Elastic Elements in Track Influencing Total Track Costs

and

Reducing Vibrations

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Challenges

Austria

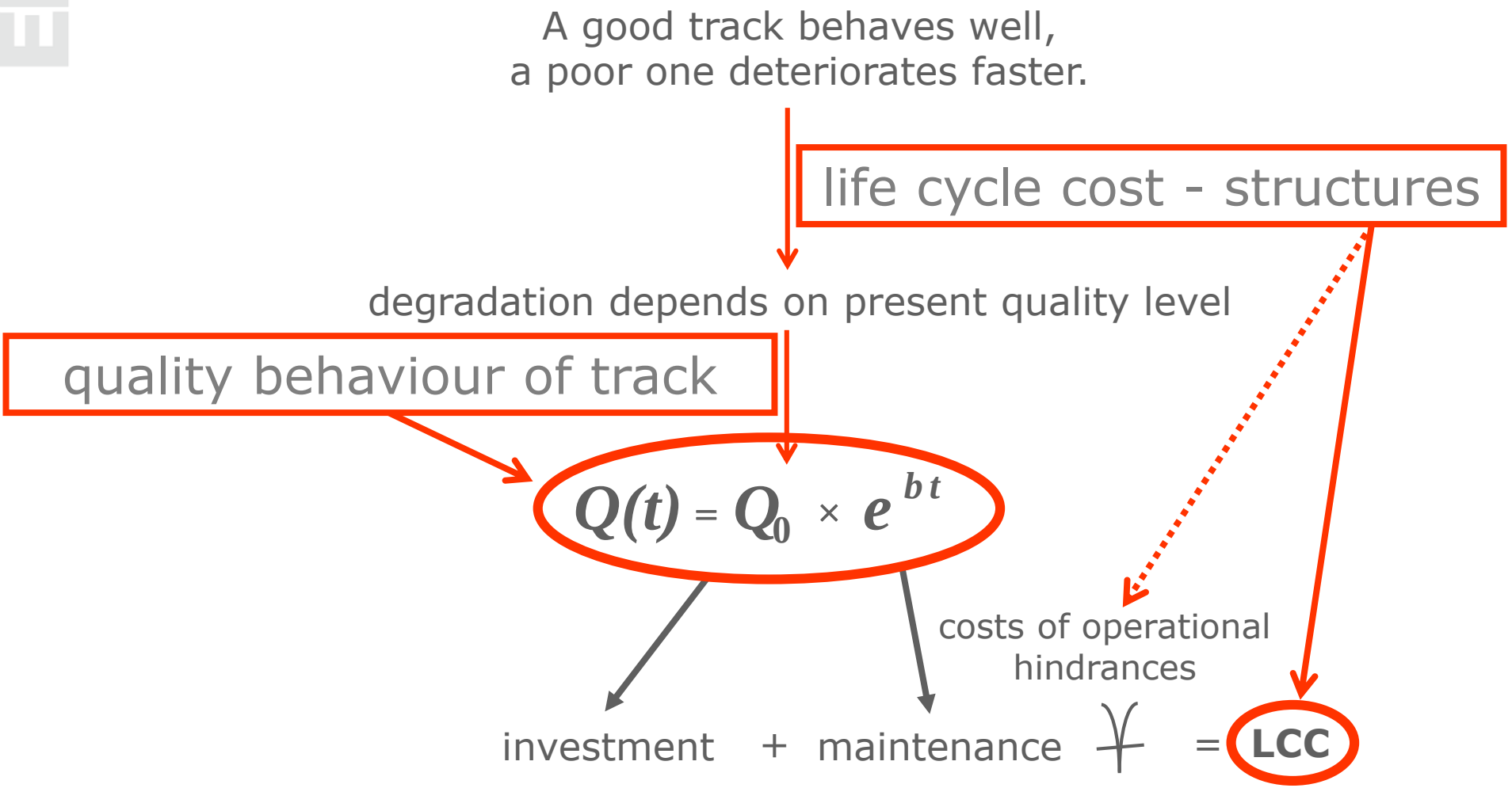
solution: SUSTAINABILITY
technical AND economical

LCM

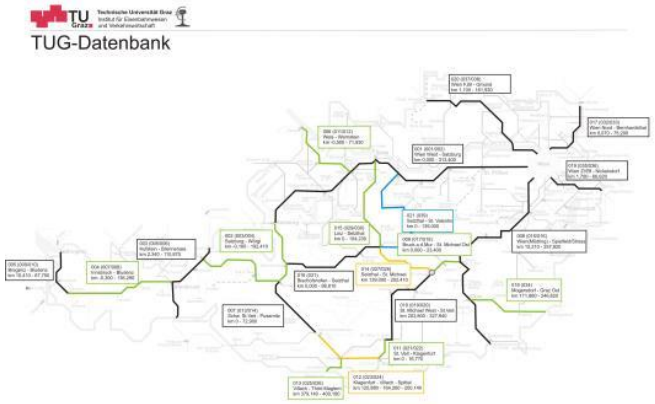
quality behaviour

life cycle costing (LCC)

