

Optimization of Turnouts using defined elasticity



Turnouts



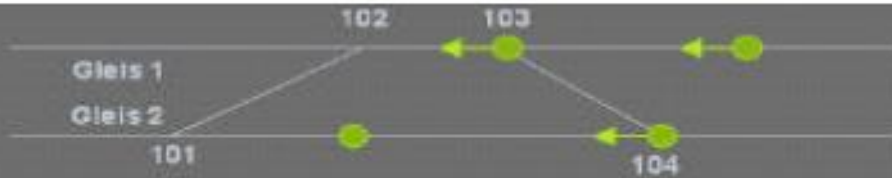
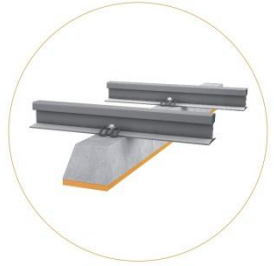
- Turnouts make the network
- They define the operating efficiency and service capability of the whole system (e.g. availability / speed)
- The investment cost of a turnout is on average 4 times higher compared to the regular track
- Turnouts cause much higher maintenance expenses



- For investment 1% of the total costs arise for turnouts, but ...
- For maintenance >25% of total costs arise for turnouts



Turnouts



Welche 104 Richtung Baden
Welche 101 – Gleis 2



Welche 103 Richtung Baden
Welche 102 – Gleis 1

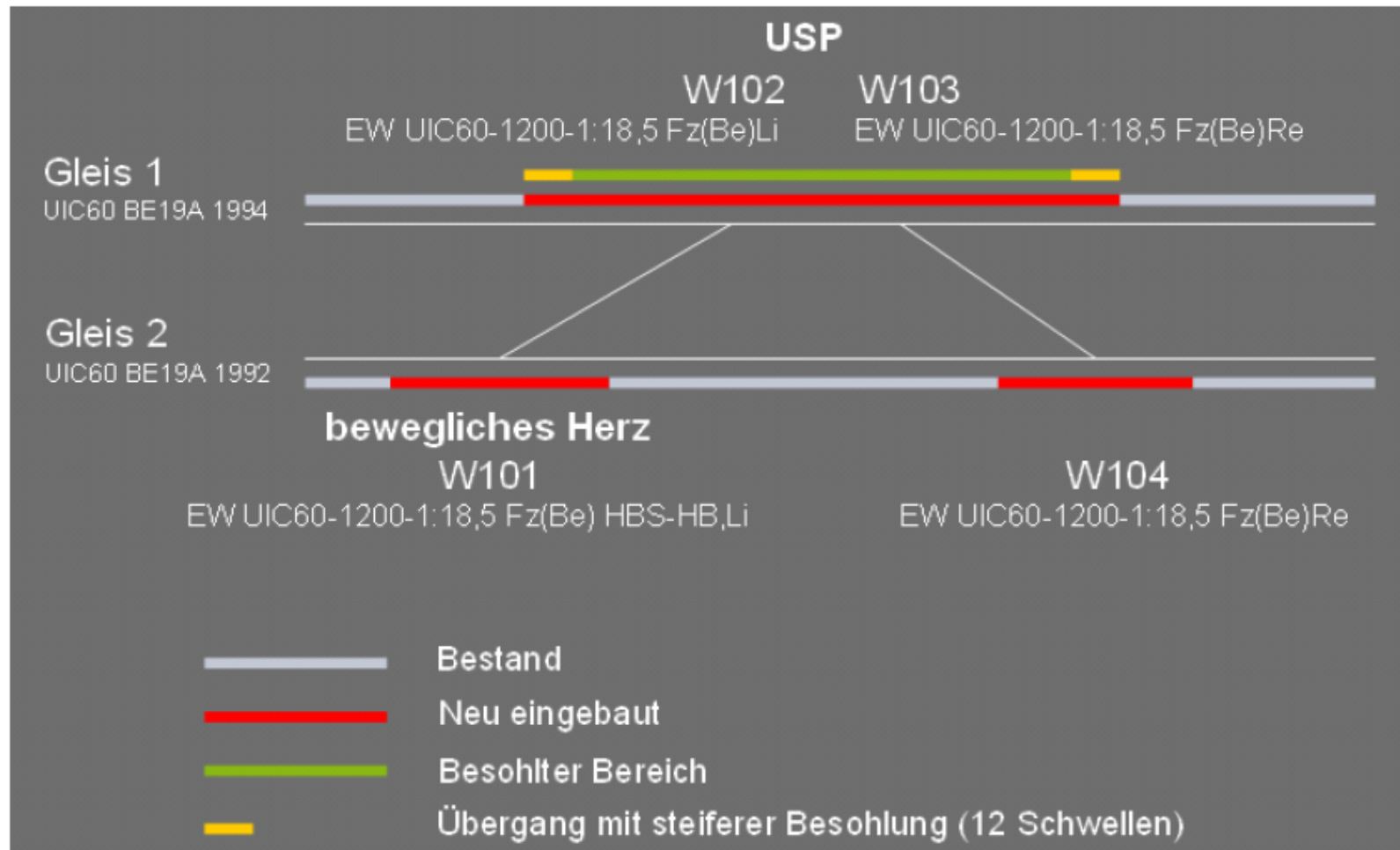


Übergang nach Welche 103 – Gleis 1

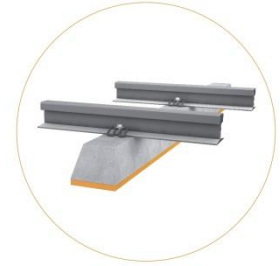


