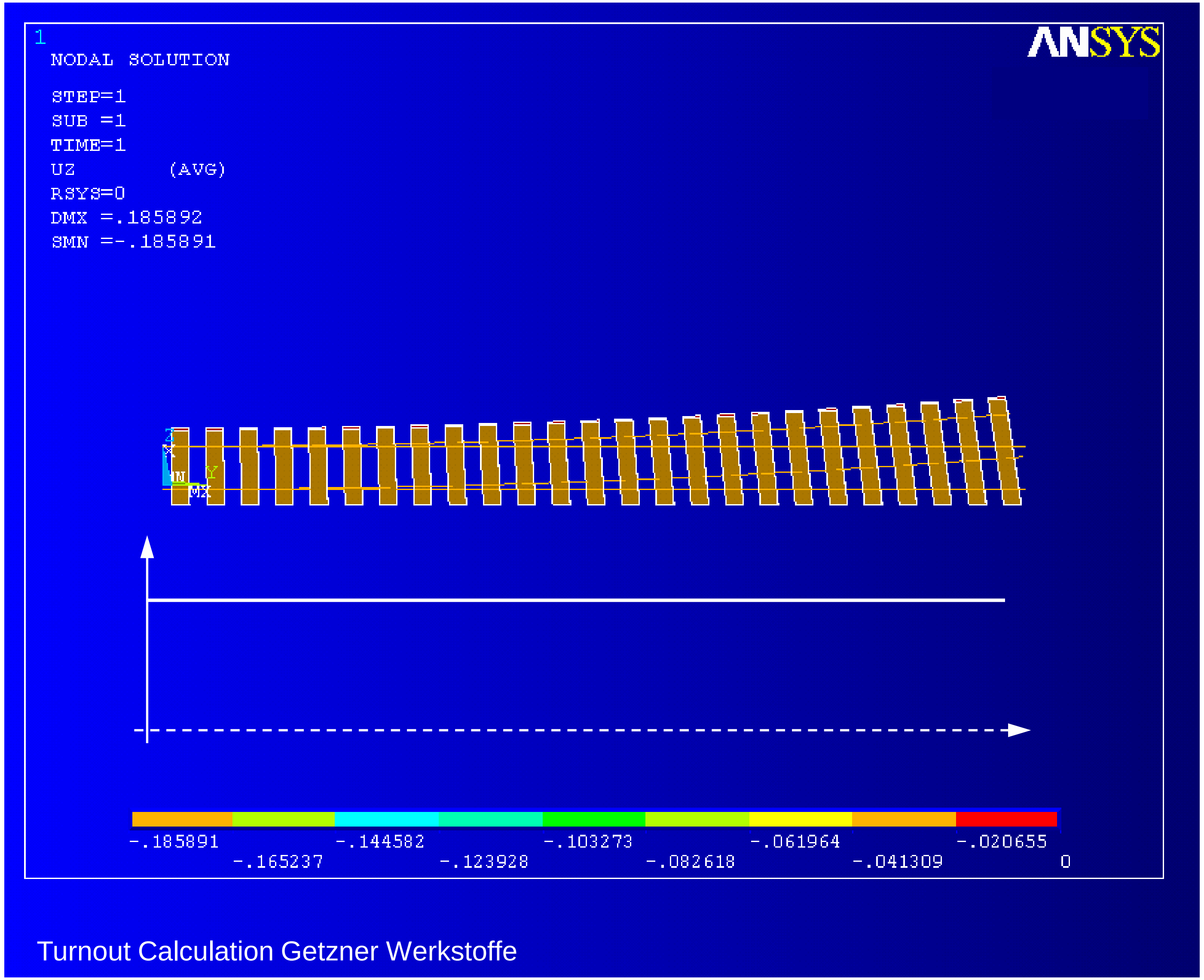
Turnout area: Influence of the bedding modulus



➢ homogeneous bedding modulus ≠ homogeneous vertical deflection

➢ Reducing the bedding modulus does not automatically lead to a smoother transition → the differences in vertical deflection would increase!

Finite Element Modelling (FEM)



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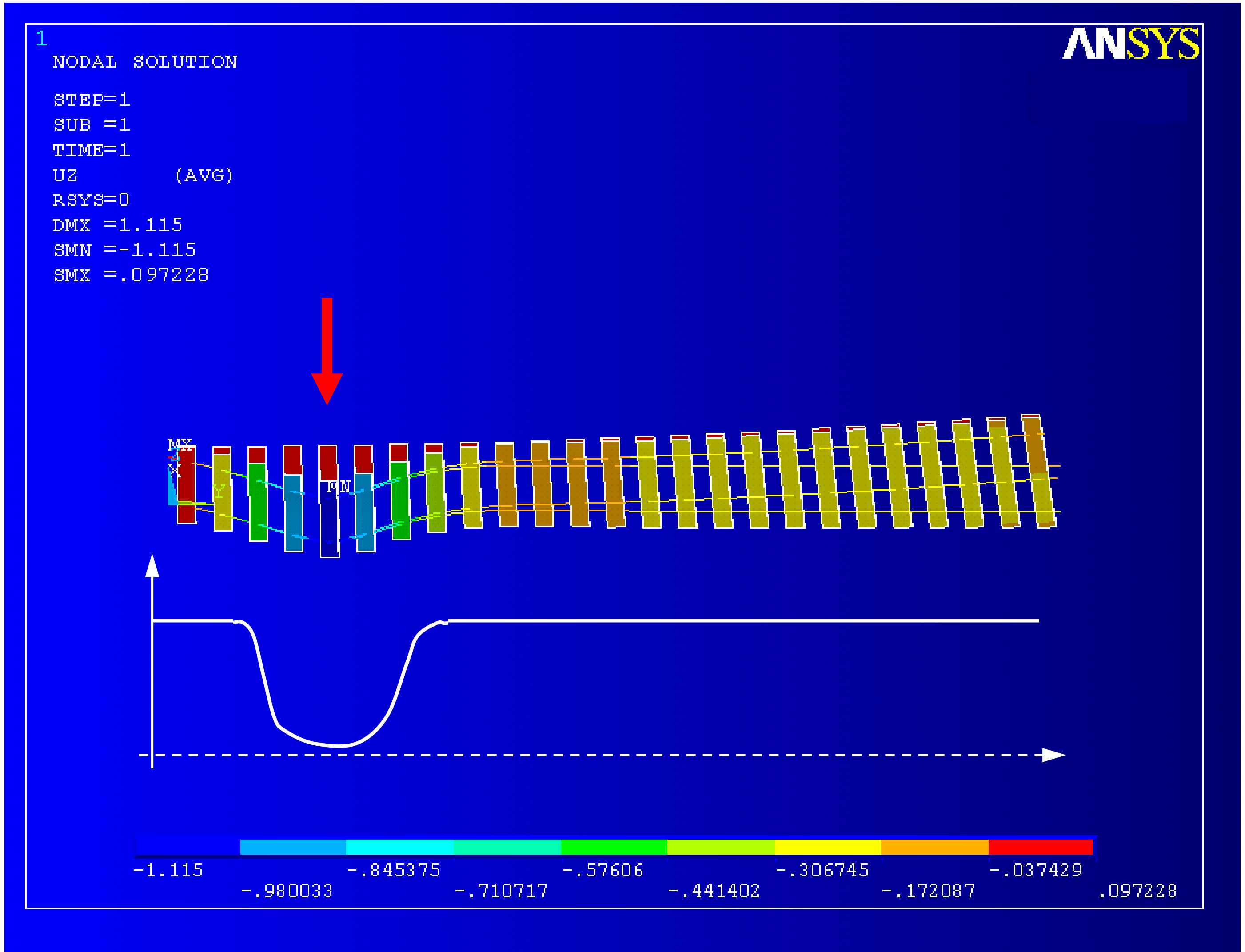
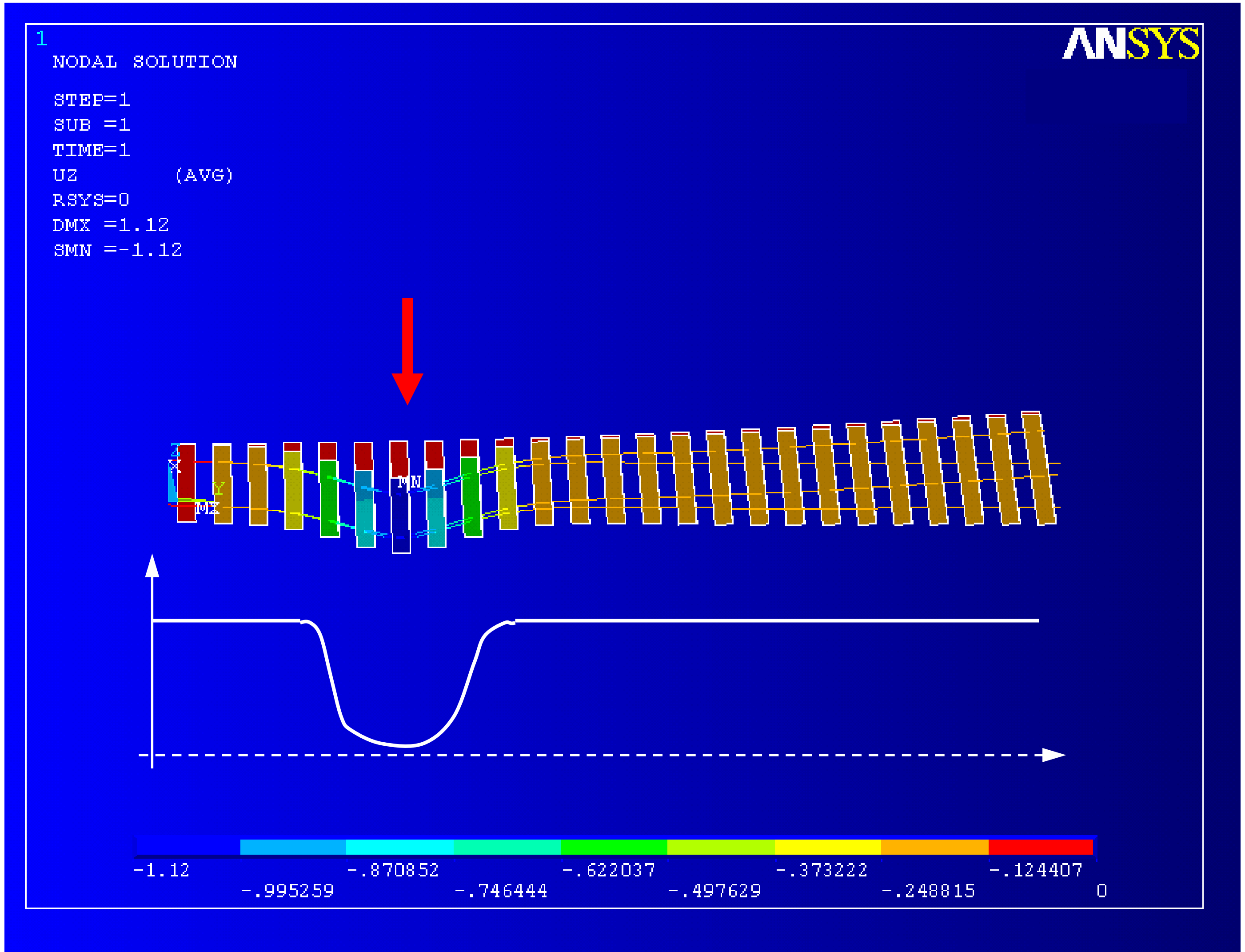


Turnout Calculation Getzner Werkstoffe

Finite Element Modelling (FEM)