Quality Behaviour

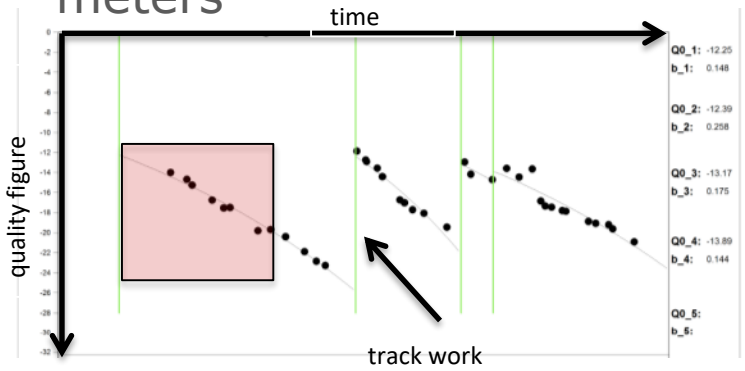


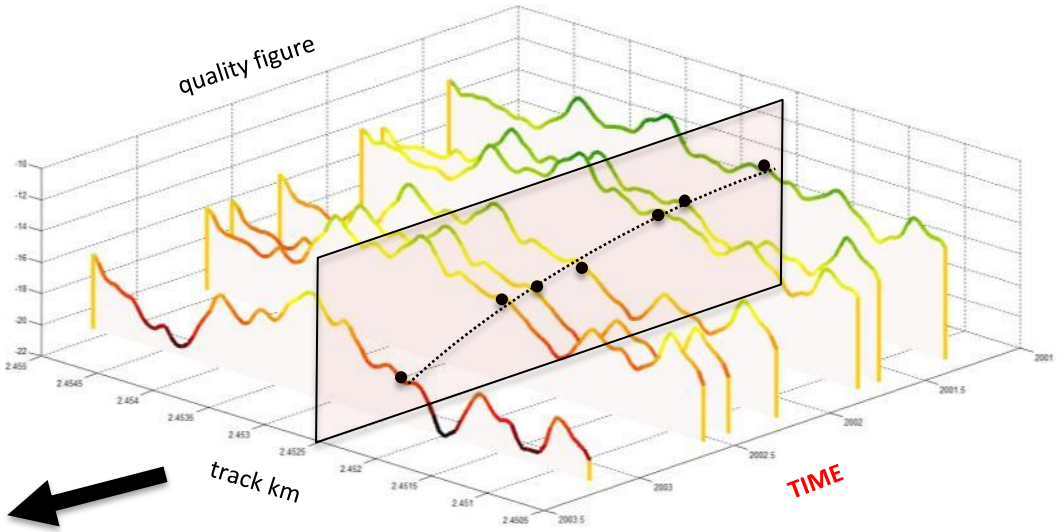
Quality Behaviour – Technical Evaluation



- measured data since 2001
- data of 4,000 km of main track: type and age of track and components, all recording car data, maintenance executed, transport data and alignment

Regression analyses based on quality figures as standard deviation every 5 meters





$$Q(t) = Q_n \times e^{b_n t}$$

general behaviour but variation in „b", related to the various track parameters

Standard Kilometres

Main Track-Parameters

transport volume [gross-tonnes/day, track]	track [number]	rail profile [ ]	rail steel grade [ ]	sleeper [ ]	radius [m]	rails [ ]	subsoil condition [ ]
> 70,000	1	60E1	R400HT	concrete	> 3,000 m	CWT	good
45,000 - 70,000	2	54E2	R350HT	concrete USP	1,000 m - 3,000 m	jointed	weak
30,000 - 45,000	2+2	49E1	R260	wooden	600 m - 1,000 m		poor
15,000 - 30,000			R200	HDS USP	400 m - 600 m		bad
8,000 - 15,000					250 m - 400 m		
2,000 - 8,000					< 250 m		
< 2,000							

300 relevant combinations → 80 describe economic target situation

Service Life Track – Limiting Components

Rails

Rails can be easily changed. Rail exchange is costly but "cheap" compared to other measures.

Sleepers

Sleeper exchange is enormously costly and not easy to be executed on a high quality level. But: Concrete sleepers can reach service lives of 50 years, steel sleepers as well. Wooden sleepers are worn out latest at 30 years life span.

Ballast

Also ballast can be changed or at least cleaned. It's a very costly measure.

Ballast is in general the component limiting the service life of entire track.
Furthermore, within the ranking of cost drivers ballast is the third on the list, after initial quality and switch density.

Component Strategies Sleepers

Concrete sleepers are generally the best option (on proper substructure):

- High side resistance
- Low investment
- Low maintenance demand
- Long service life
- But: High deterioration of ballast

Tests show that conventional concrete sleepers have less than 10% contact area to the ballast bed (without using Dynamic Track Stabilising).

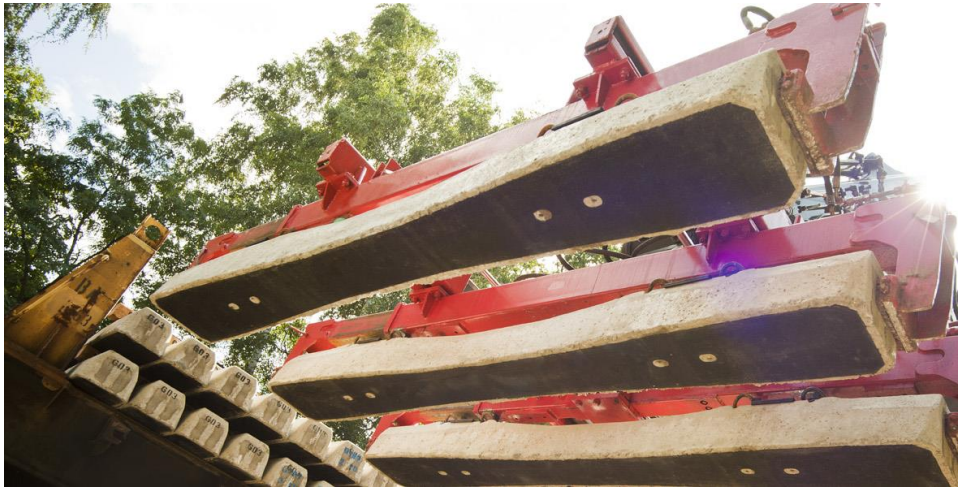
Solution?

Sleepers with Under Sleeper Pads

Underneath the concrete sleeper a polyurethane layer is introduced.

This gives two main benefits:

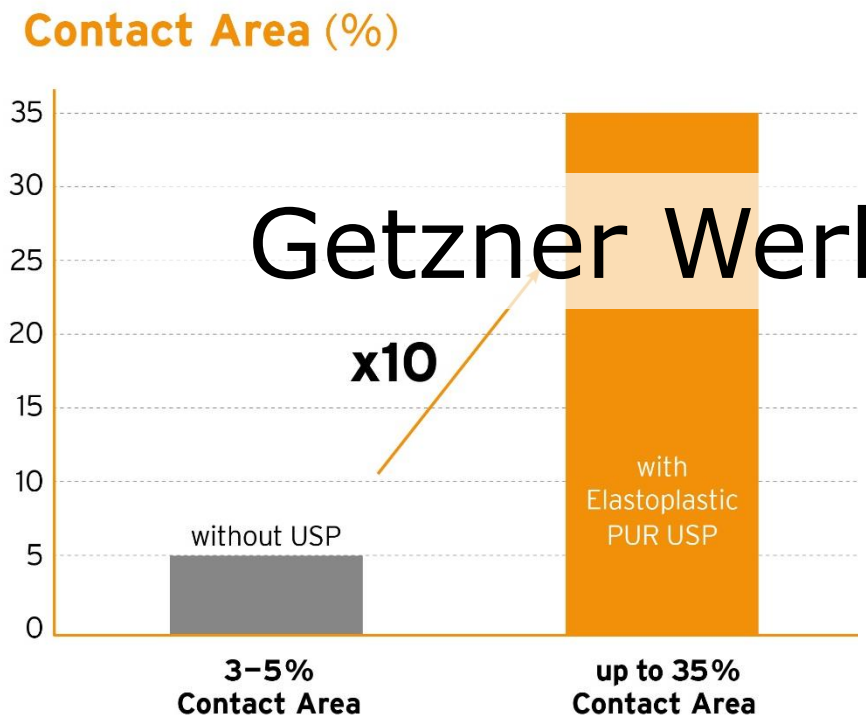
- Additional elasticity → distribution of the load to more sleepers
- Contact area between ballast and sleeper is increased → reduction of stresses in ballast bed