Gleis 2 – 1992

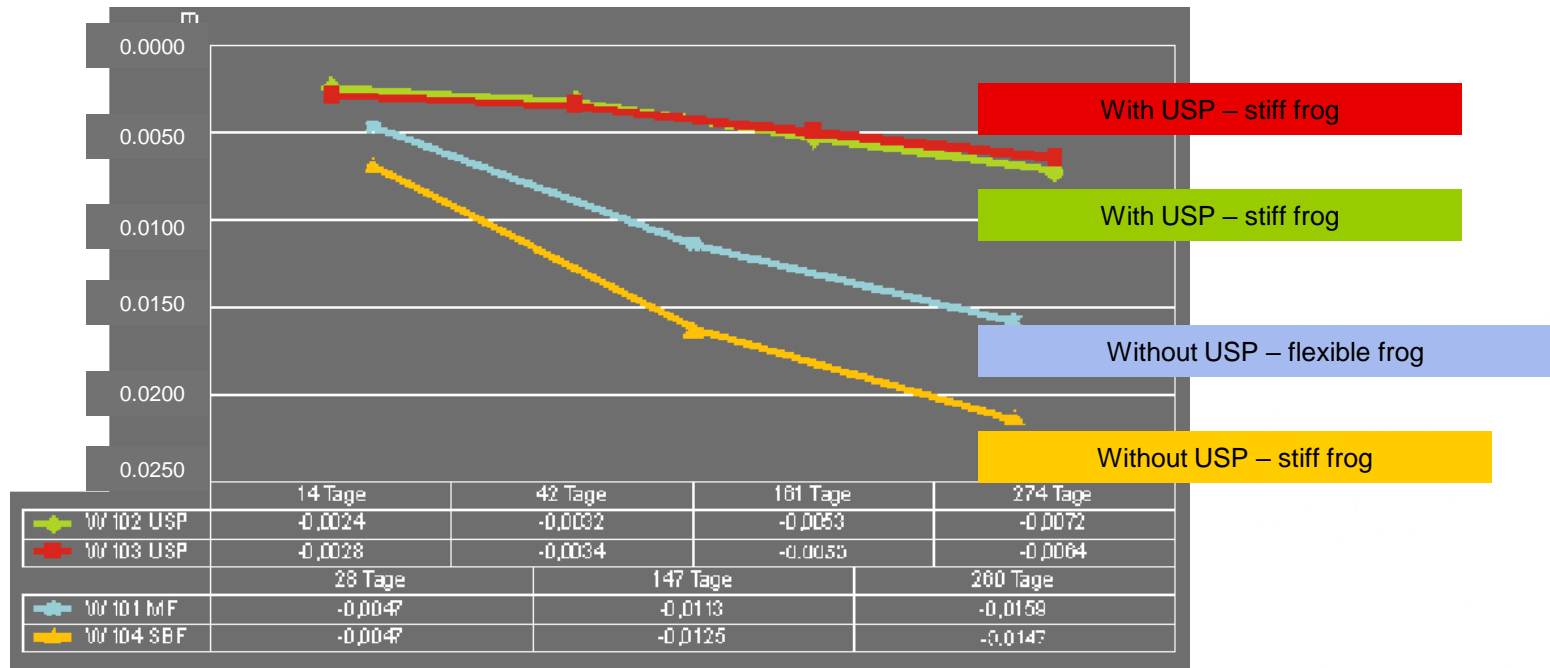
Turnouts



Turnouts

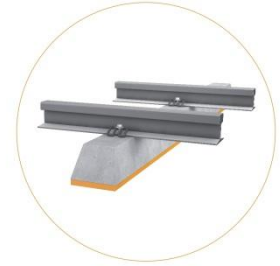


Quality level of the turnout



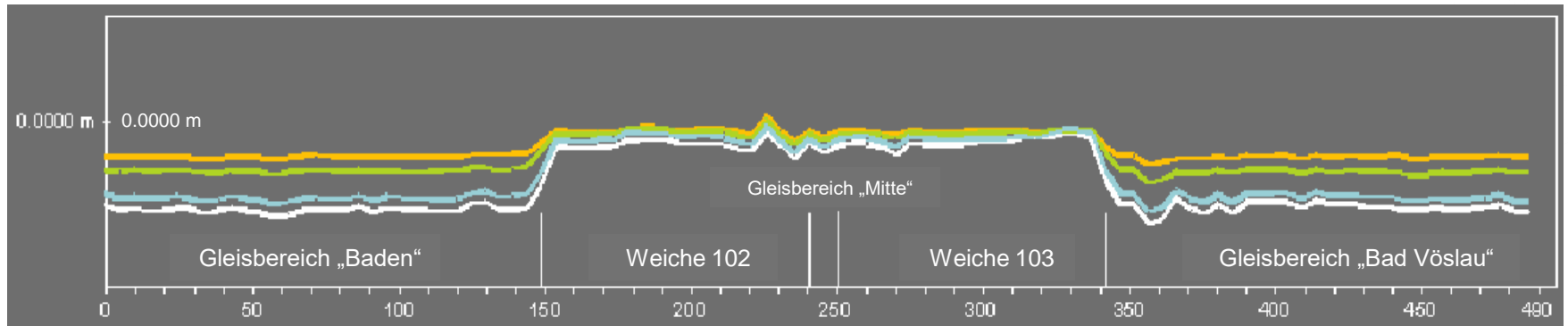
Positive effect of USP – even compared to turnouts with flexible frog

Turnouts



Nullmessung vom 21. Oktober 2002
Erstmessung vom 4., 5. und 6. November 2002
Zweitmessung vom 2., 3., 4. Dezember 2002
Drittmessung vom 1. und 2. April 2003
Viertmessung vom 22. und 23. Juli 2003

Settlement



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

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

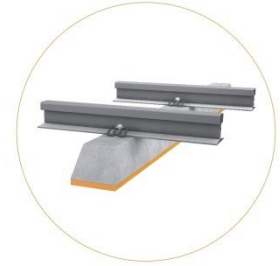


Regular Track

Turnouts with Sleeper Pads

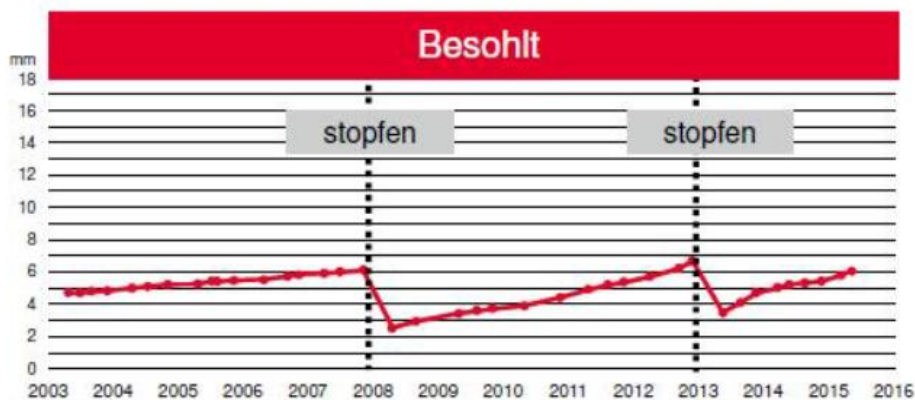
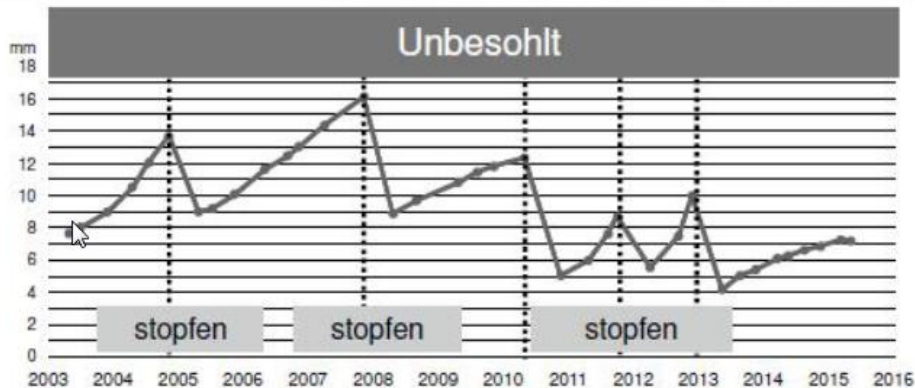
Transition Zones with adjusted stiffness