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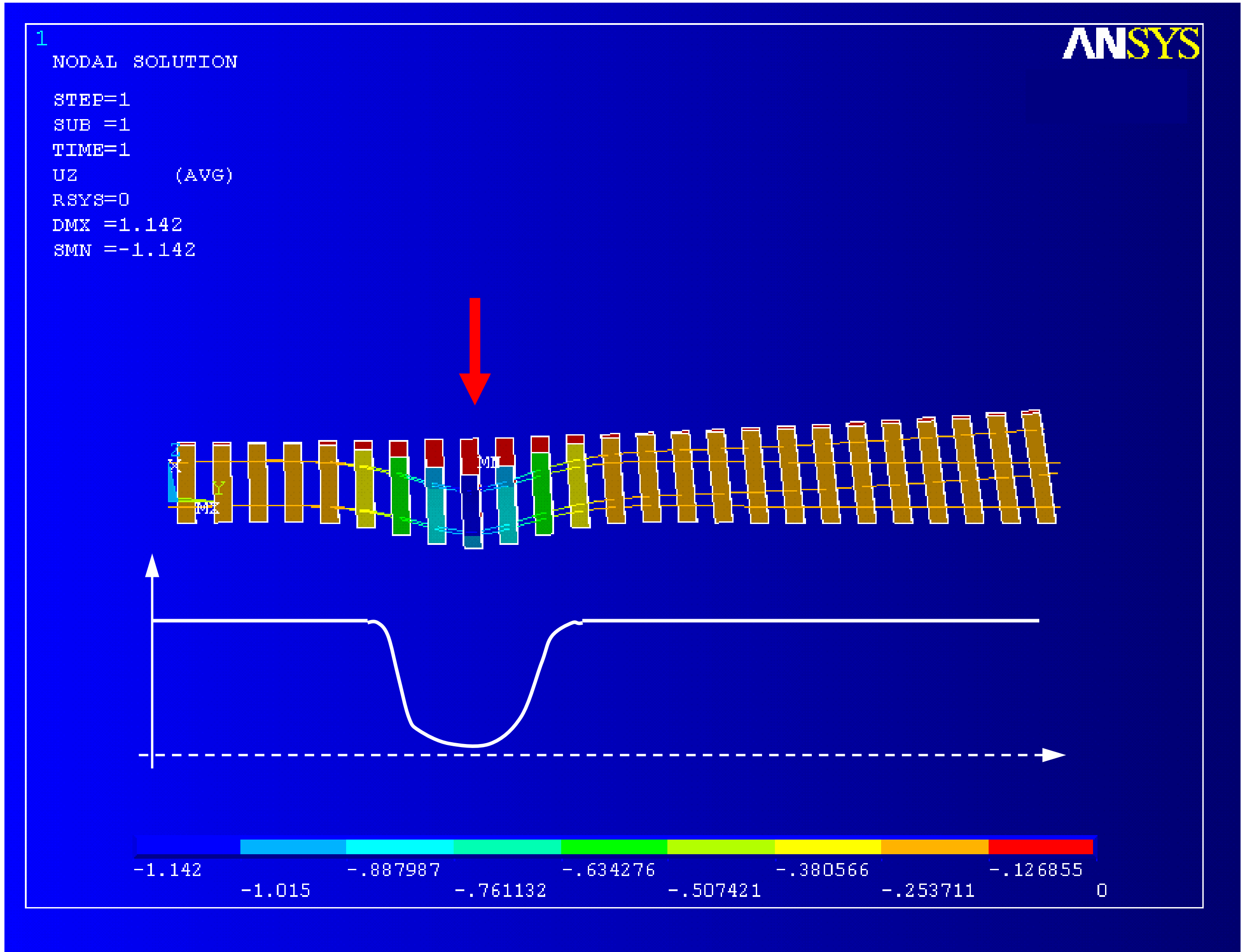

Turnout Calculation Getzner Werkstoffe

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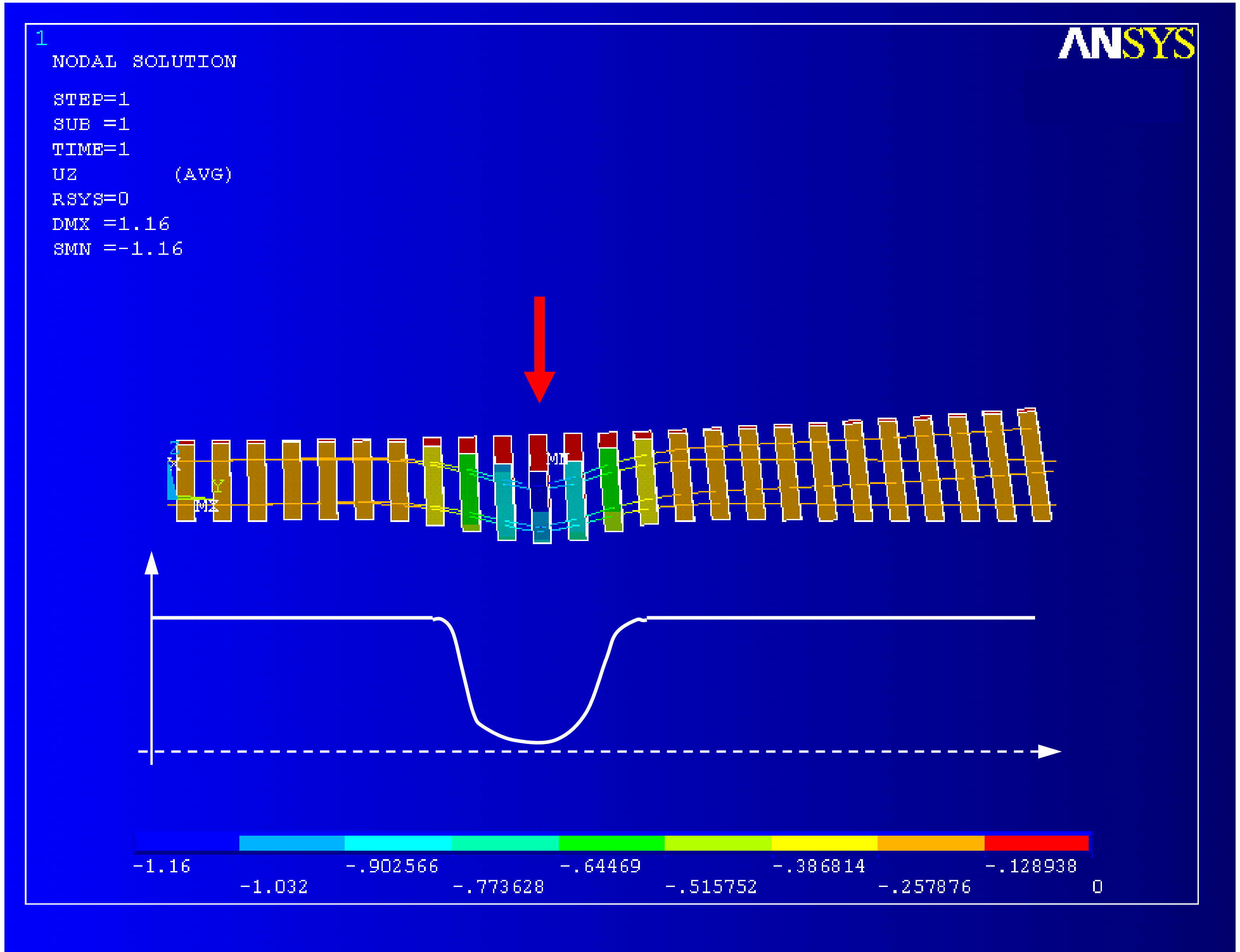

Turnout Calculation Getzner Werkstoffe

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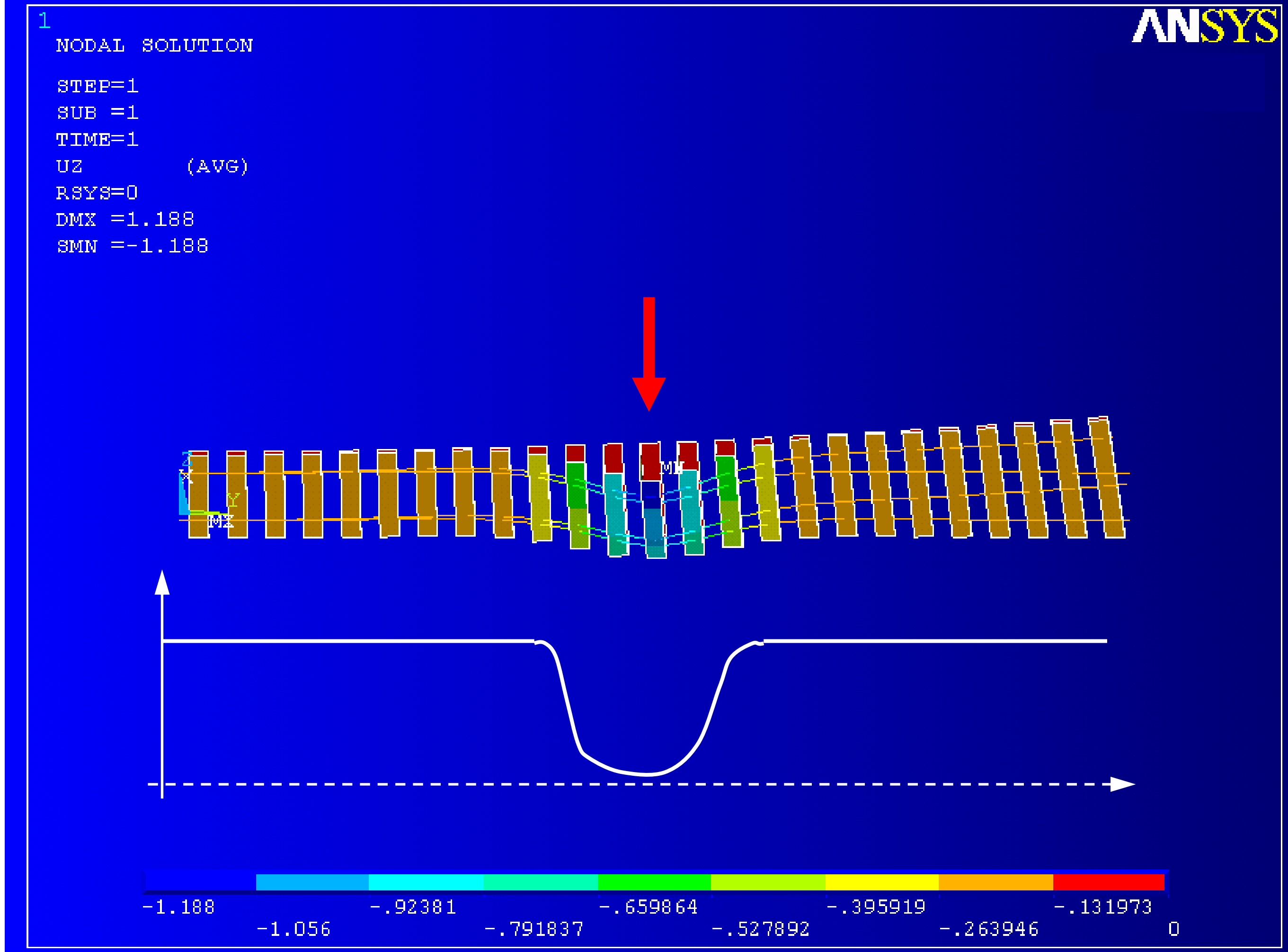

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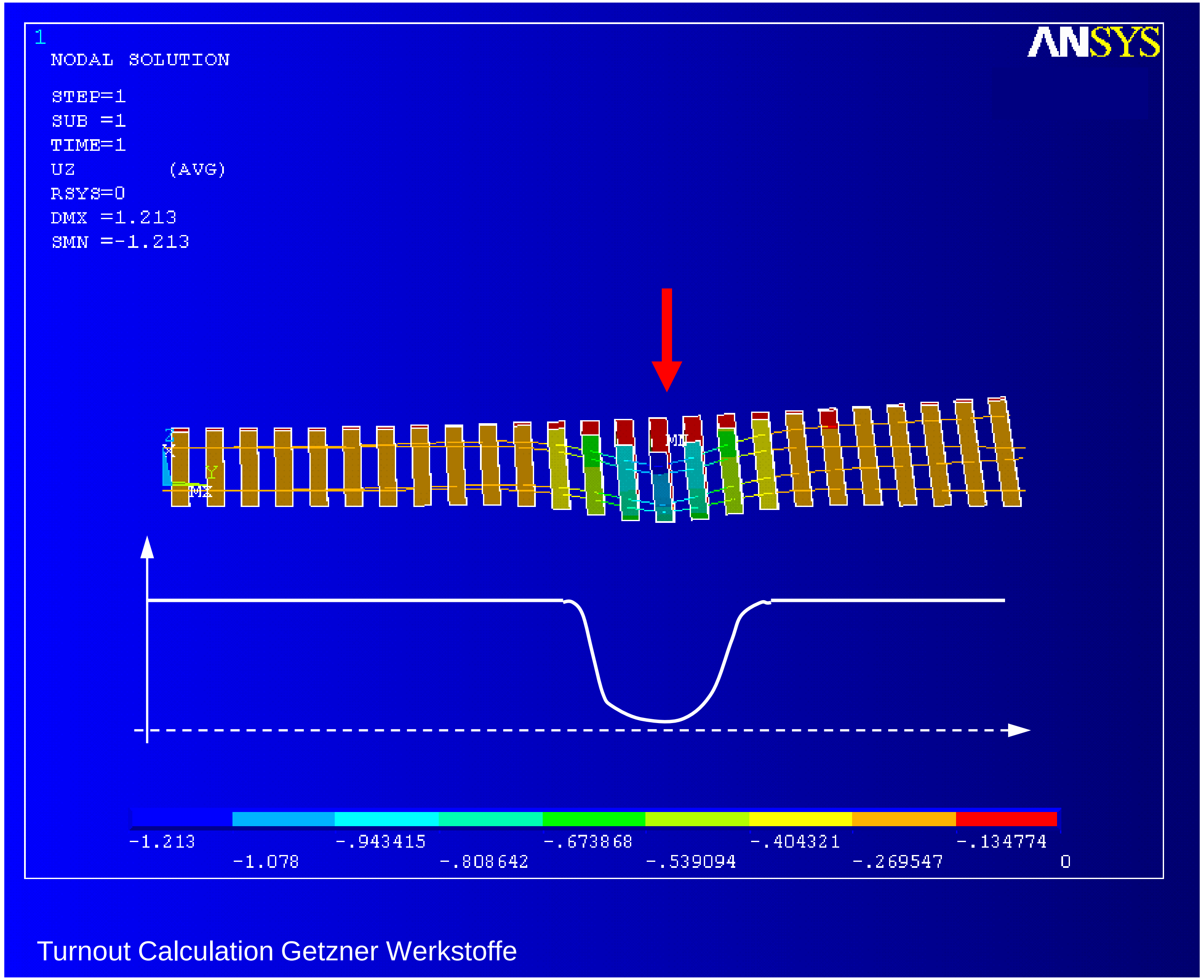