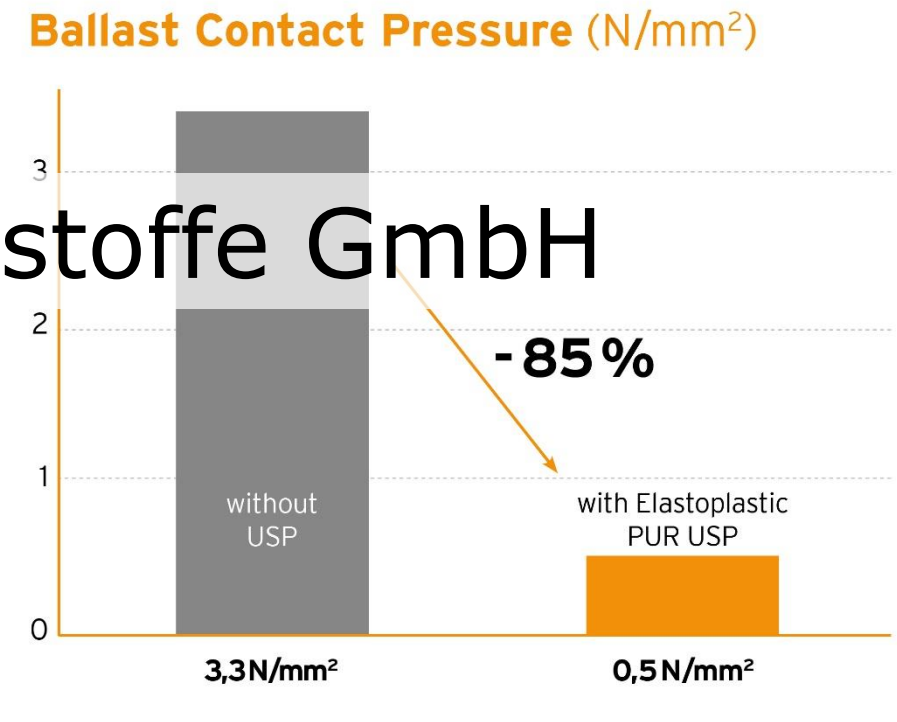


CONTACT AREA
sleeper - ballast
without DGS
using DGS

Initial settlement is reduced → initial quality increases → track deterioration is reduced