Turnouts



Less Maintenance Effort

Optimierte Instandhaltungsstrategien
im Bereich der Kostentreiber – **Weichen**



21st May 2009
Tokyo

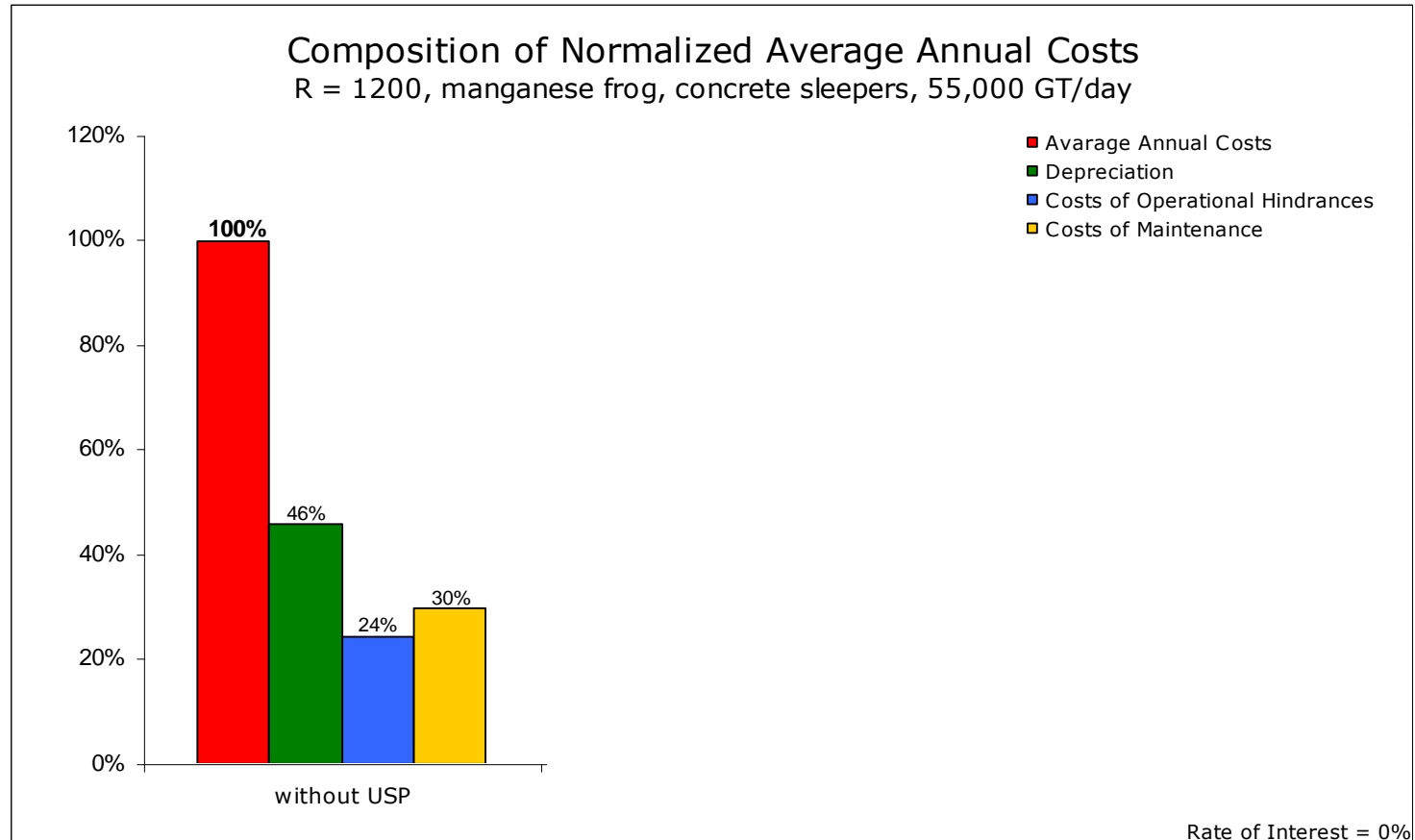


Under Sleeper
Pads



Peter Veit

Economic Efficiency of USP Turnout



Internal rate of return for additional investment: 13% to 15%



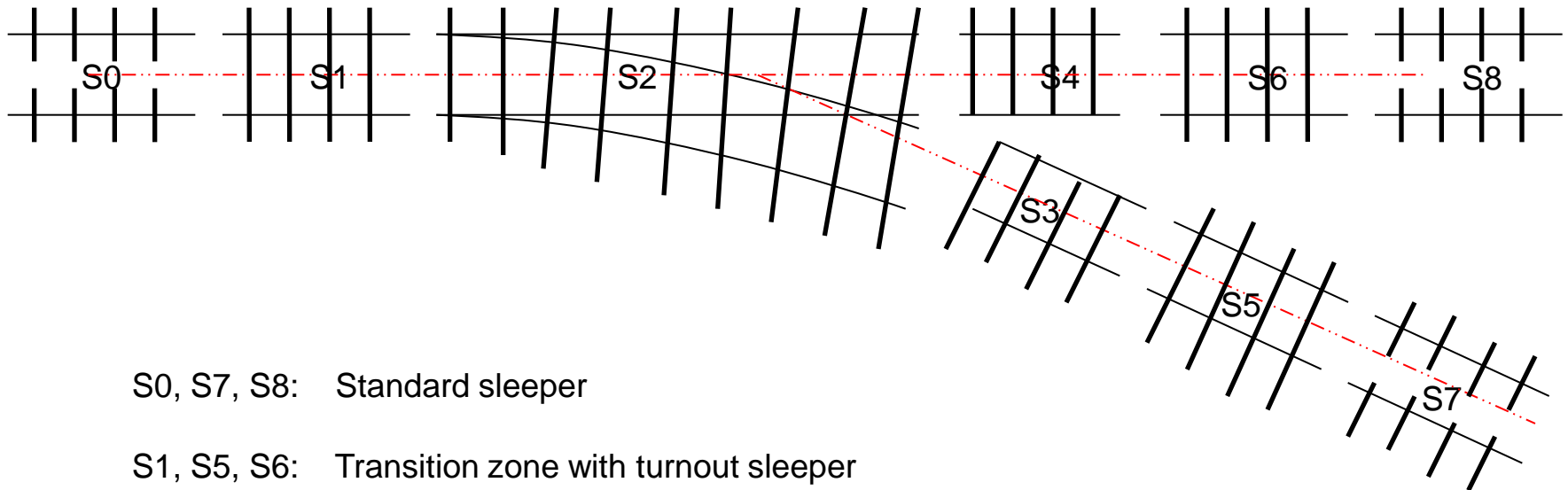
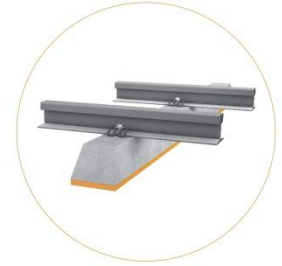
How can designed elasticity optimize
a turnout?