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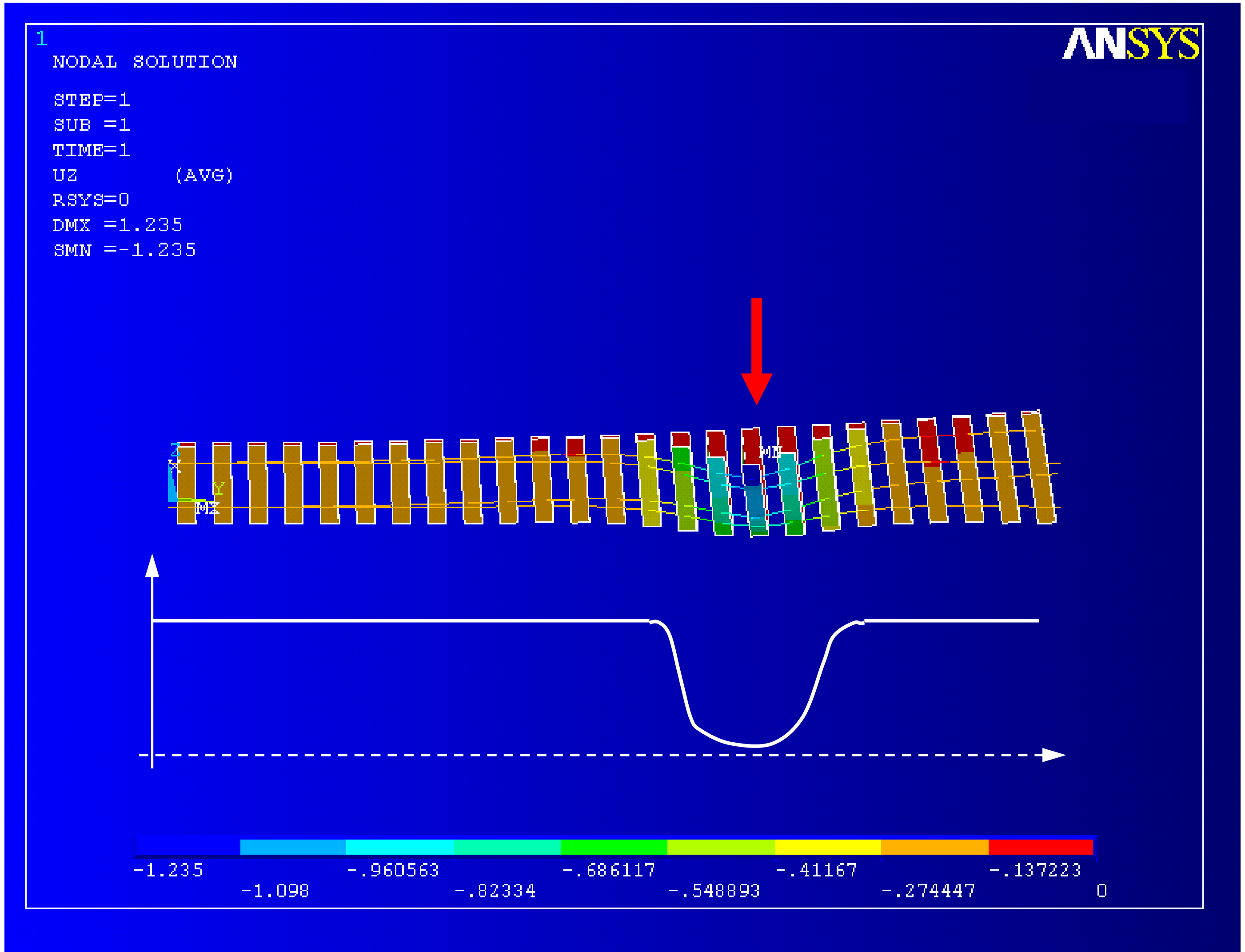

Turnout Calculation Getzner Werkstoffe

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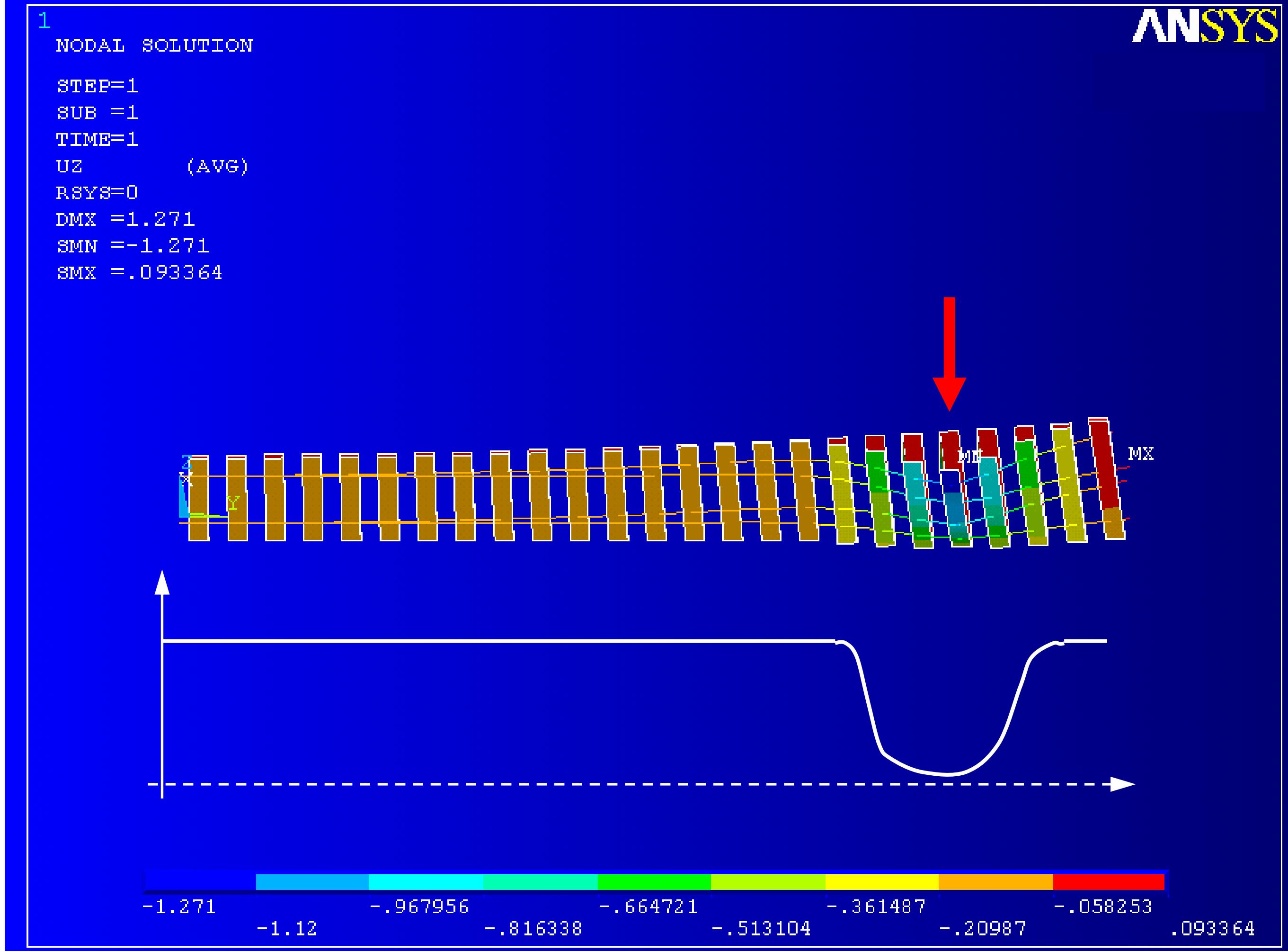