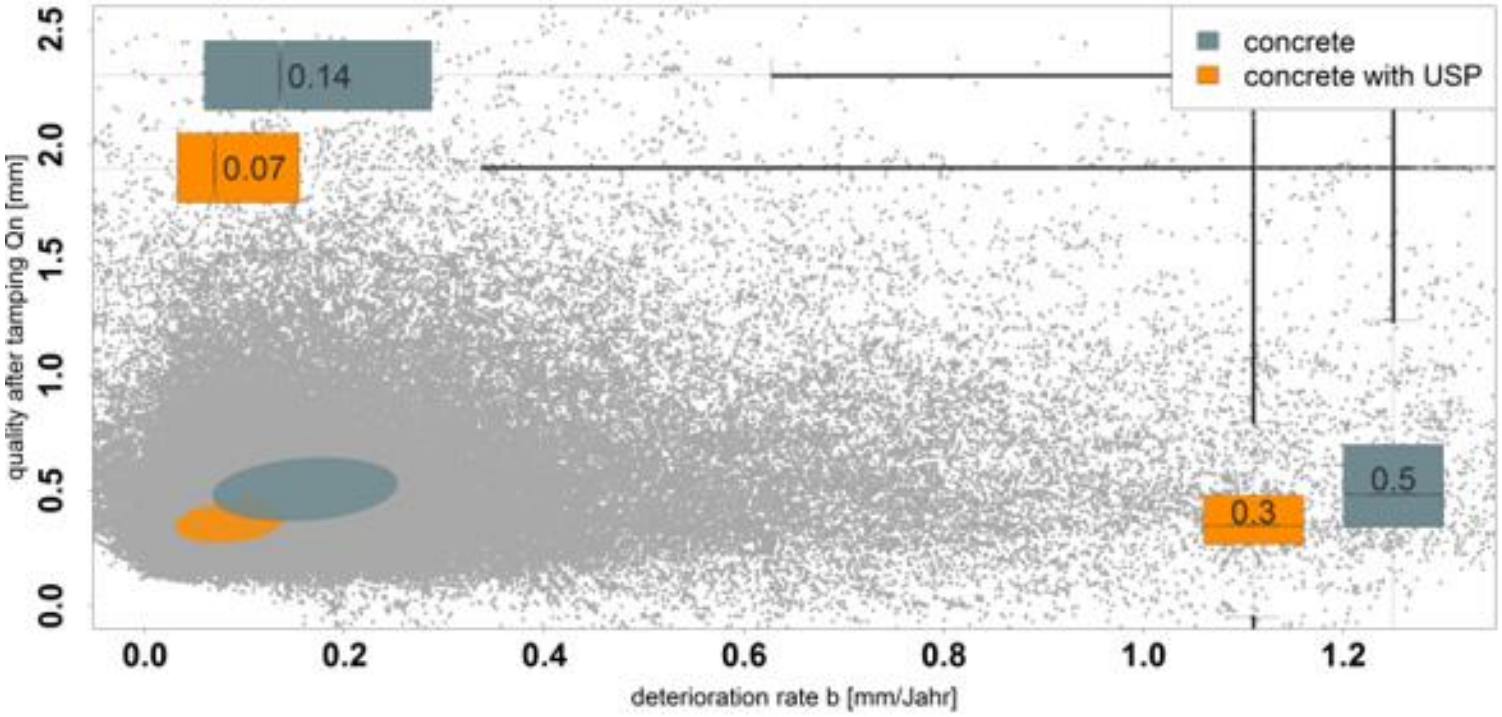
Reduction of Contact Pressure





Under Sleeper Pads

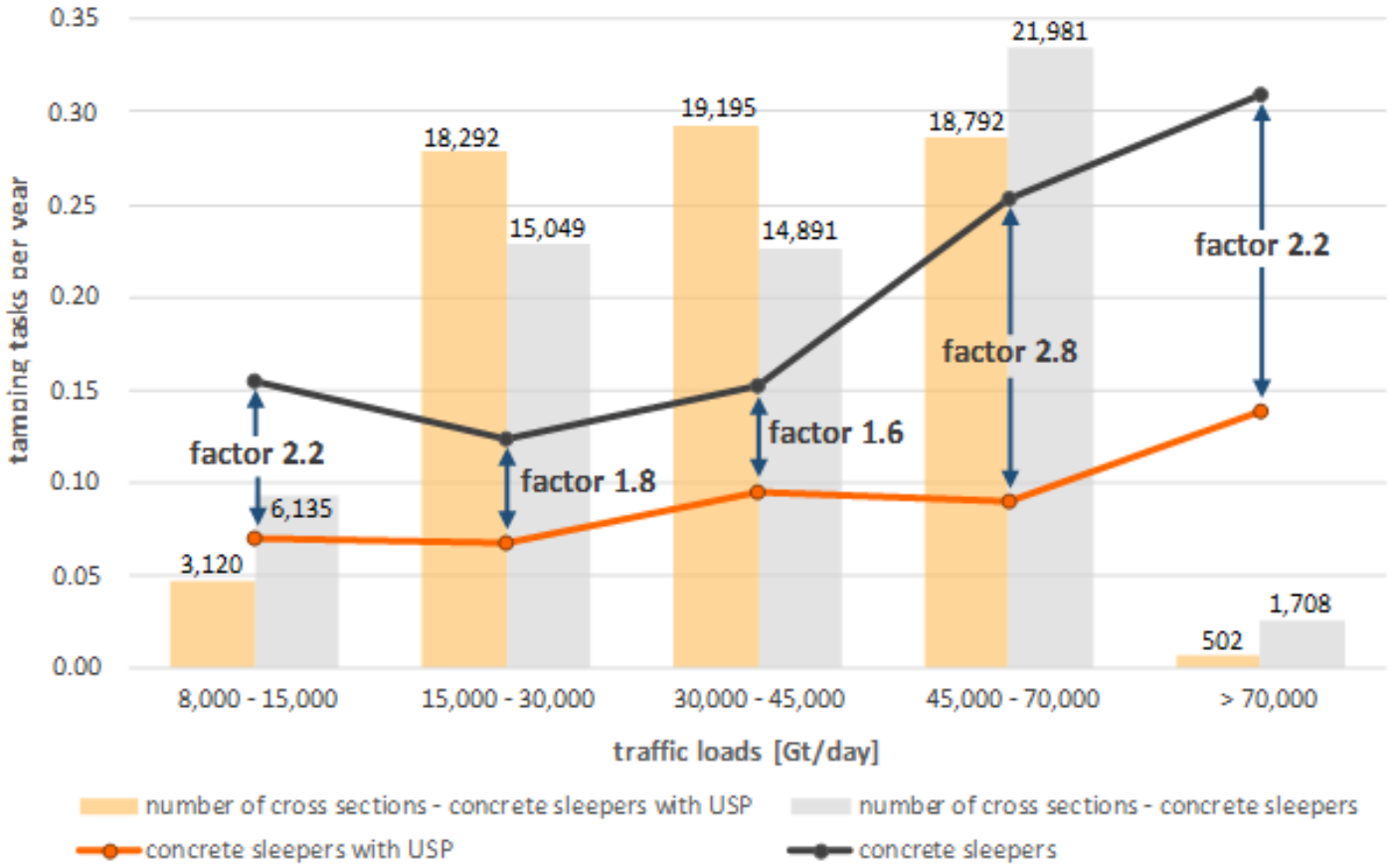
Evaluation from the OeBB Network (~ 60,000 sections)