Asymmetrical geometry



Turnouts



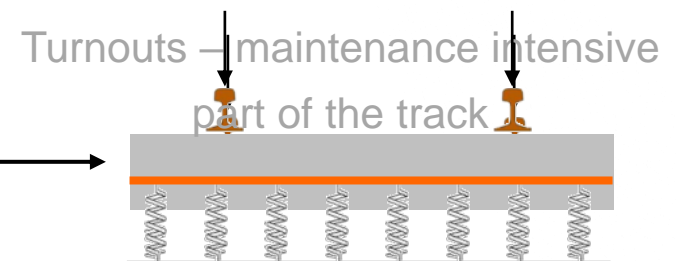
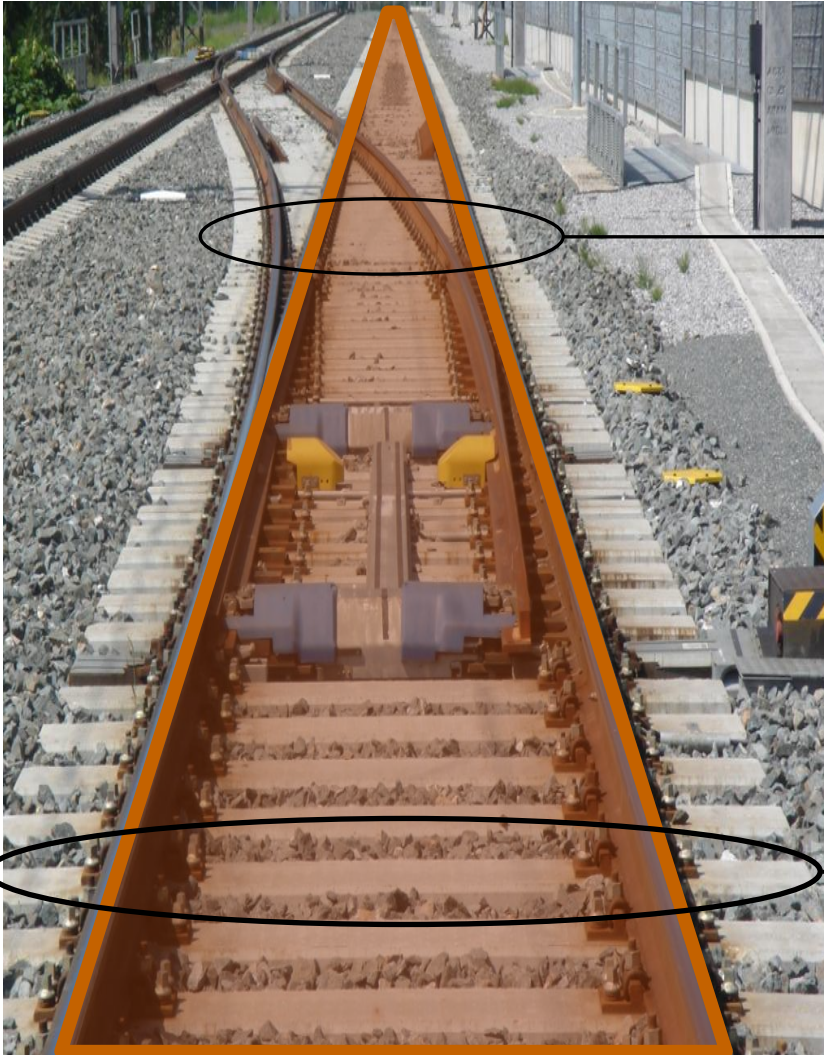
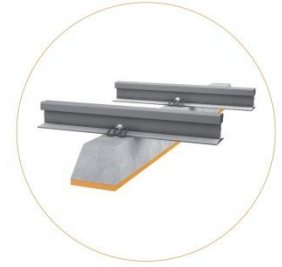
S0, S7, S8: Standard sleeper