Turnout Calculation Getzner Werkstoffe

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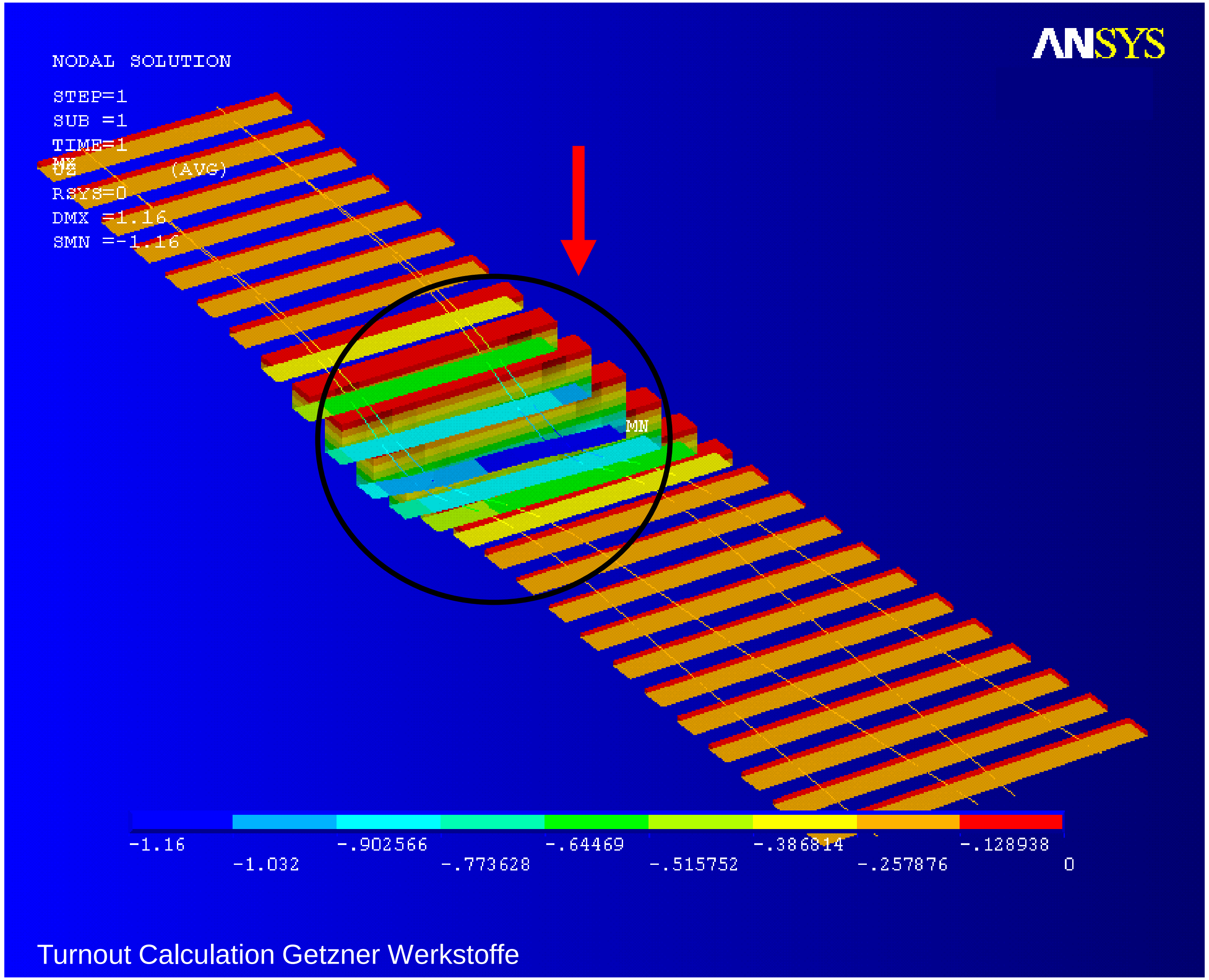
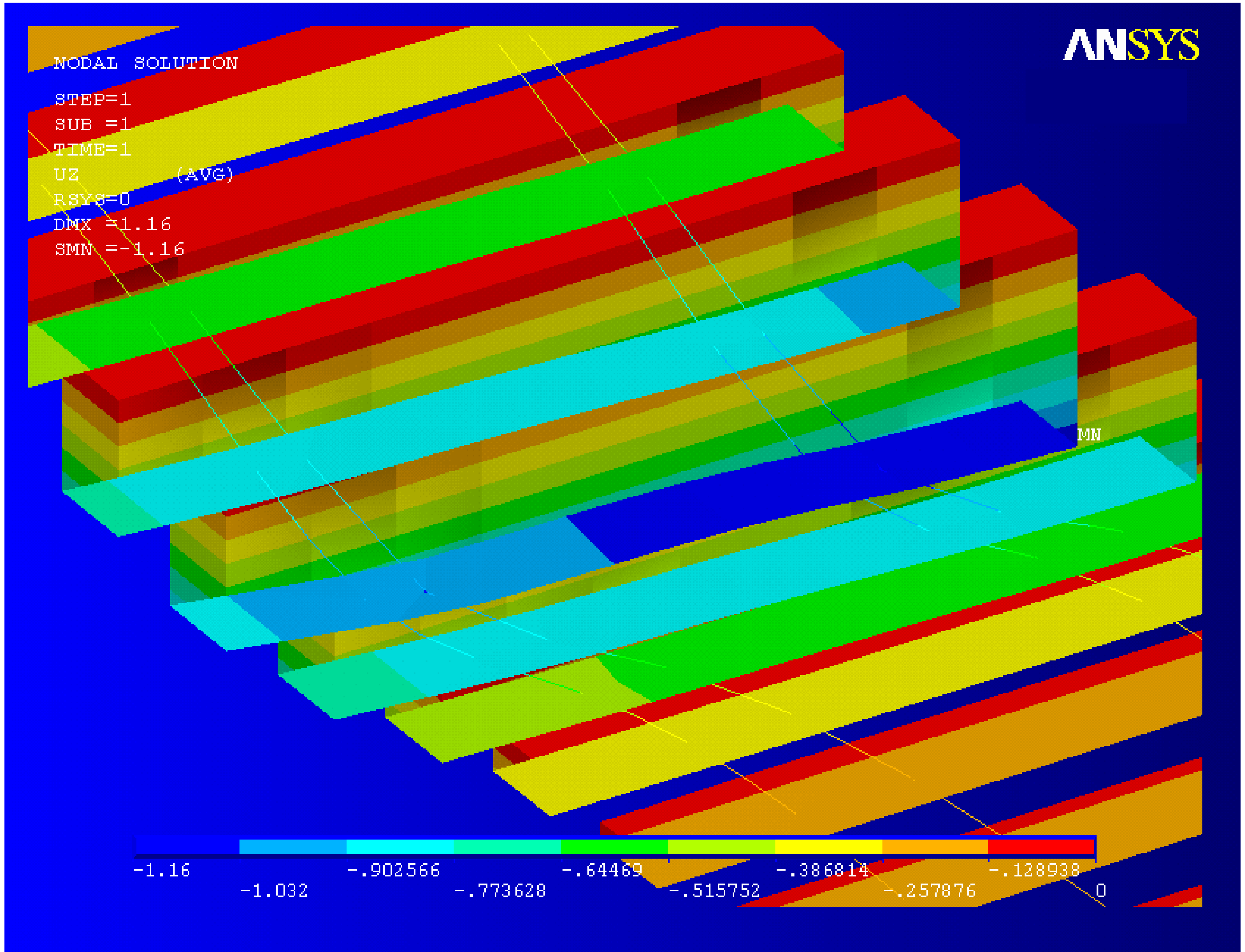
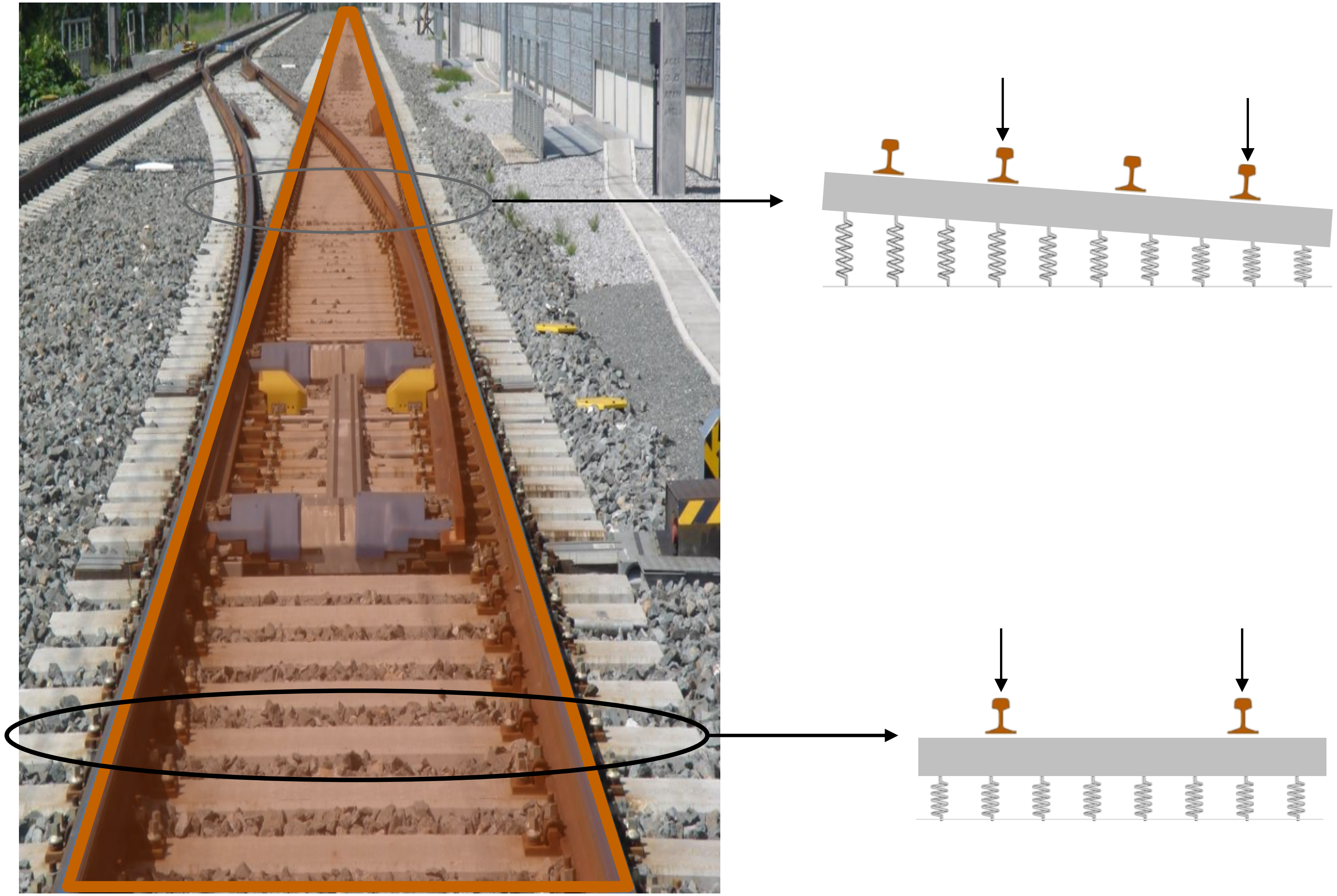


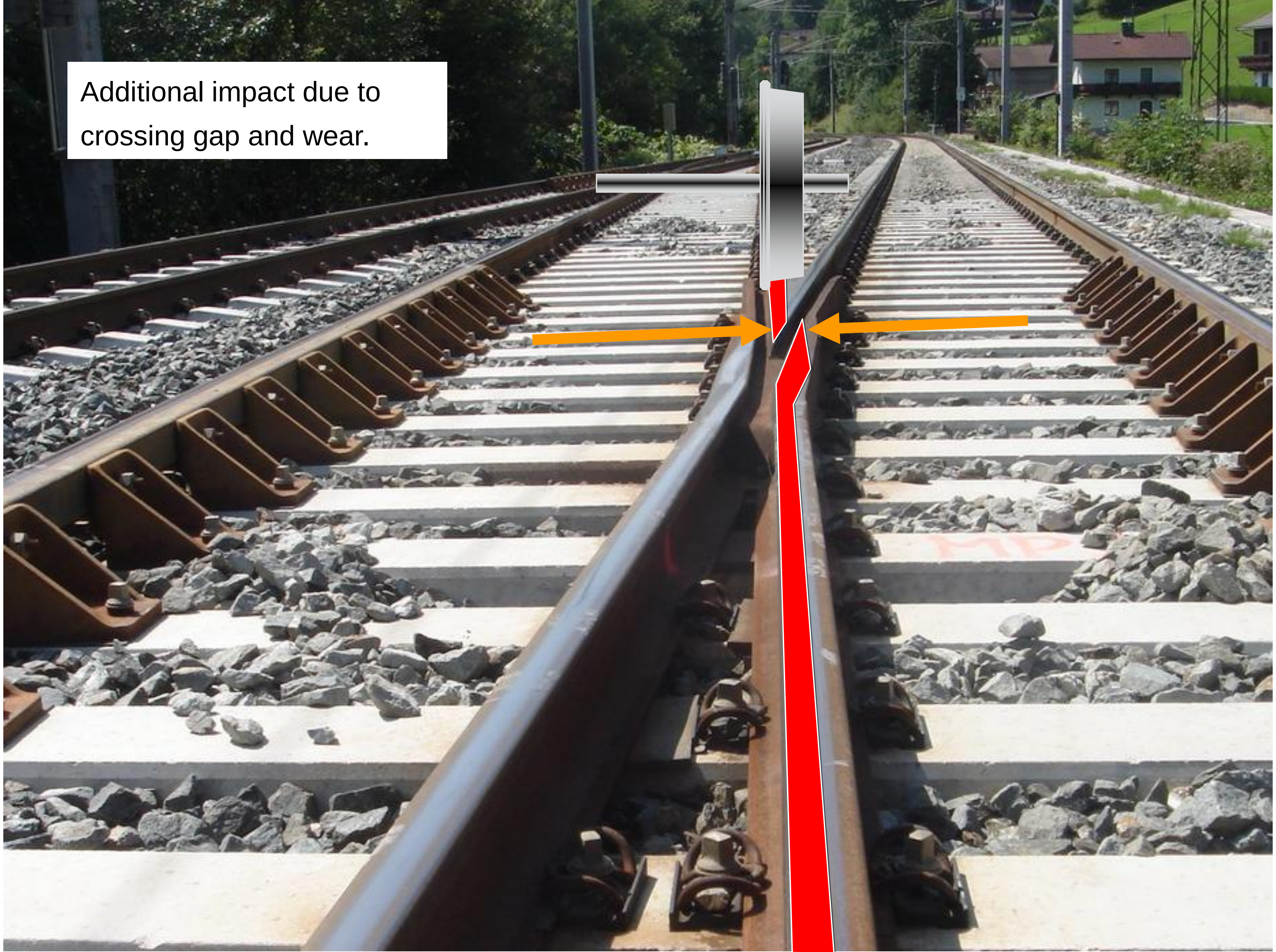
Finite Element Modelling (FEM)



Turnout Calculation Getzner Werkstoffe

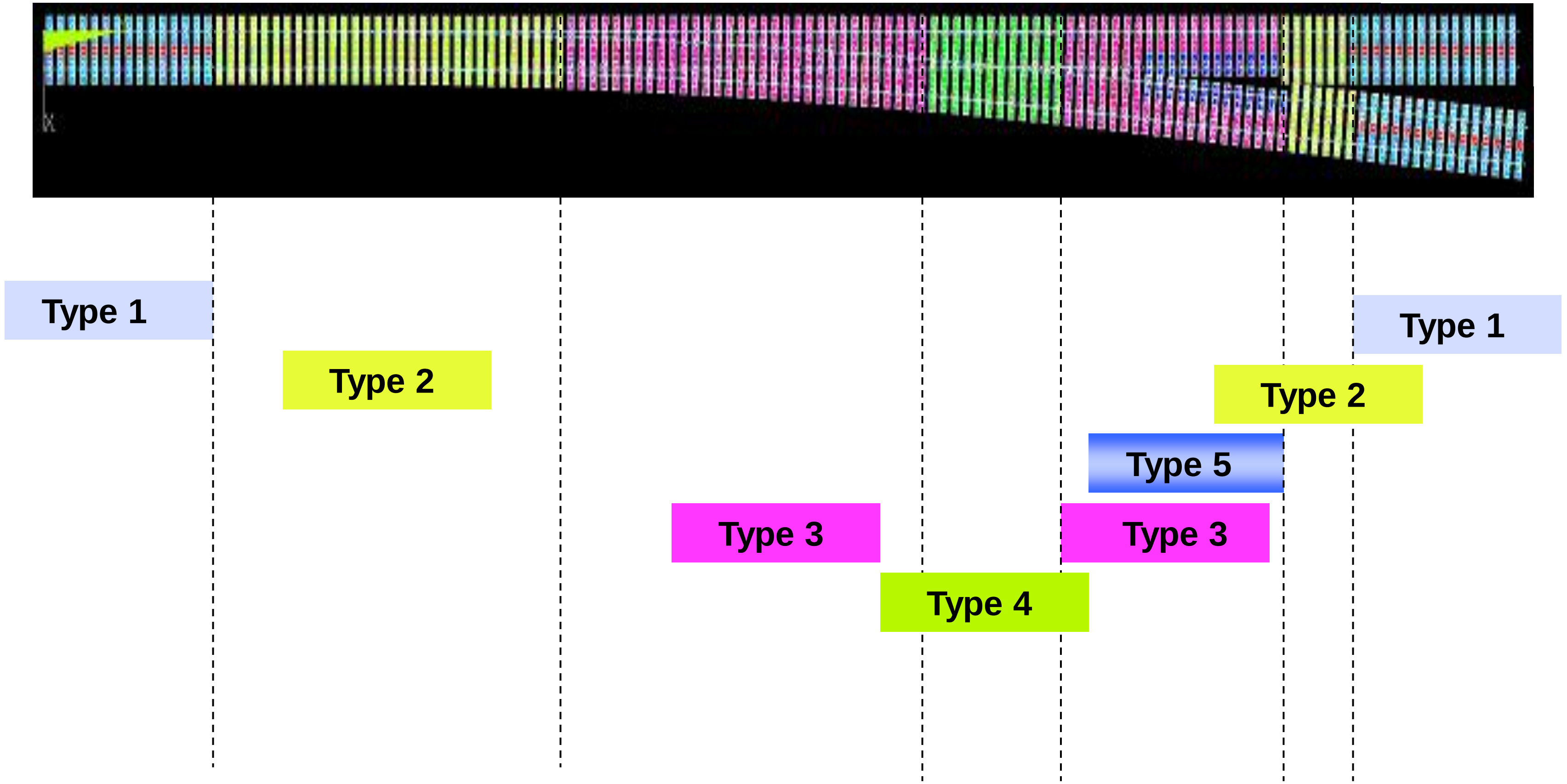
Modelling




Additional impact due to crossing gap and wear.