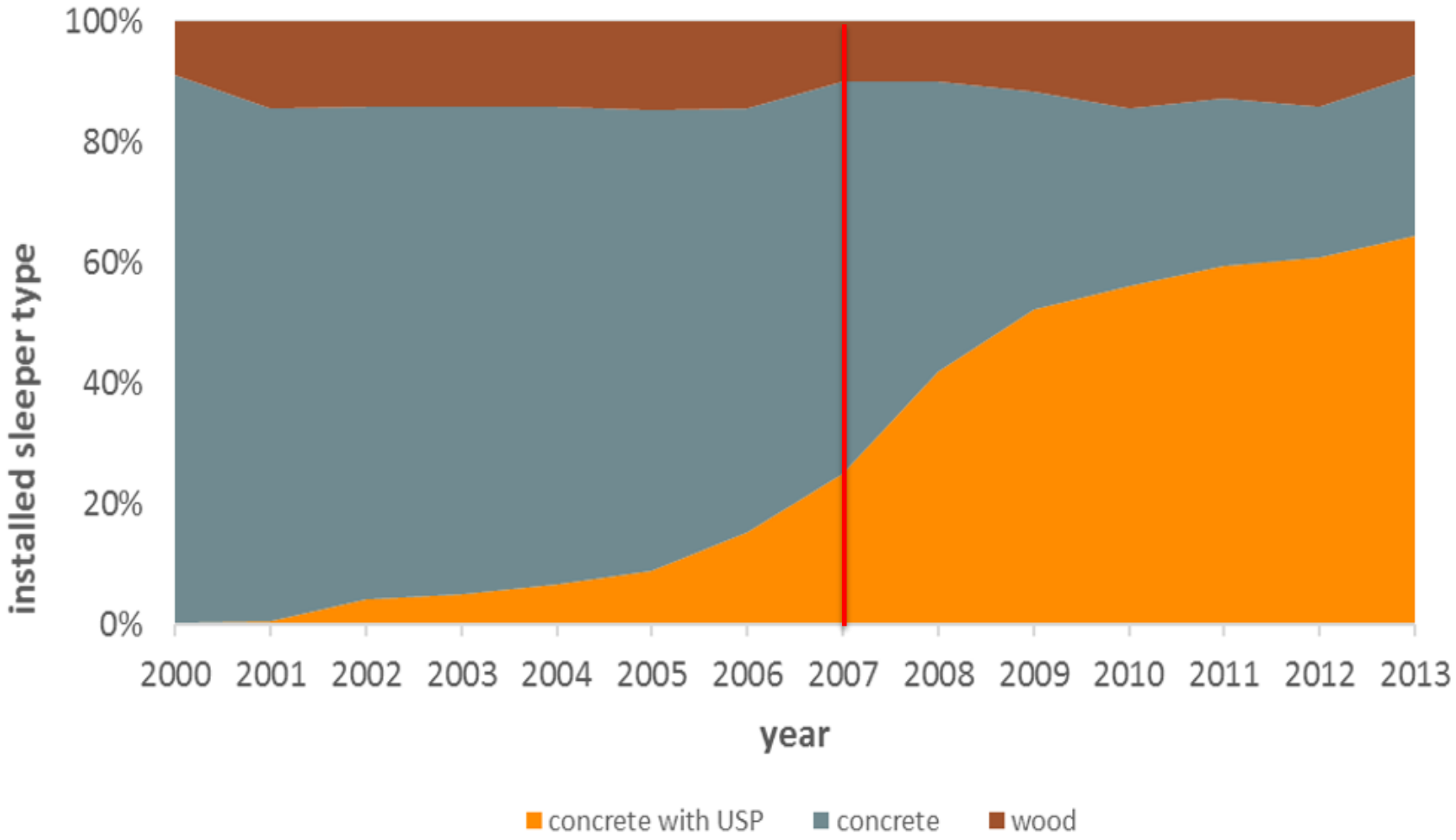
Initial settlement is reduced → initial quality increases → track deterioration is reduced

Under Sleeper Pads

Tamping demand is halved!

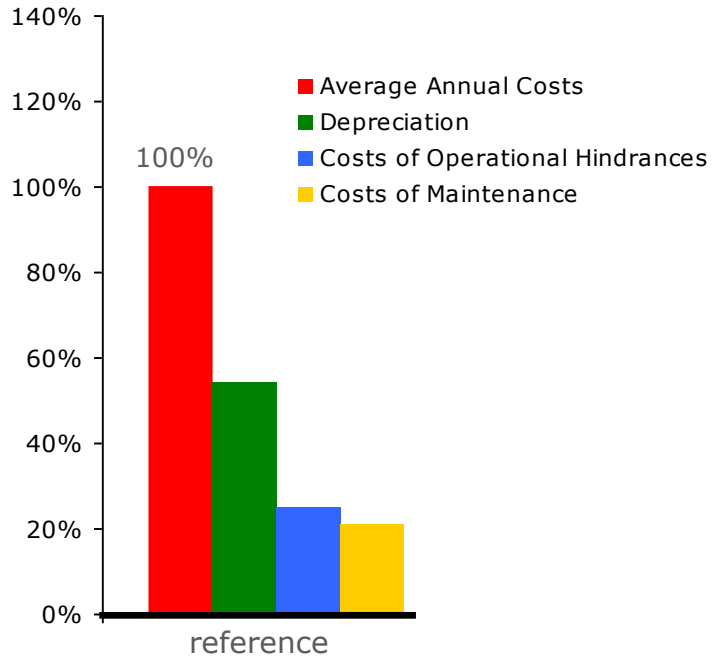


Under Sleeper Pads - Implementation



Under Sleeper Pads

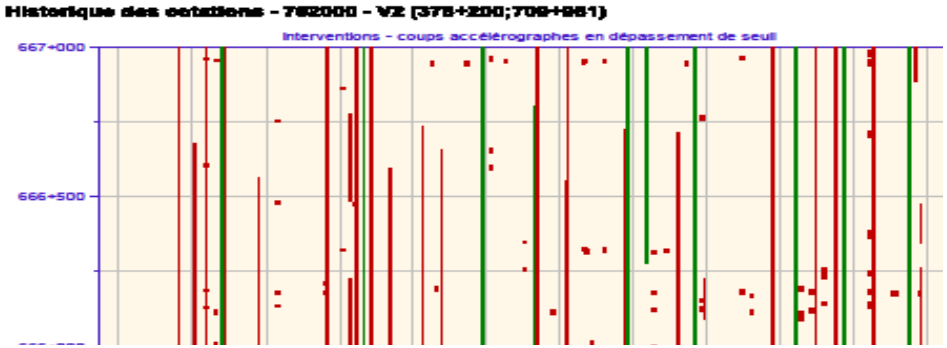
Economic Evaluation (UIC leaflet)



IRR up to 20% for high loaded sections

Under Sleeper Pads – TGV in France

without USP



σ_v = 1.3 mm (1 km)

with USP

σ_v = 0.6 mm (1 km)