S1, S5, S6: Transition zone with turnout sleeper

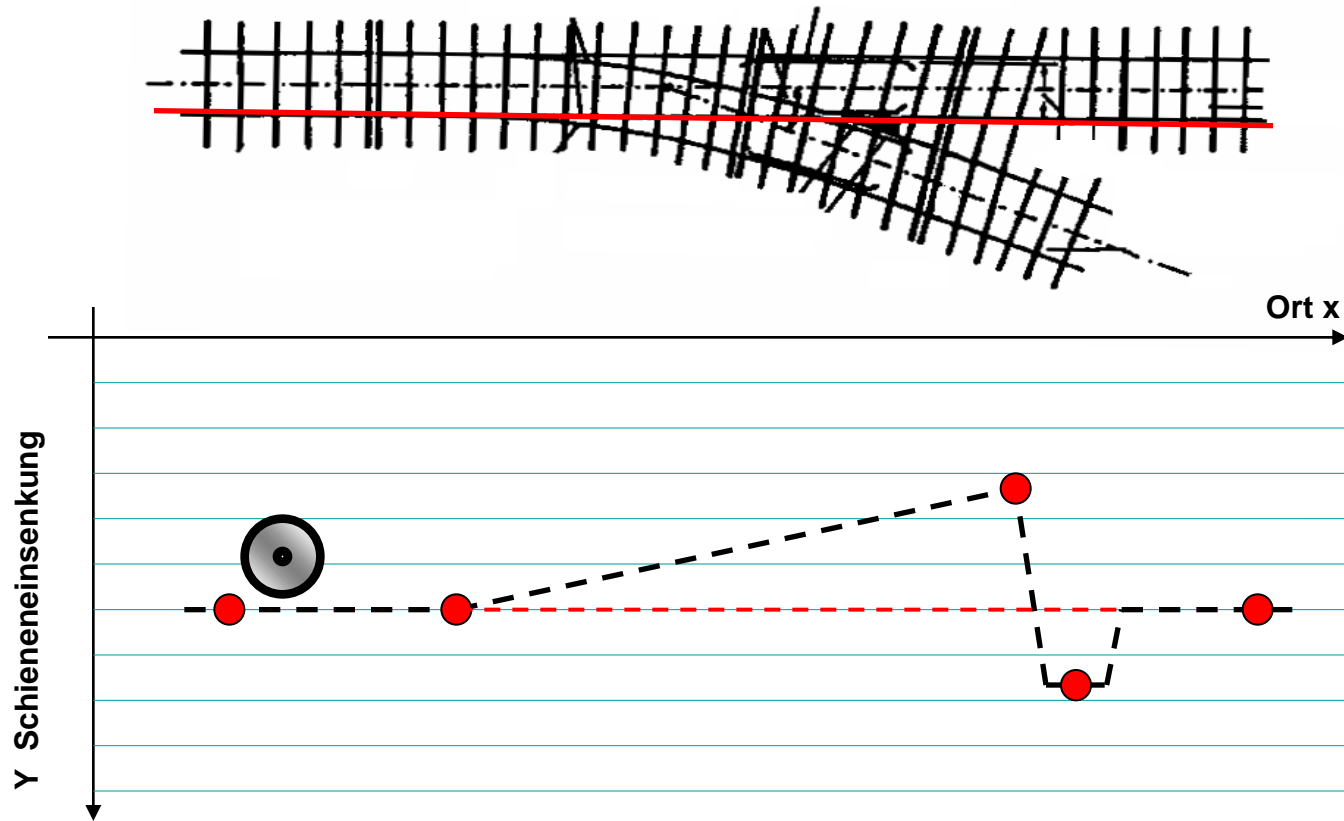
S2: extra long turnout sleeper

S3, S4: Area with asymmetrical and short sleeper

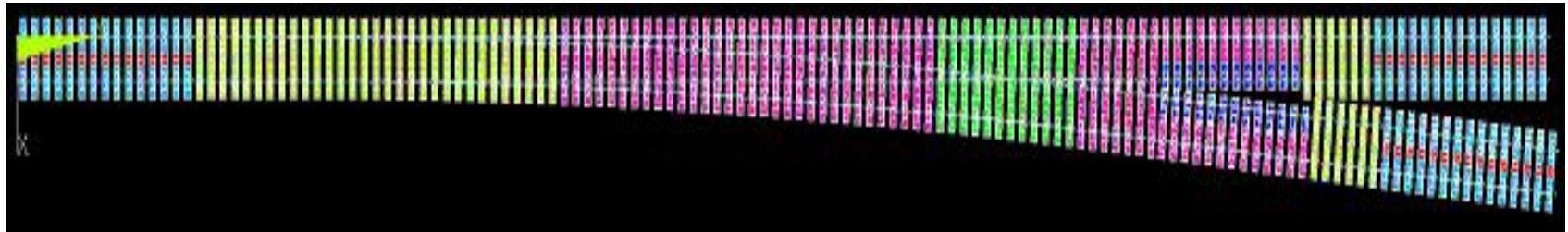
Turnouts



Turnouts



Turnouts



Type 1

Type 2

Type 3

Type 4

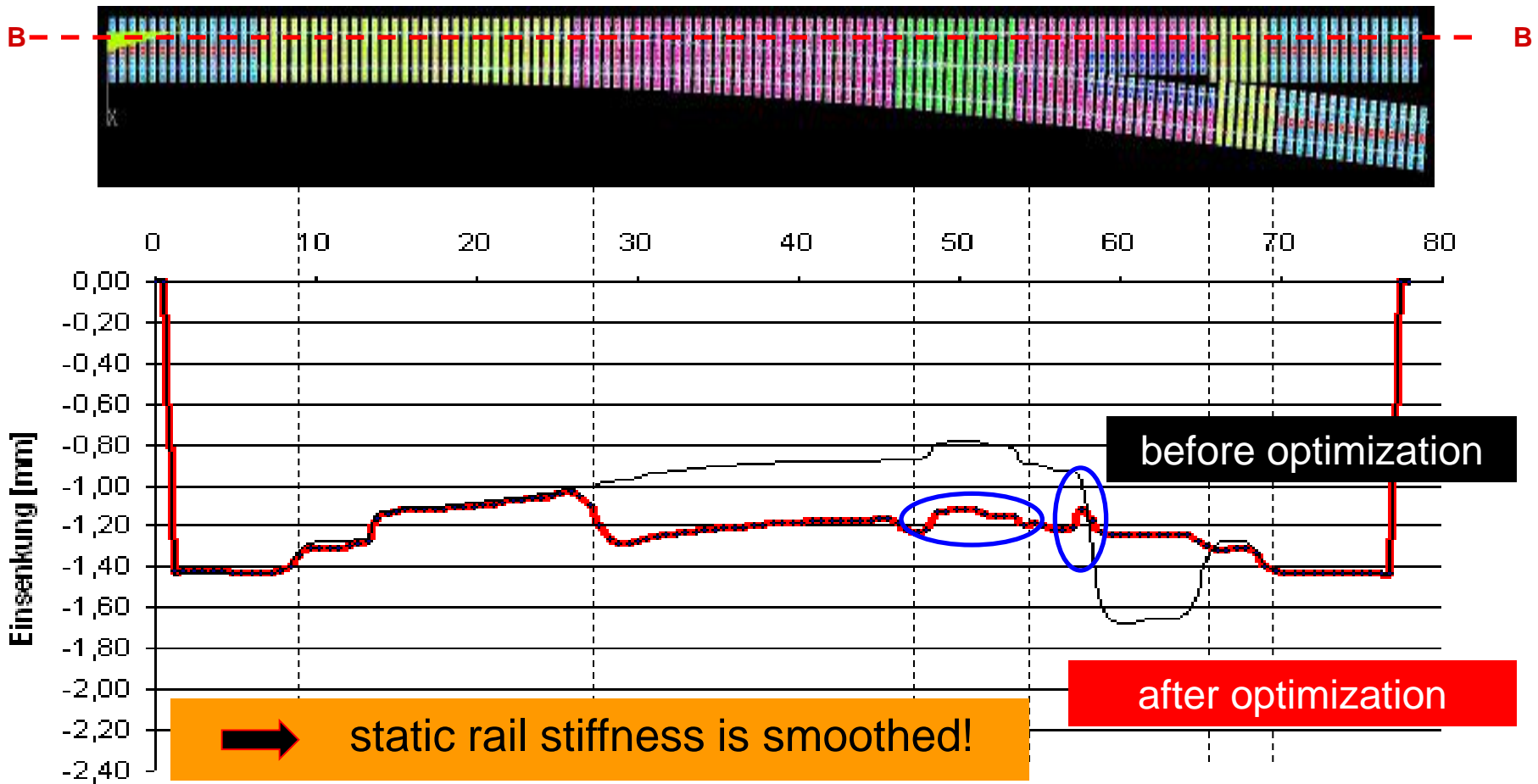
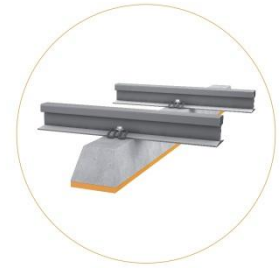
Type 5

Type 3

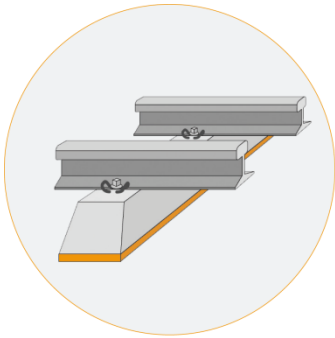
Type 2

Type 1

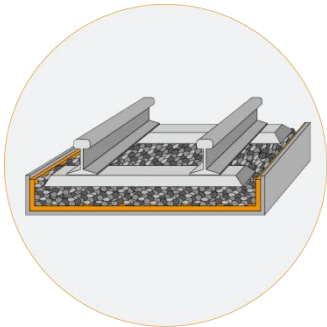
Turnouts



Where to introduce designed elasticity?