FEM – Design – High performance solution (e.g. HSR)

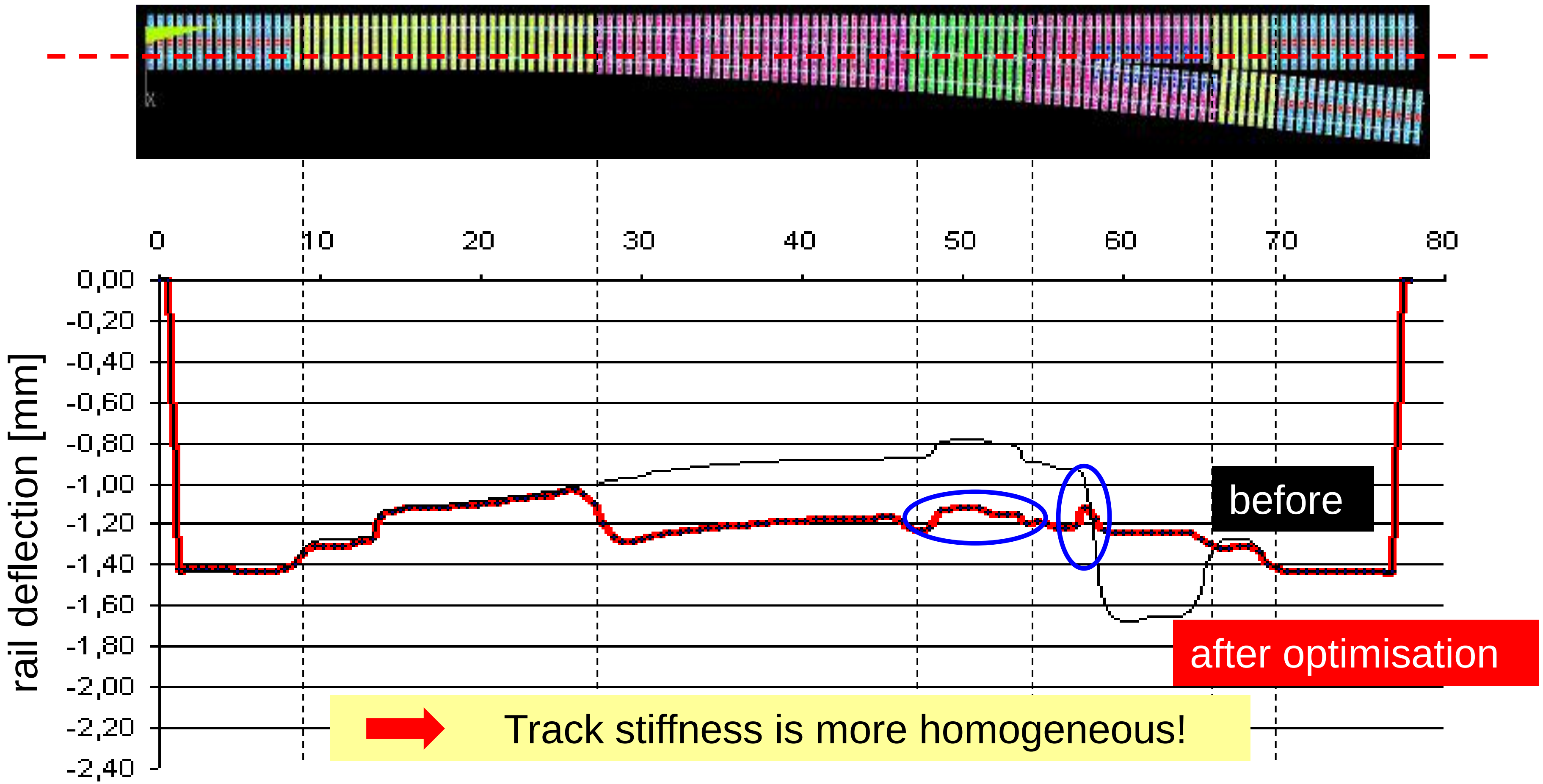
Solution with → Under Sleeper Pads



C= 0.36 N/mm³ - 0.12 N/mm³

FEM – Optimisation of bedding

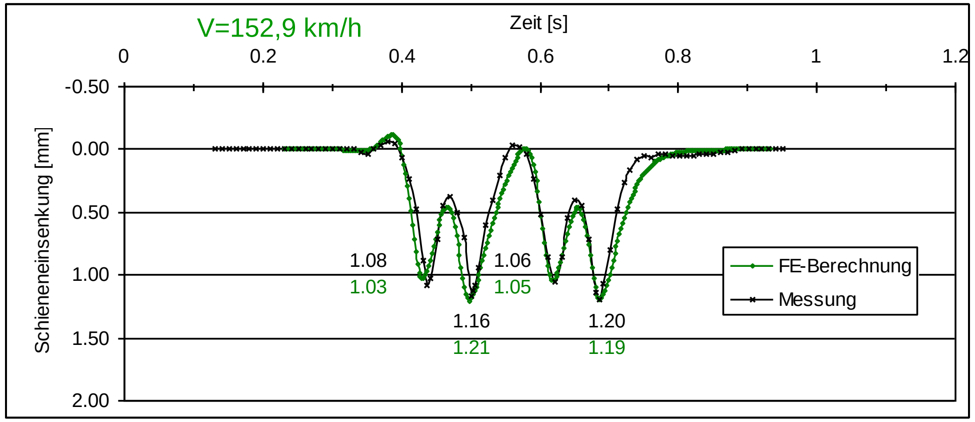
Results of optimisation



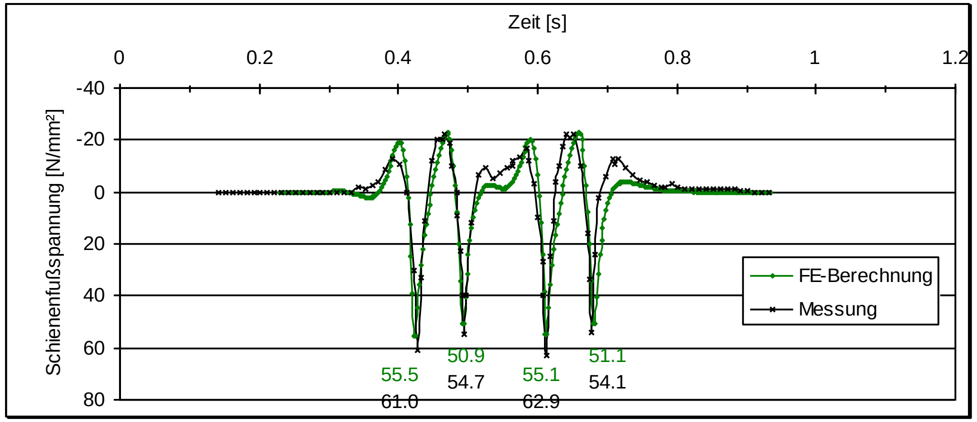
Modelling

Sector 1: Verification of the dynamic structural behavior on part model

Turnout bearers with Under Sleeper Pads in slab of Sittenbergtunnel



Rail deflection



Railfoot stress

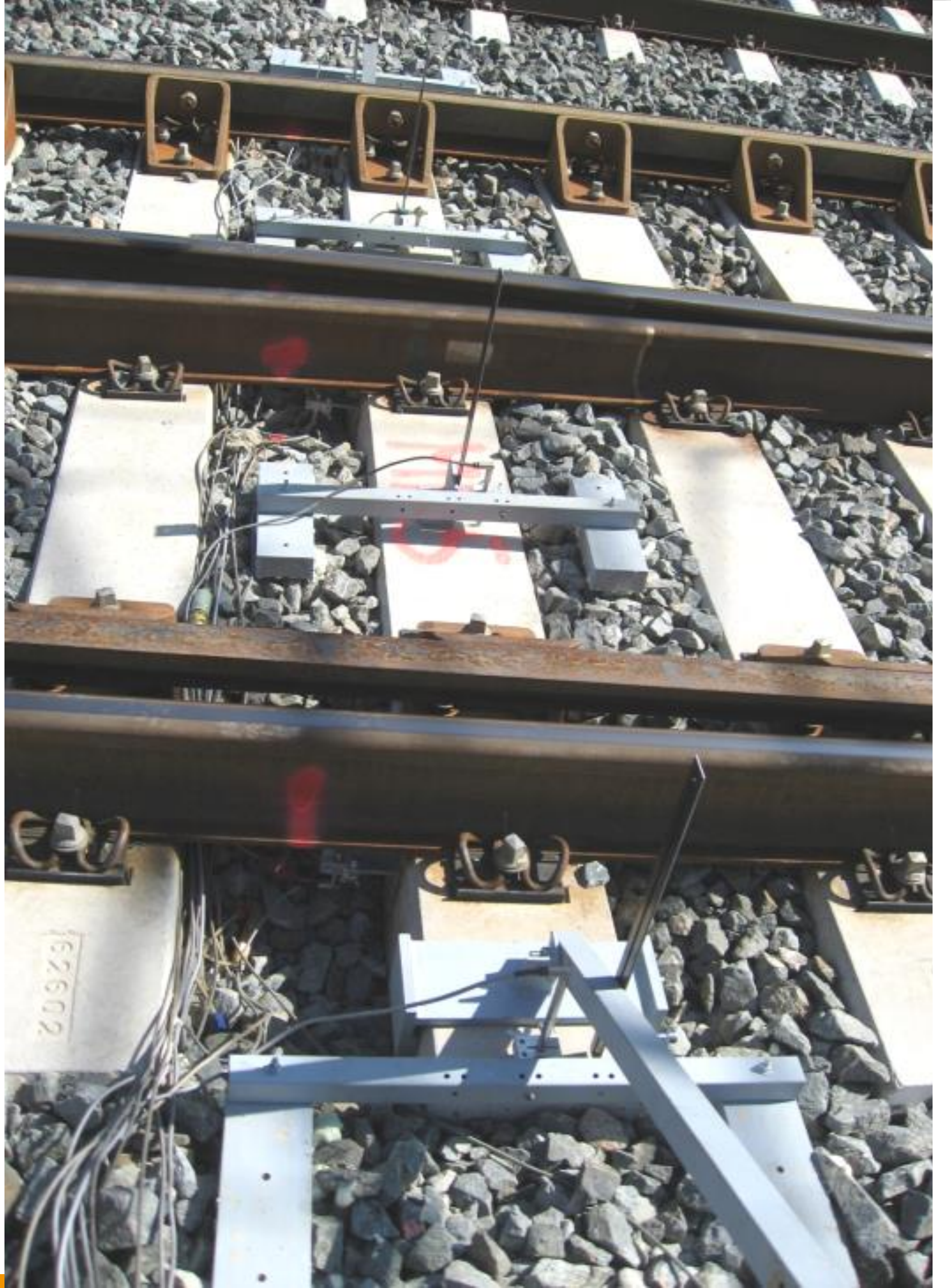
Benefits

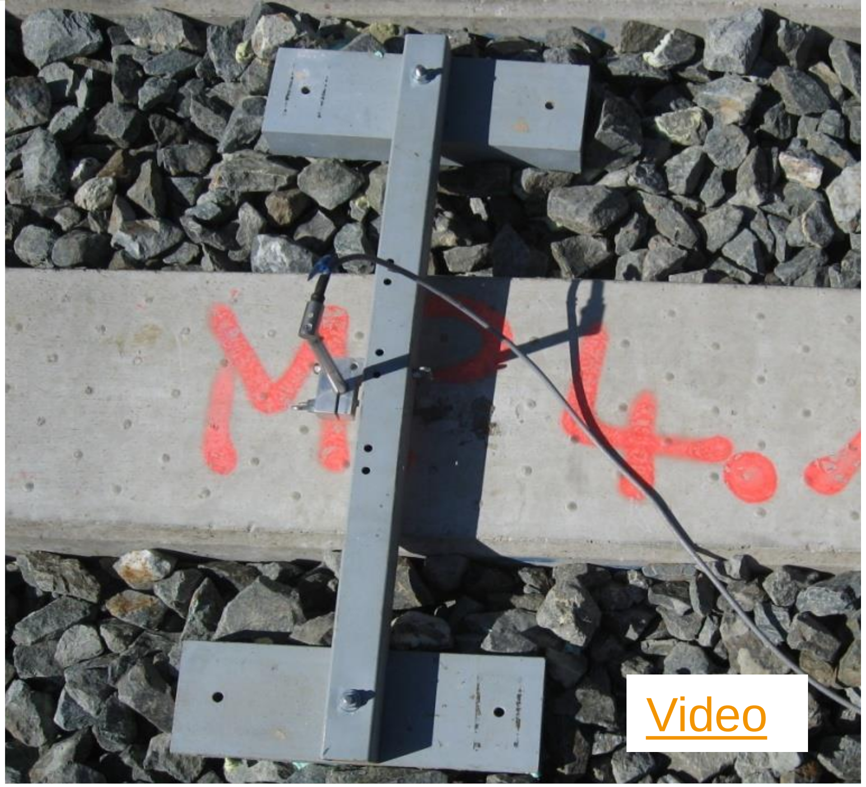
Elasticity in Turnouts - Biggest Benefits:

- Improvement of track quality
- Reduction of maintenance, longer tamping intervals in ballast
- Optimisation due to changing geometry
- Improvement of track stability
- Reduction of rail corrugation in tight curves
- Reduction of vibrations

Example:

Measurement at a padded turnout in Austria (Baden)

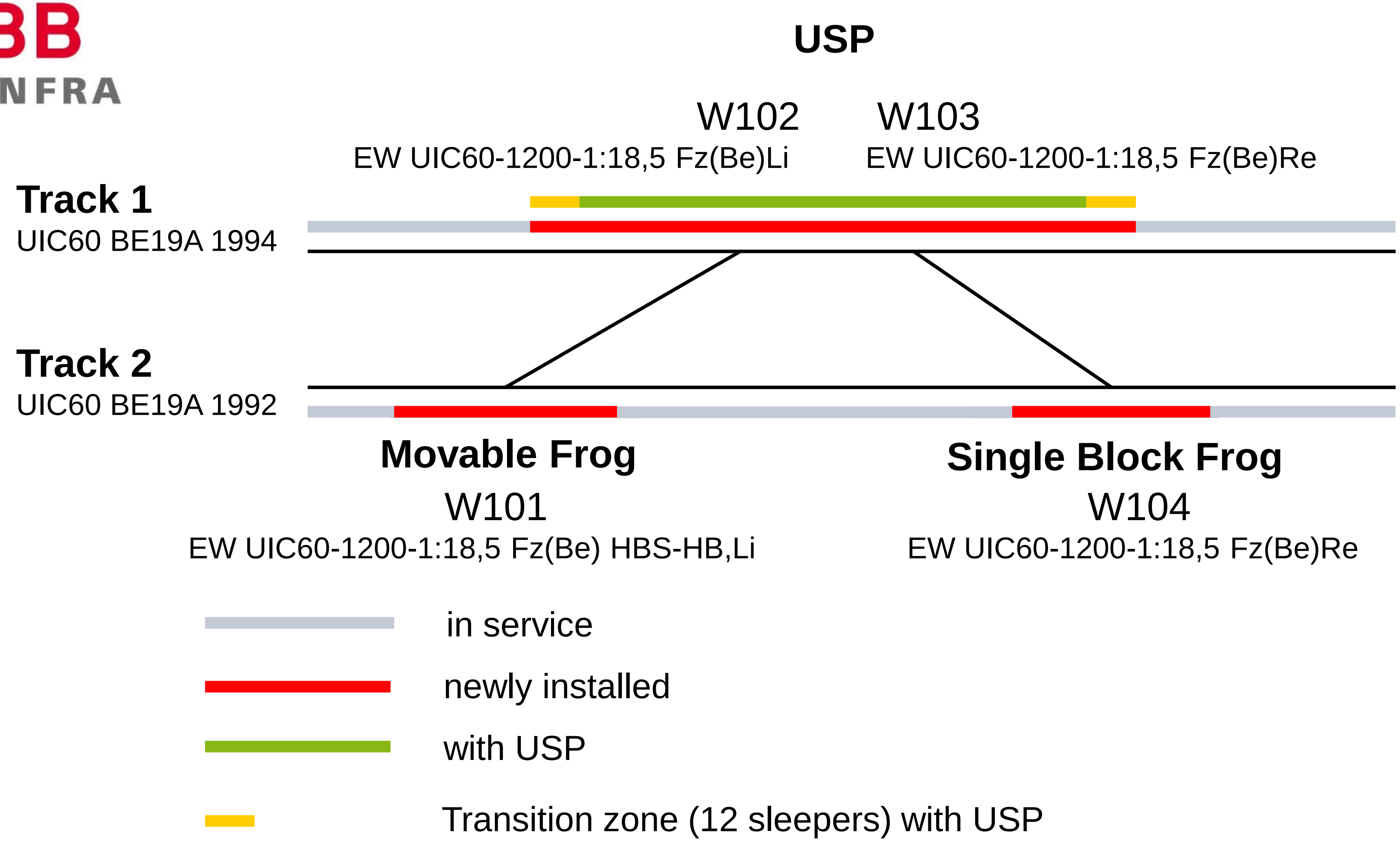




Video

References: Austria / Baden

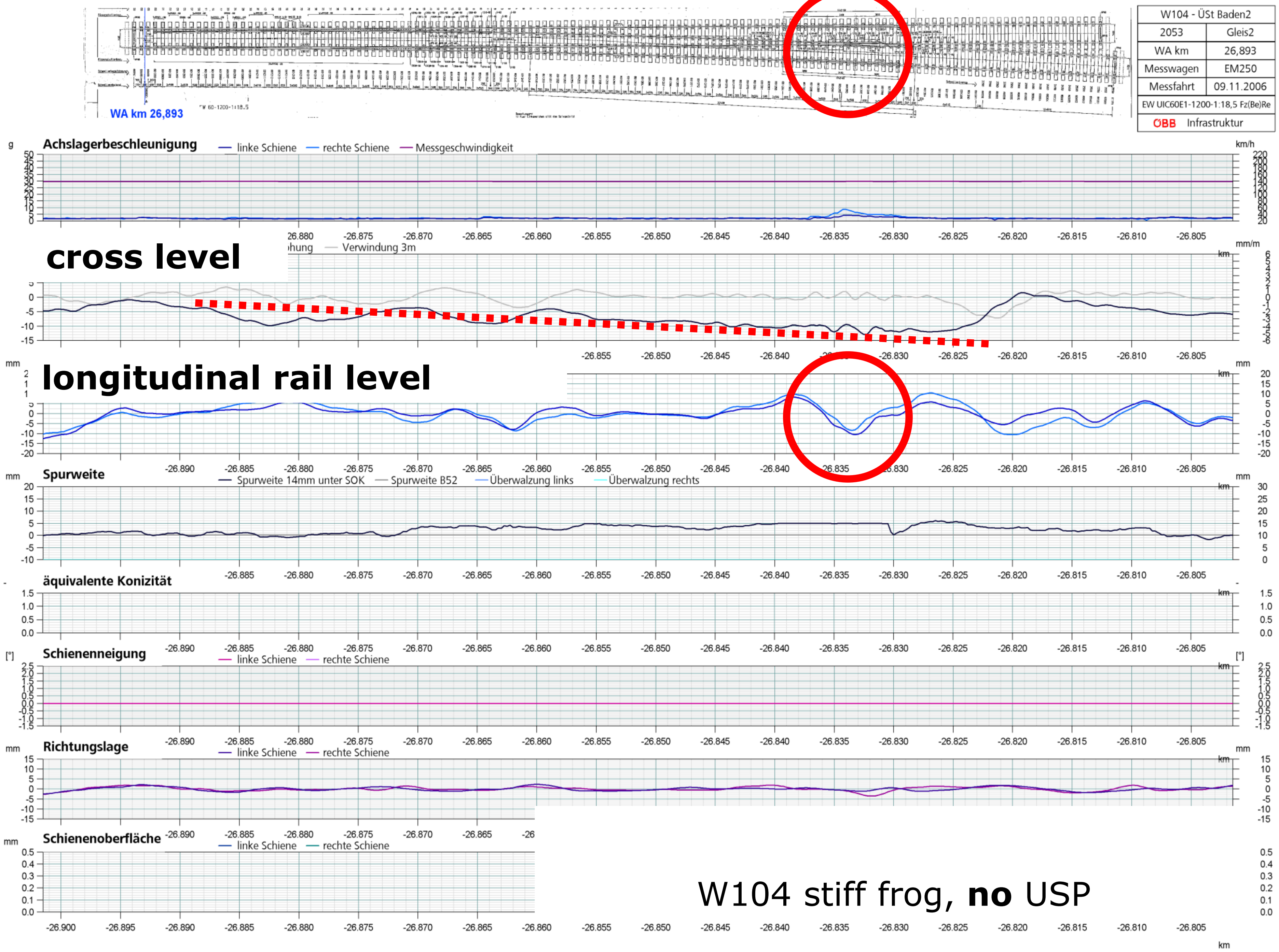
ÖBB INFRA



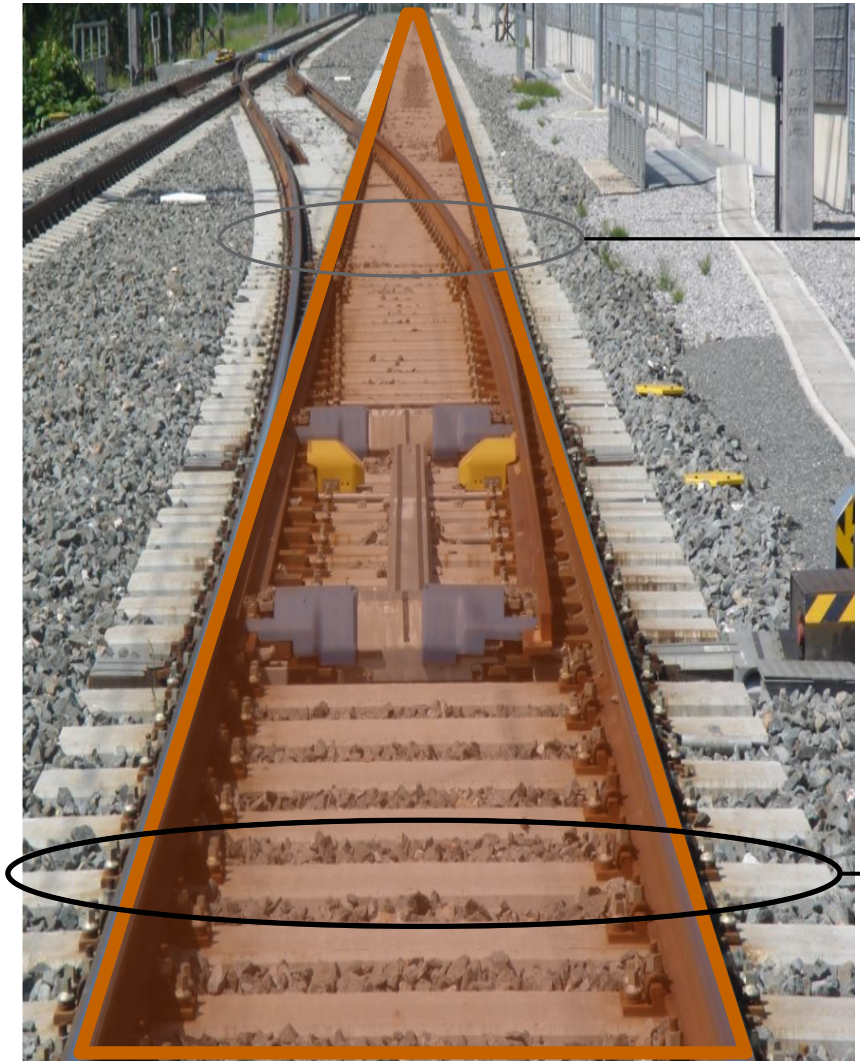
- Example of a turnout in Austria (Baden)
- Inside the turnout area: 4 turnouts
- Track 1: 2 rigid frogs with UTP
- Track 2: 1 movable frog, 1 single block frog

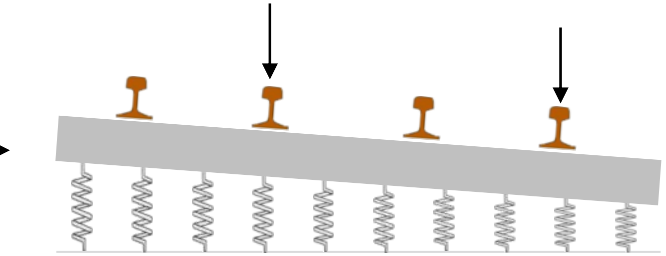
Parameters

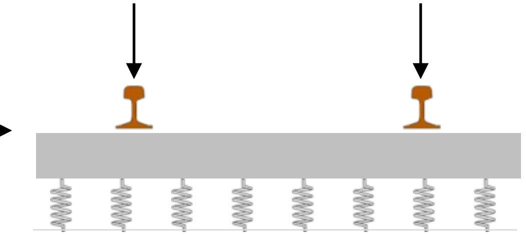
- Axle Loads of 25 to
- Speed of up to 275 km/h → turnout crossing time ~1 s