TGV: high speed line 320 km/h

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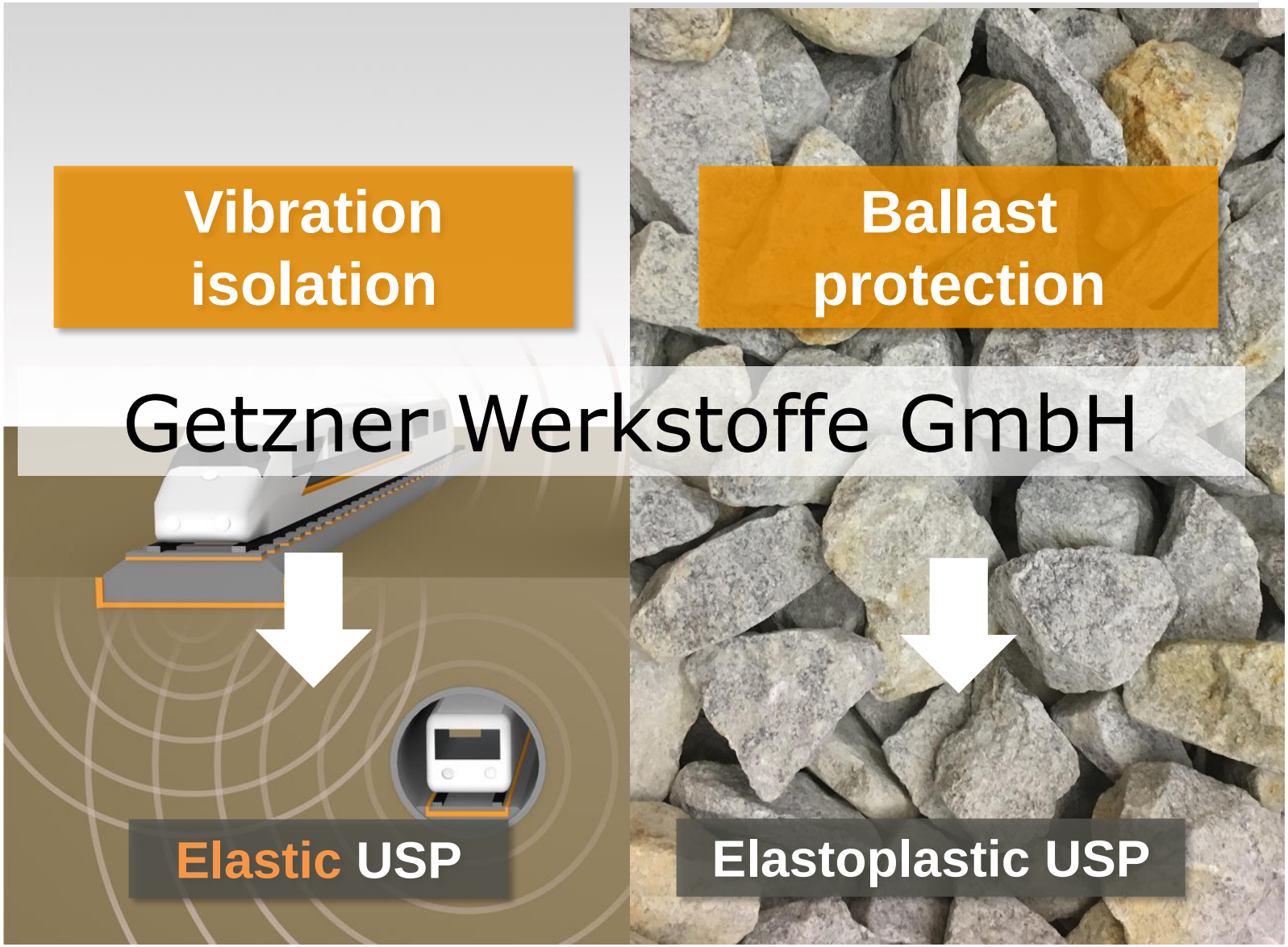
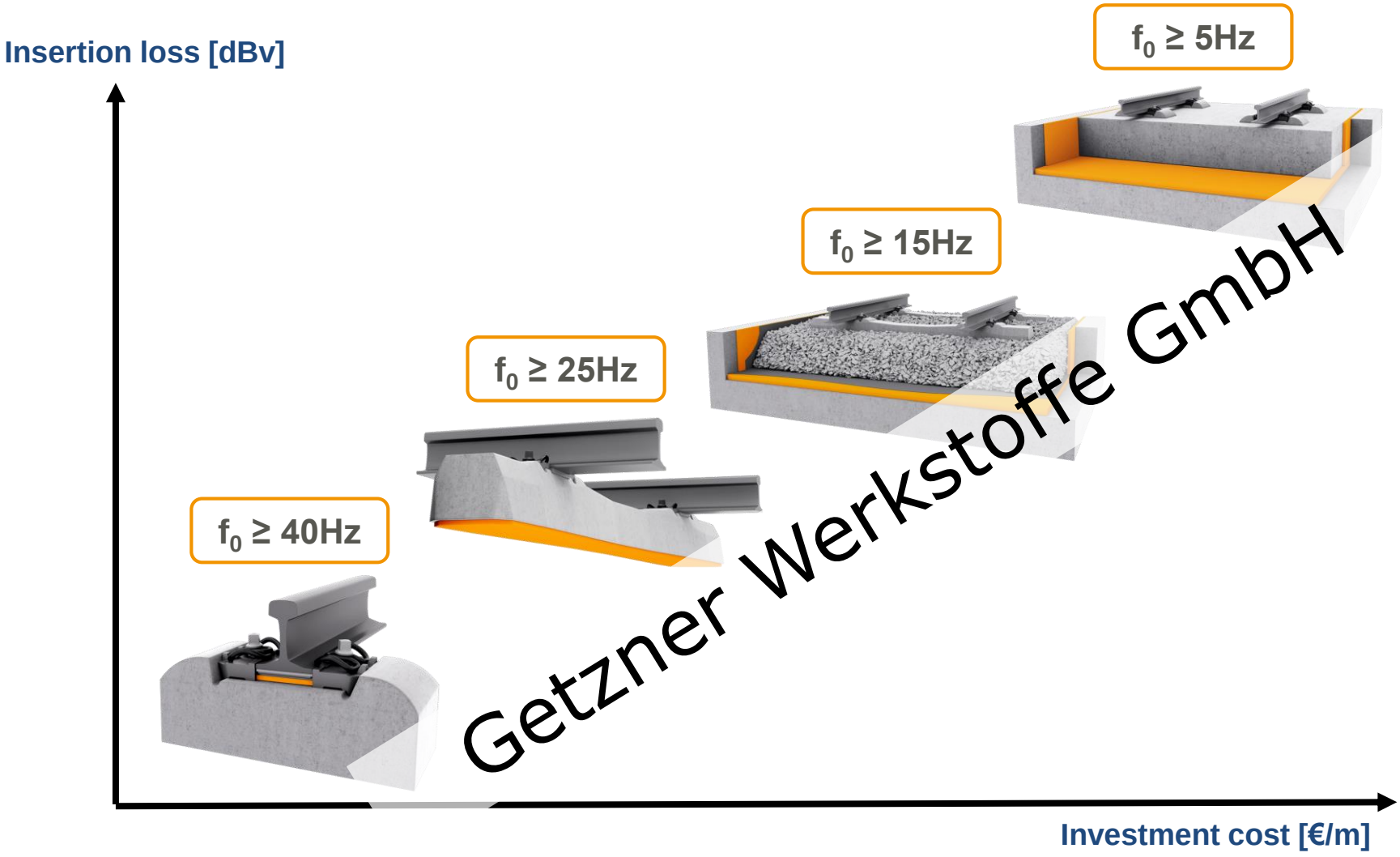
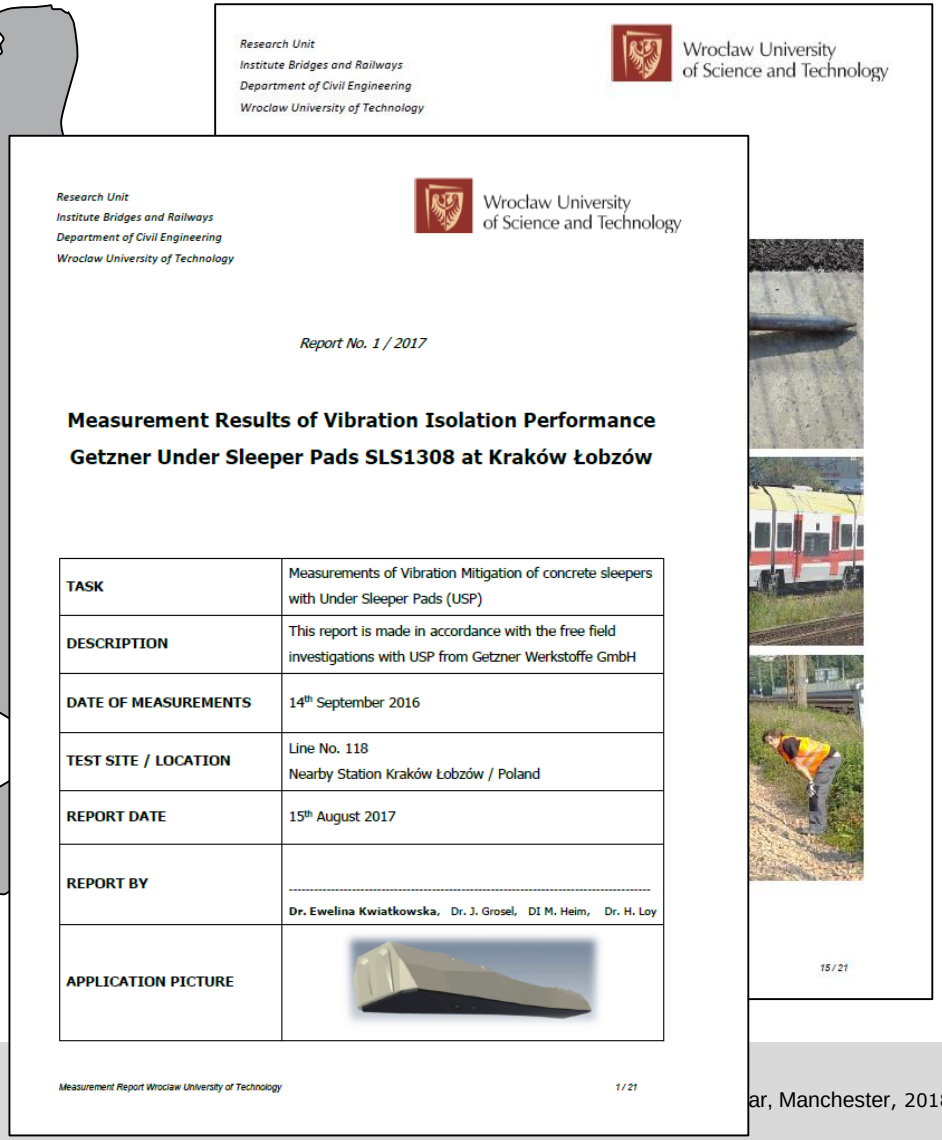