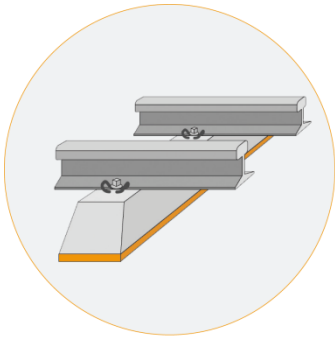
Sleeper pads



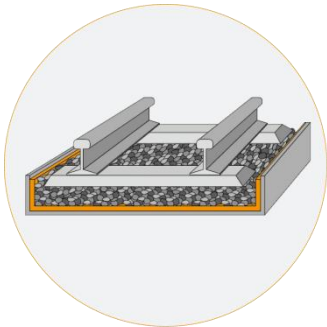
Sub-ballast mats



Where to introduce designed elasticity?



Sleeper pads



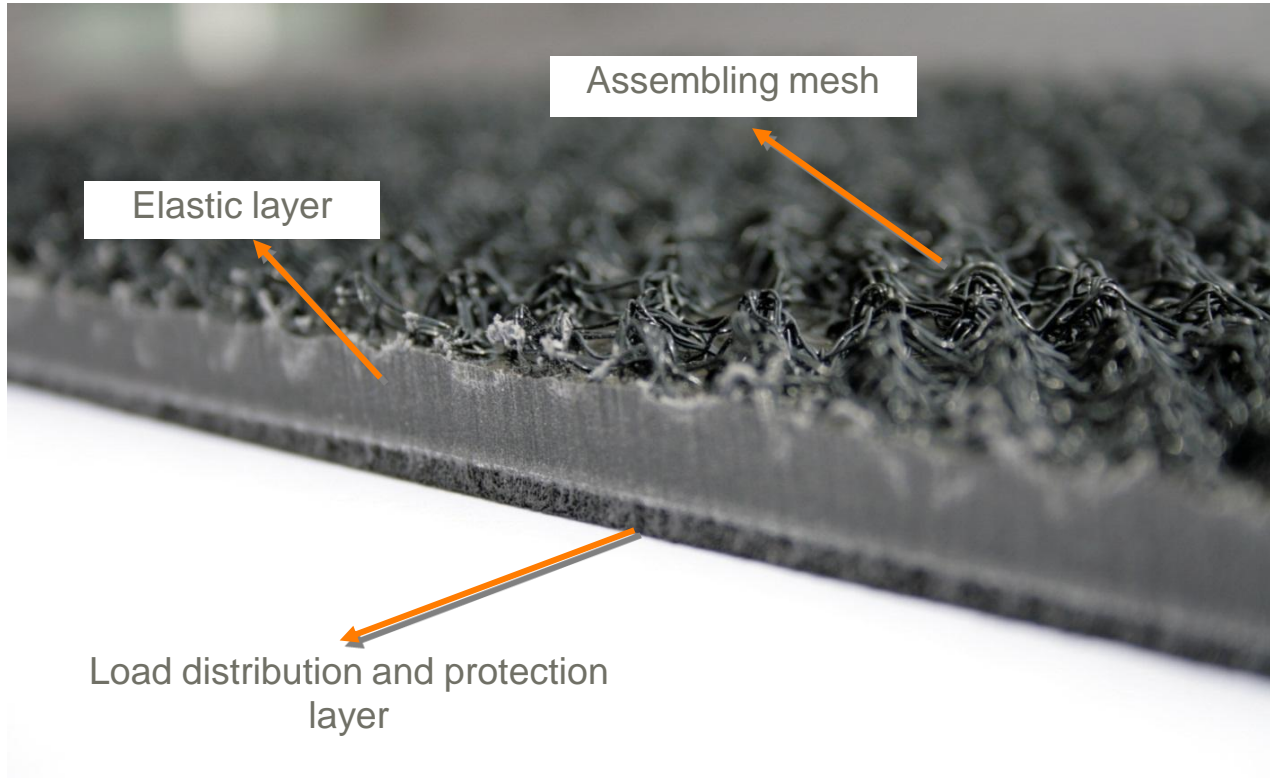
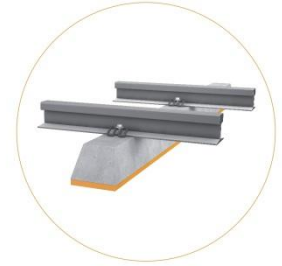
Sub-ballast mats





Under Sleeper pads

General



- **Assembling mesh** → for durable a full surface conection between concrete sleeper and USP!
- **Protection layer** → avoids perforation of the elastic material (just for high elastic pads)

Effects in track using Under Sleeper pads

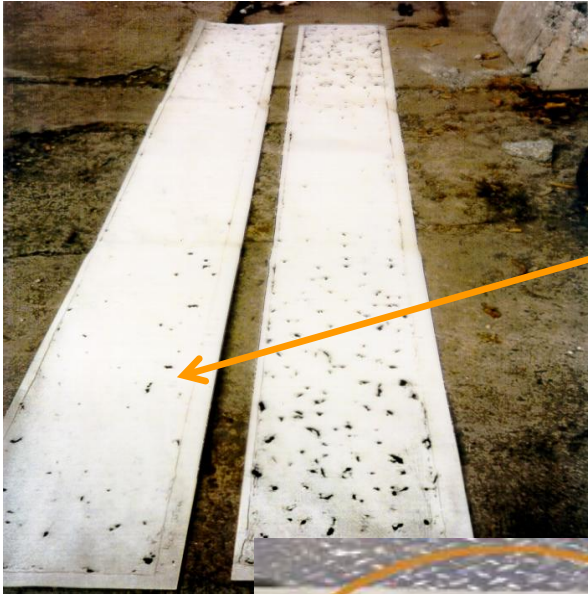


Increase of contact area between concrete sleeper and ballast

Distribution of axle load to more sleeper

Reduced dynamic impacts

Increase of contact area



3% to 5% after tamping

up to 35% using USP



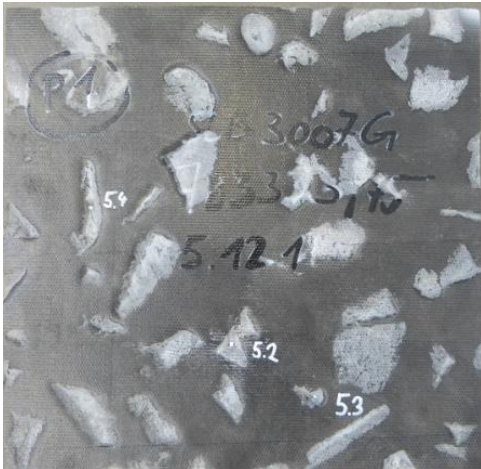
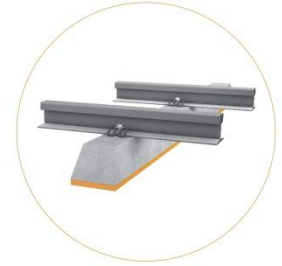
Padded Sleeper from DB track after 190 Mio. Load Tons (Type Plastic/Elastic)