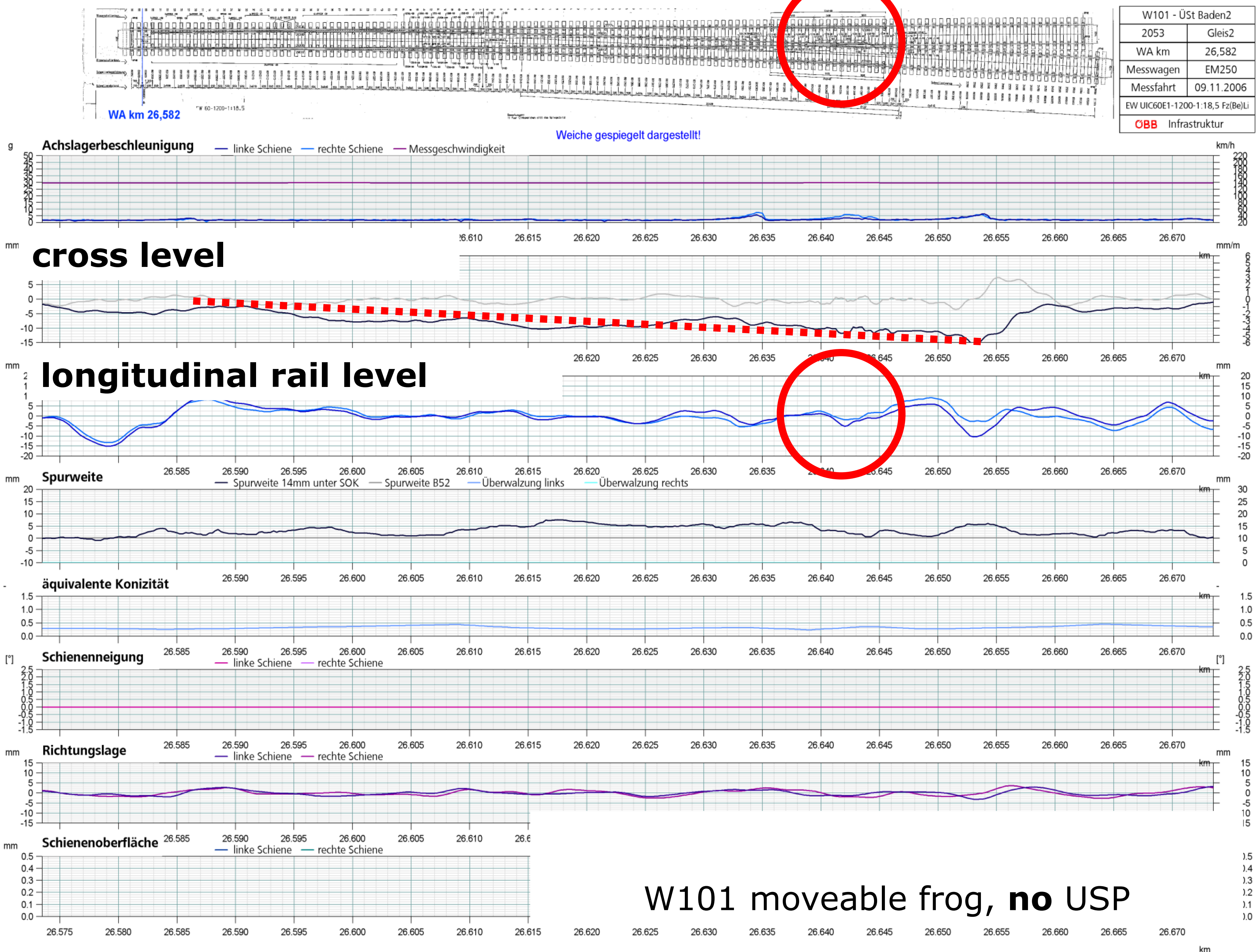

W104 - ÜSt Baden2
2053
Gleis2
WA km
26,893
Messwagen
EM250
Messfahrt
09.11.2006
EW UIC60E1-1200-1:18,5 Fz(Be)Re
ÖBB Infrastruktur
WA km 26,893
Achslagerbeschleunigung
linke Schiene
rechte Schiene
Messgeschwindigkeit
cross level
Verwindung 3m
longitudinal rail level
Spurweite
Spurweite 14mm unter SOK
Spurweite B52
Überwalzung links
Überwalzung rechts
äquivalente Konizität
Schienenneigung
linke Schiene
rechte Schiene
Richtungslage
linke Schiene
rechte Schiene
Schienenoberfläche
linke Schiene
rechte Schiene
km
W104 stiff frog, **no** USP

References: Austria / Baden

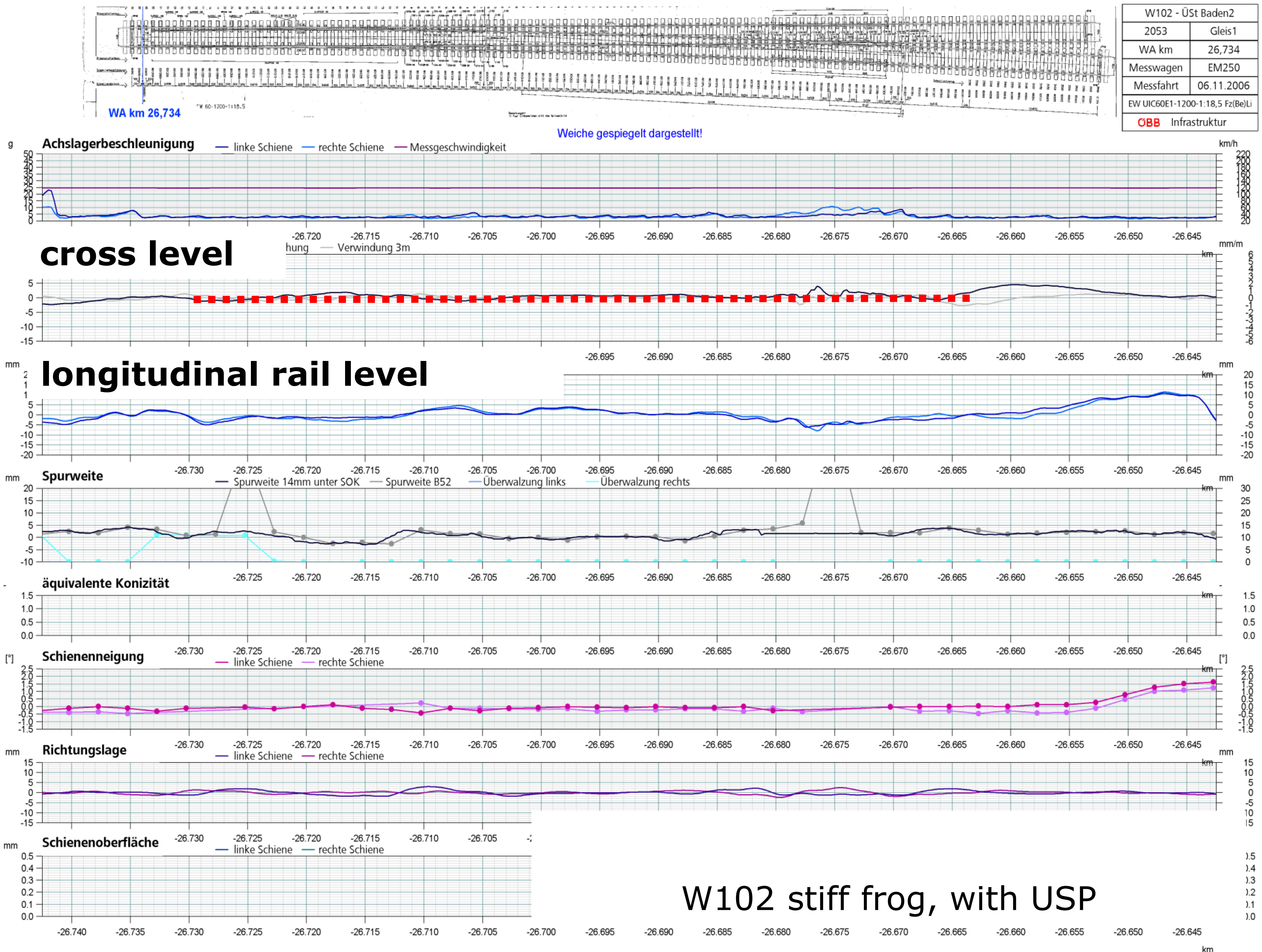




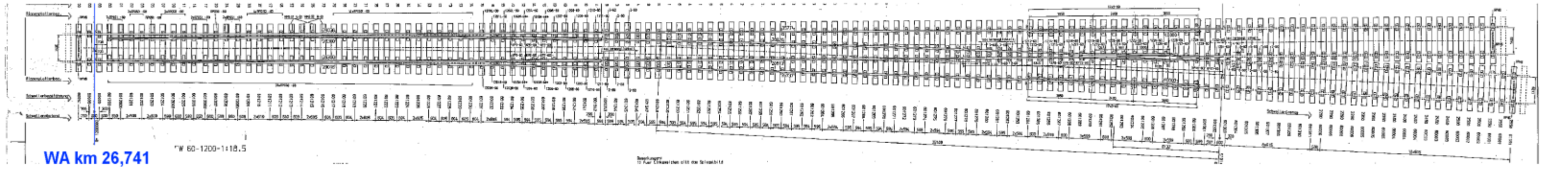




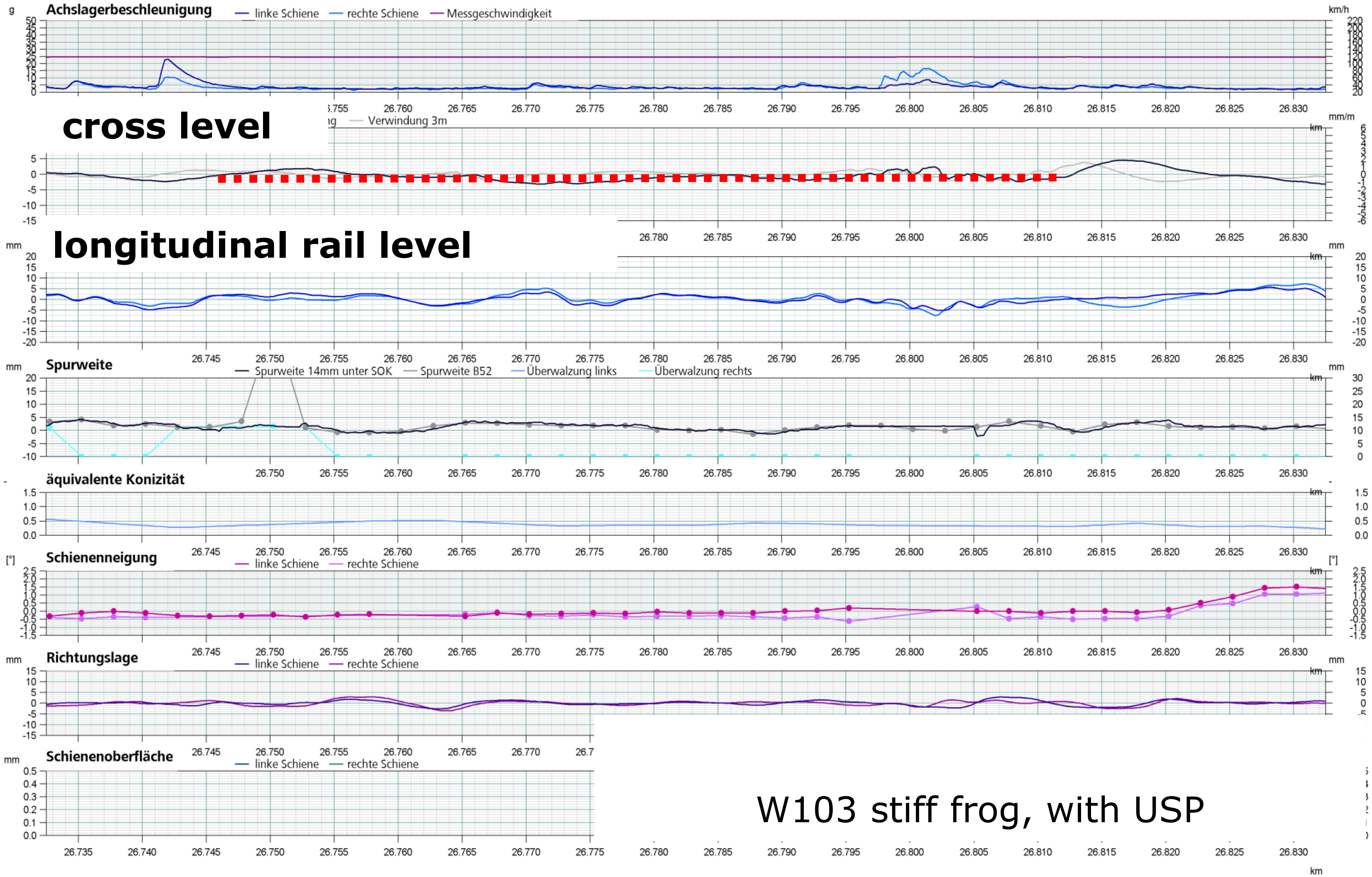
W101 moveable frog, **no** USP



W102 stiff frog, with USP



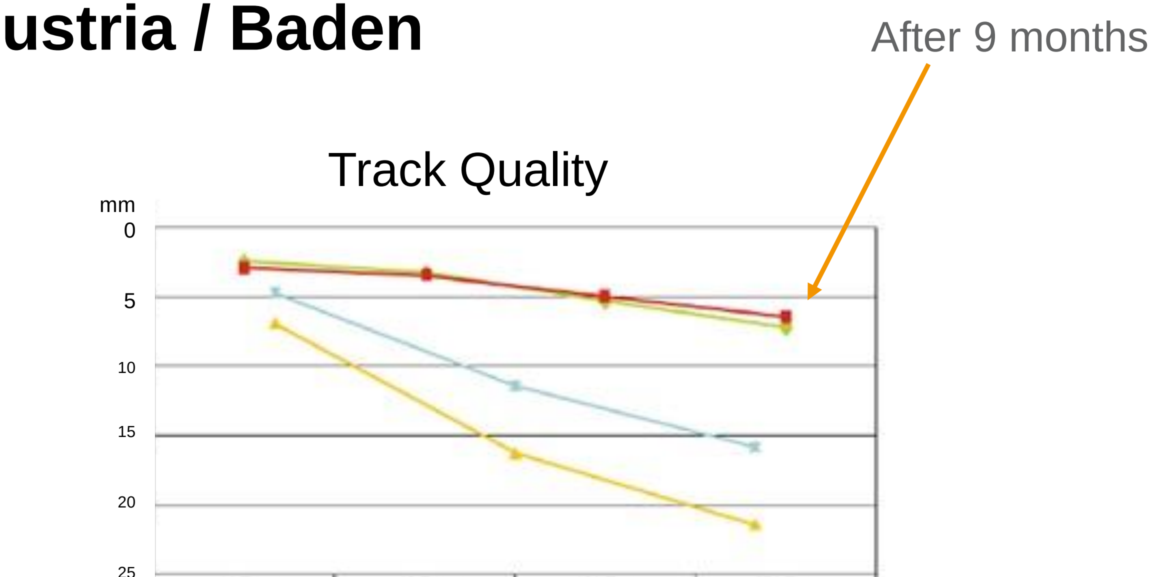
W103 - ÜSt Baden2	
2053	Gleis1
WA km	26,741
Messwagen	EM250
Messfahrt	06.11.2006
EW UIC60E1-1200-1:18,5 Fz(Be)Re	
ÖBB Infrastruktur	



W103 stiff frog, with USP

References: Austria / Baden

ÖBB INFRA



	14 Tage	42 Tage	161 Tage	274 Tage
W 102 USP	-0,0024	-0,0032	-0,0063	-0,0072
W 103 USP	-0,0028	-0,0034	-0,0050	-0,0064

	28 Tage	147 Tage	260 Tage
W 101 MF	-0,0047	-0,0113	-0,0169
W 104 SBF	-0,0047	-0,0125	-0,0147

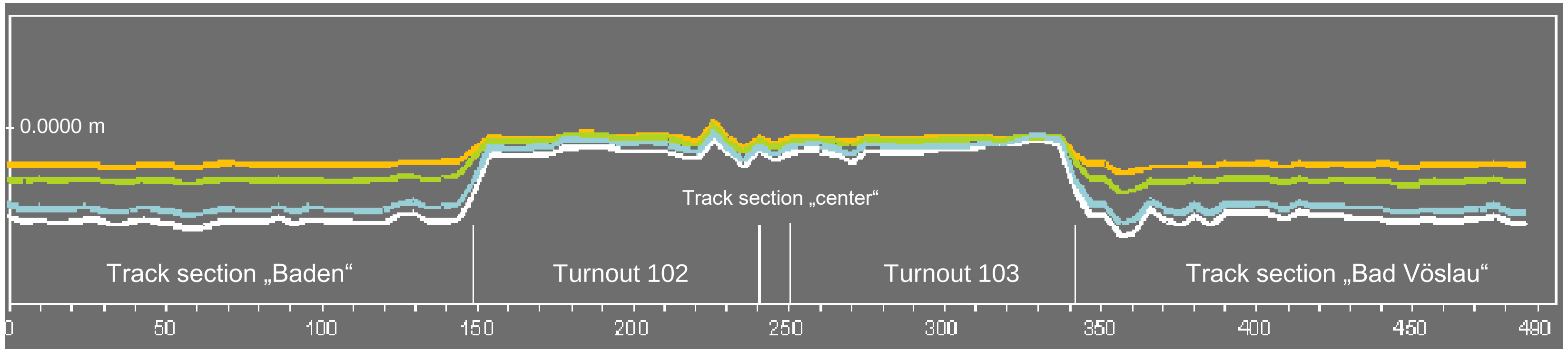
- Turnout 102 and 103 equipped with USP
- Turnout 101 and 103 without USP
- Track quality of track with USP ist better than track without USP.
- Less track settlement 274 days after installation

References: Austria / Baden

- More constant vertical deflection at padded turnouts
- More constant vertical deflection leads to increased passanger comfort

Reference measurement: 21st of October 2002
First measurment: 4th, 5th and 6th of November 2002
Second measurement: 2nd, 3rd and 4th of Dezember 2002
Third measurement: 1st and 2nd of April 2003
Fourth measuremente: 22nd and 23rd of Juli 2003

Vertical deflection

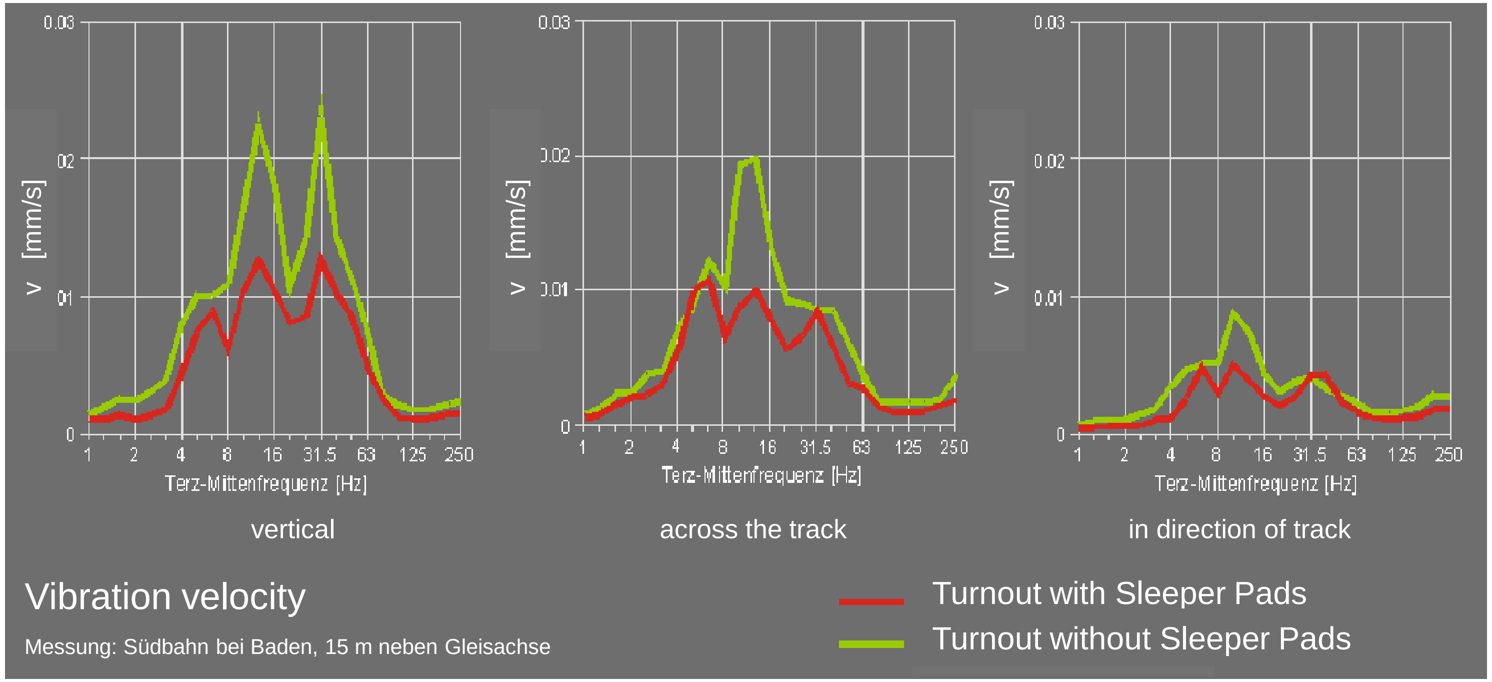


EW UIC60-1200-1:18,5 Fz(Be)Li   EW UIC60-1200-1:18,5 Fz(Be)Re

Regular Track
Turnouts with Sleeper Pads
Transition Zones with adjusted stiffness

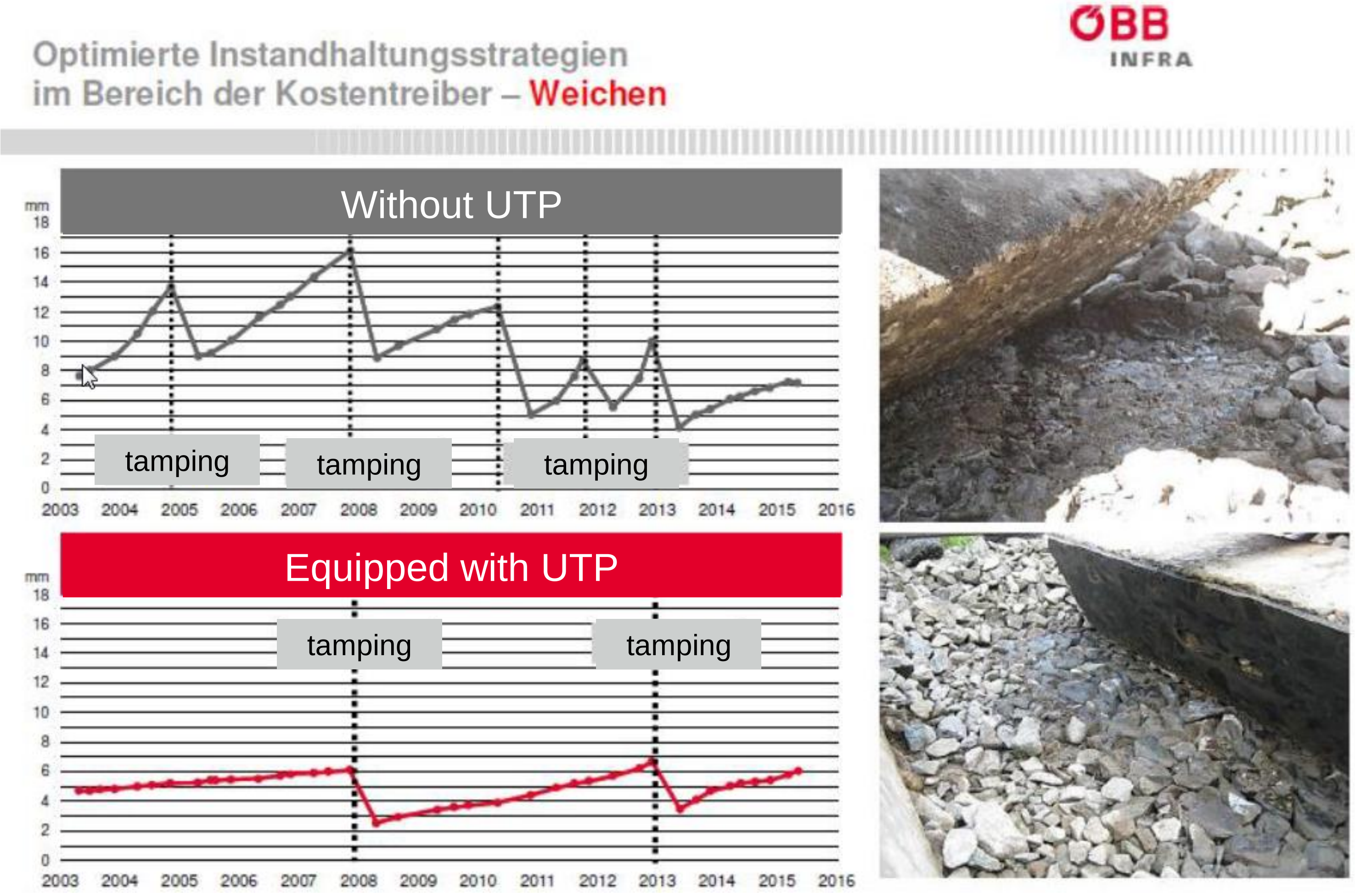
References: Austria / Baden

- Vibration velocity



- Lower vibration velocity at padded turnouts
- This leads to increased passanger comfort

References: Austria / Baden



- Less maintenance effort due to ballast protection (enhanced tamping cycles)

„The implementation of PUR elasticity by Getzner is the biggest innovation for turnouts in the past years“,

ERICH WIPFLER, HEAD OF VAE ENGINEERING DEPARTMENT ZELTWEG (AUSTRIA)