No Perforations or any other signs of damage

Increase of contact area

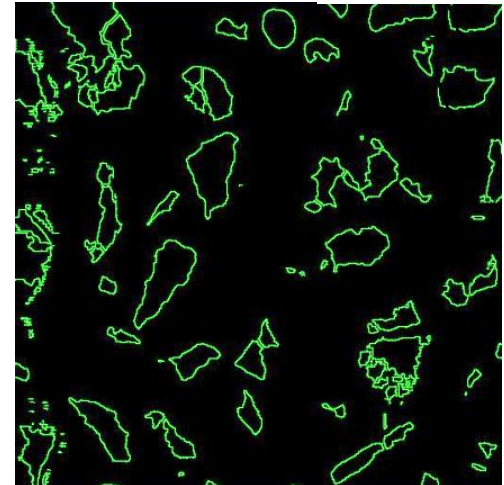


Increase of contact area



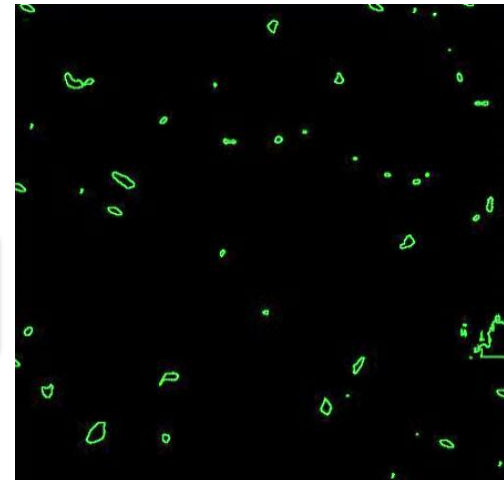
with USP

Contact area: **27,8%**

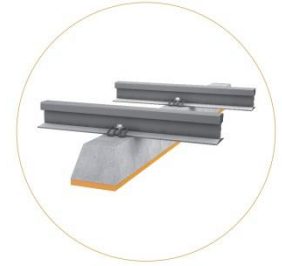


without USP

Contact Area: **1,4%**



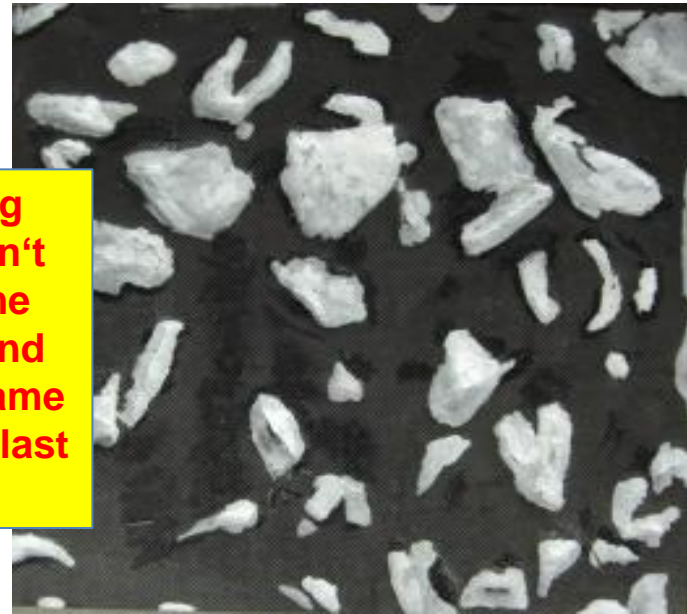
Different material – different contact area



$C_{\text{stat}} = 0.3 \text{ N/mm}^3$
6% Contact area



$C_{\text{stat}} = 0.30 \text{ N/mm}^3$
28% Contact Area

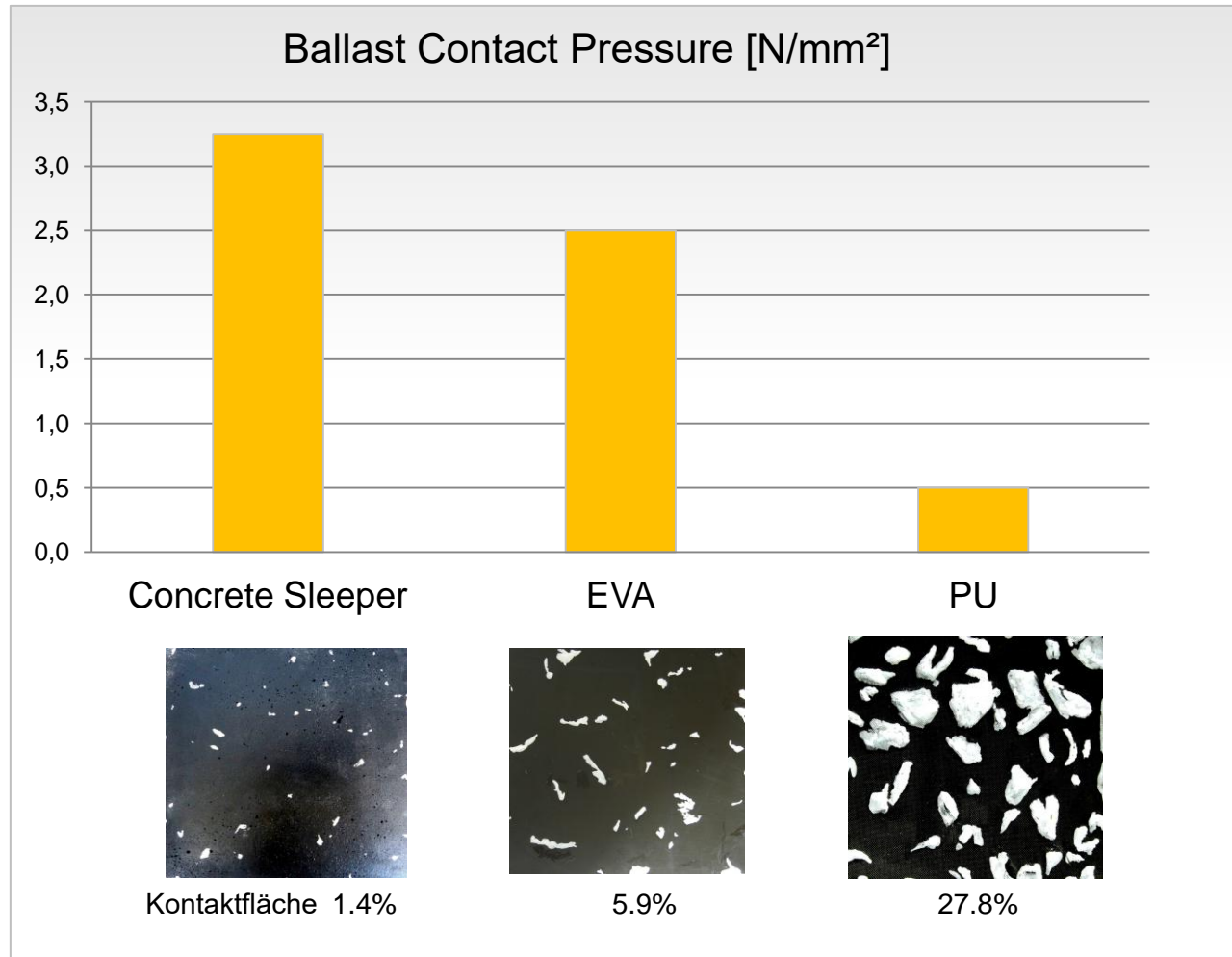
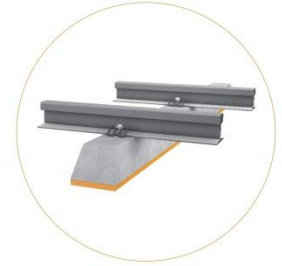


**Same bedding
modulus doesn't
mean the same
contact area and
therefore the same
reduction in ballast
pressure!!**

USP made of EVA material

Getzner USP
Type SLB 3007 G

Increase of contact area



Reduction of ballast pressure of approx.
75%
(using an elasto-plastic PU USP)

Effects in track using Under Sleeper pads

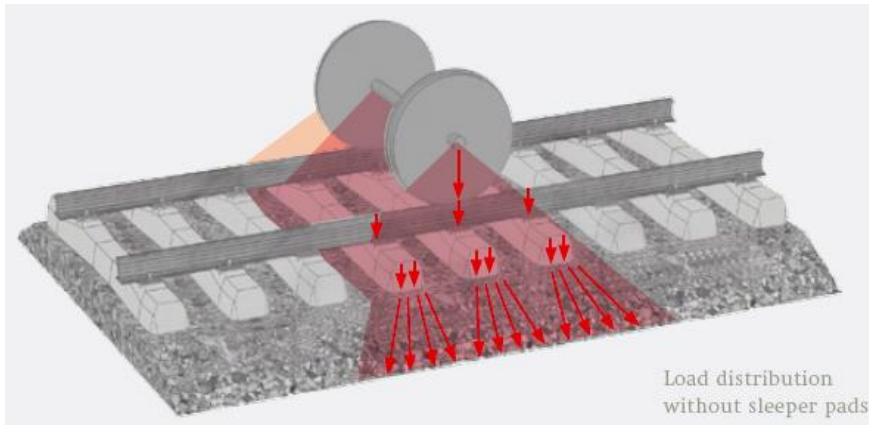
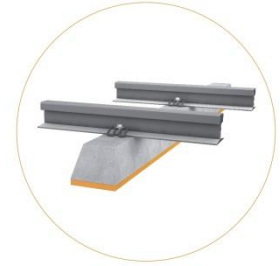


Increase of contact area between concrete sleeper and ballast

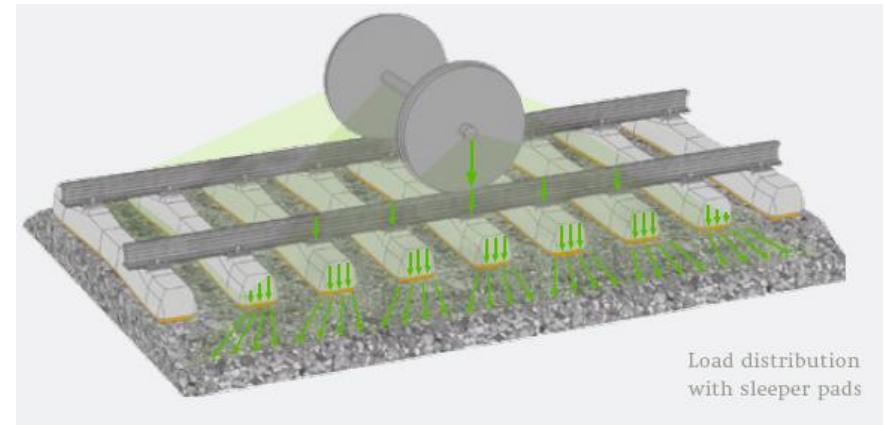
Distribution of axle load to more sleeper

Reduced dynamic impacts

Distribution of axle load to more sleeper



Sleeper w/o sleeper pad and
low rail deflection



Sleeper with sleeper pad and
designed rail deflection

Effects in track using Under Sleeper pads

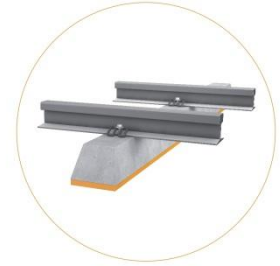


Increase of contact area between concrete sleeper and ballast

Distribution of axle load to more sleeper

Reduced dynamic impacts

Reduced dynamic impacts



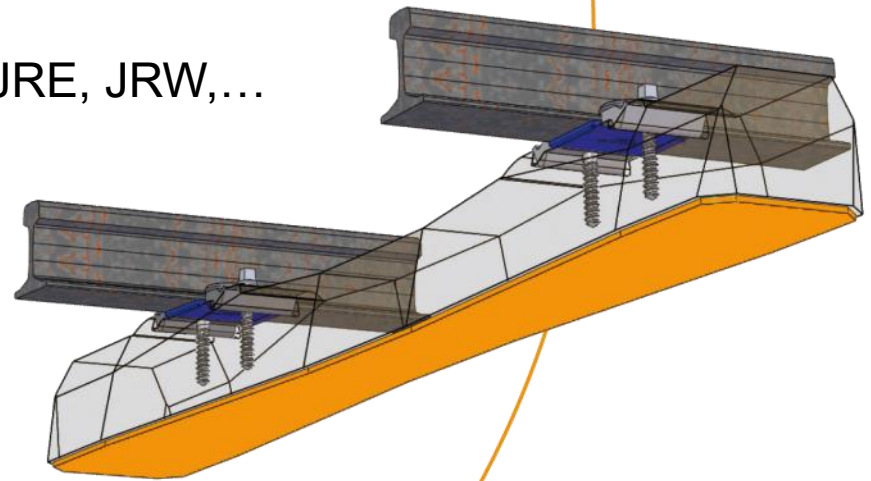
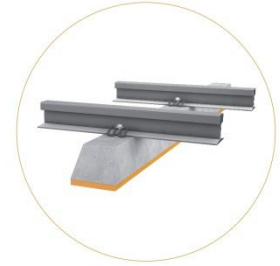
- Loss of stable bedding at the sleeper ends
- Higher deflection at the sleeper ends
- Increased bending moment in the center part of the sleeper
- Tension cracks



Source: Info Schwellenbesohlung; Dr. Rudolf Schilder, DI Florian Auer;
OeBB Infrastructure, 07.10.2008

References

- More than 1000 turnouts equipped with USP
- Standard in Austria on high ranked tracks
- Standard in Germany for turnouts >160 km/h
- Used within RFI, SNCF, Network Rail, JRE, JRW,...



THE BITTERNESS OF POOR QUALITY
REMAINS LONG AFTER THE SWEETNESS
OF LOW PRICE IS FORGOTTEN.

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