Vibration isolation
Ballast protection
Getzner Werkstoffe GmbH
Elastic USP
Elastoplastic USP

Cost vs. effectiveness



Case Study: Elastic USP/Kraków Airport Link



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Report No. 1 / 2017

Measurement Results of Vibration Isolation Performance Getzner Under Sleeper Pads SLS1308 at Kraków Łobzów

TASK	Measurements of Vibration Mitigation of concrete sleepers with Under Sleeper Pads (USP)
DESCRIPTION	This report is made in accordance with the free field investigations with USP from Getzner Werkstoffe GmbH
DATE OF MEASUREMENTS	14th September 2016
TEST SITE / LOCATION	Line No. 118 Nearby Station Kraków Łobzów / Poland
REPORT DATE	15th August 2017
REPORT BY	---------- **Dr. Ewelina Kwiatkowska,** Dr. J. Grosel, DI M. Heim, Dr. H. Loy
APPLICATION PICTURE	

Measurement Report Wroclaw University of Technology 1 / 21

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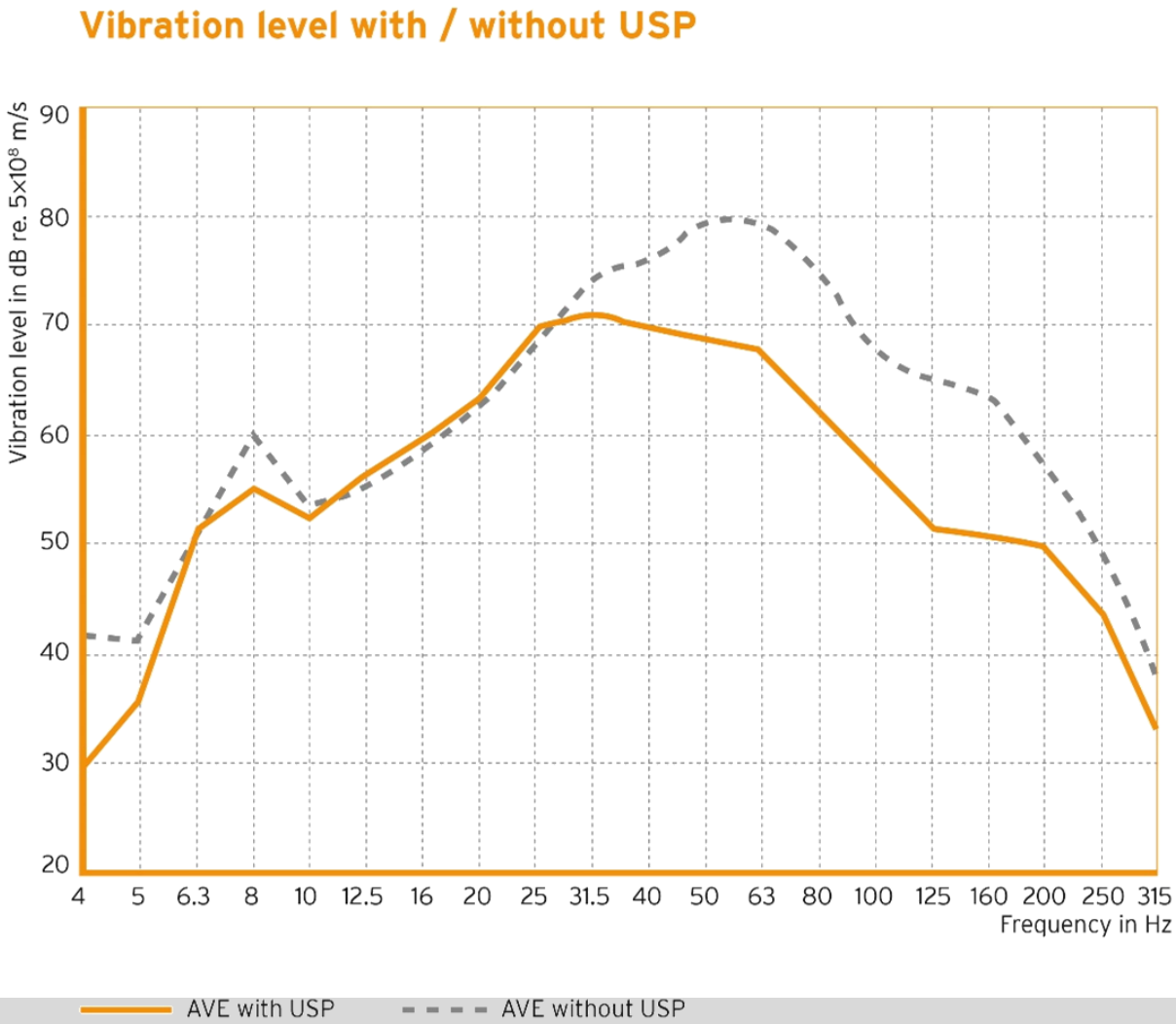
Vibration Reduction with USP SLS 1308



TU Graz I Peter Veit
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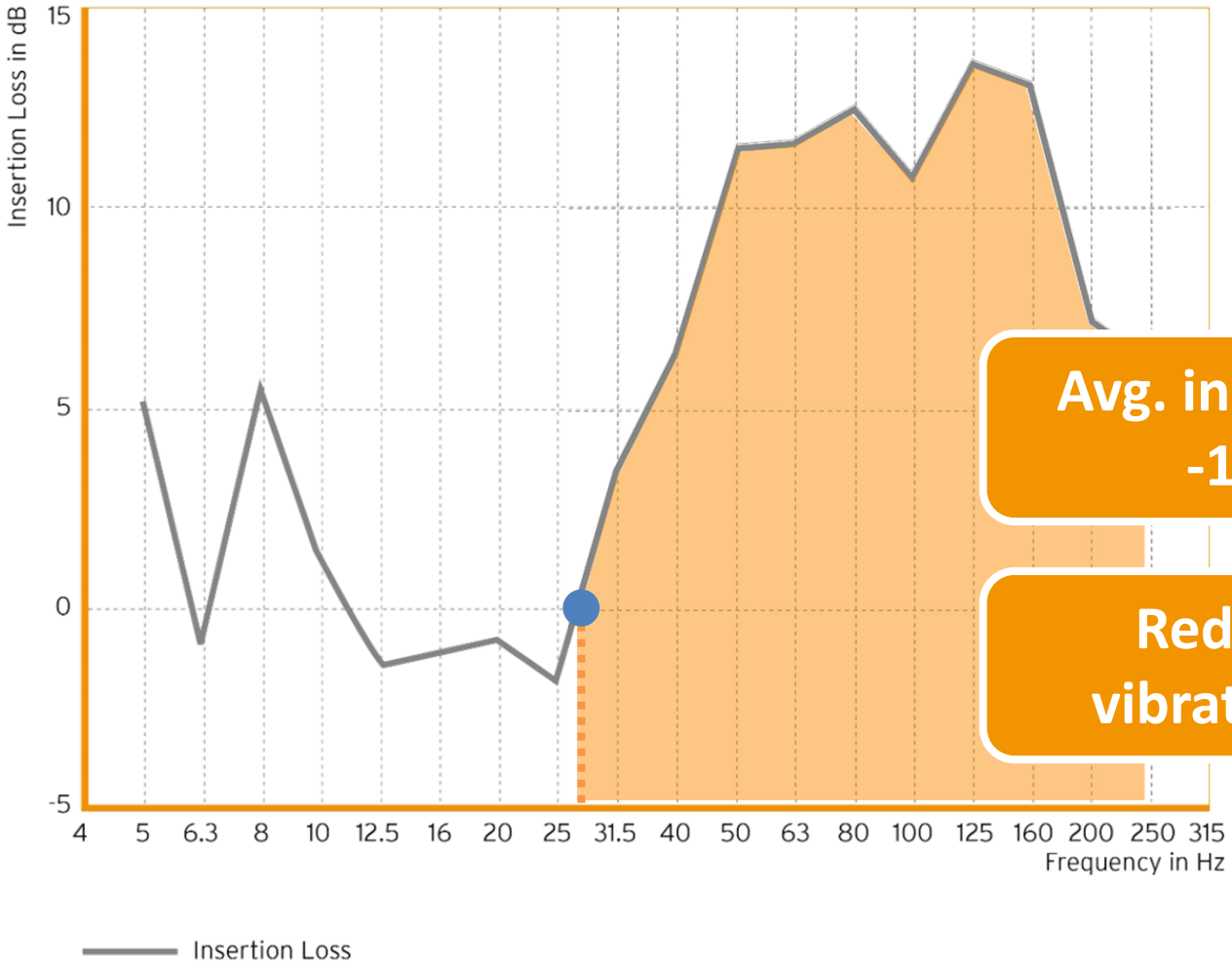
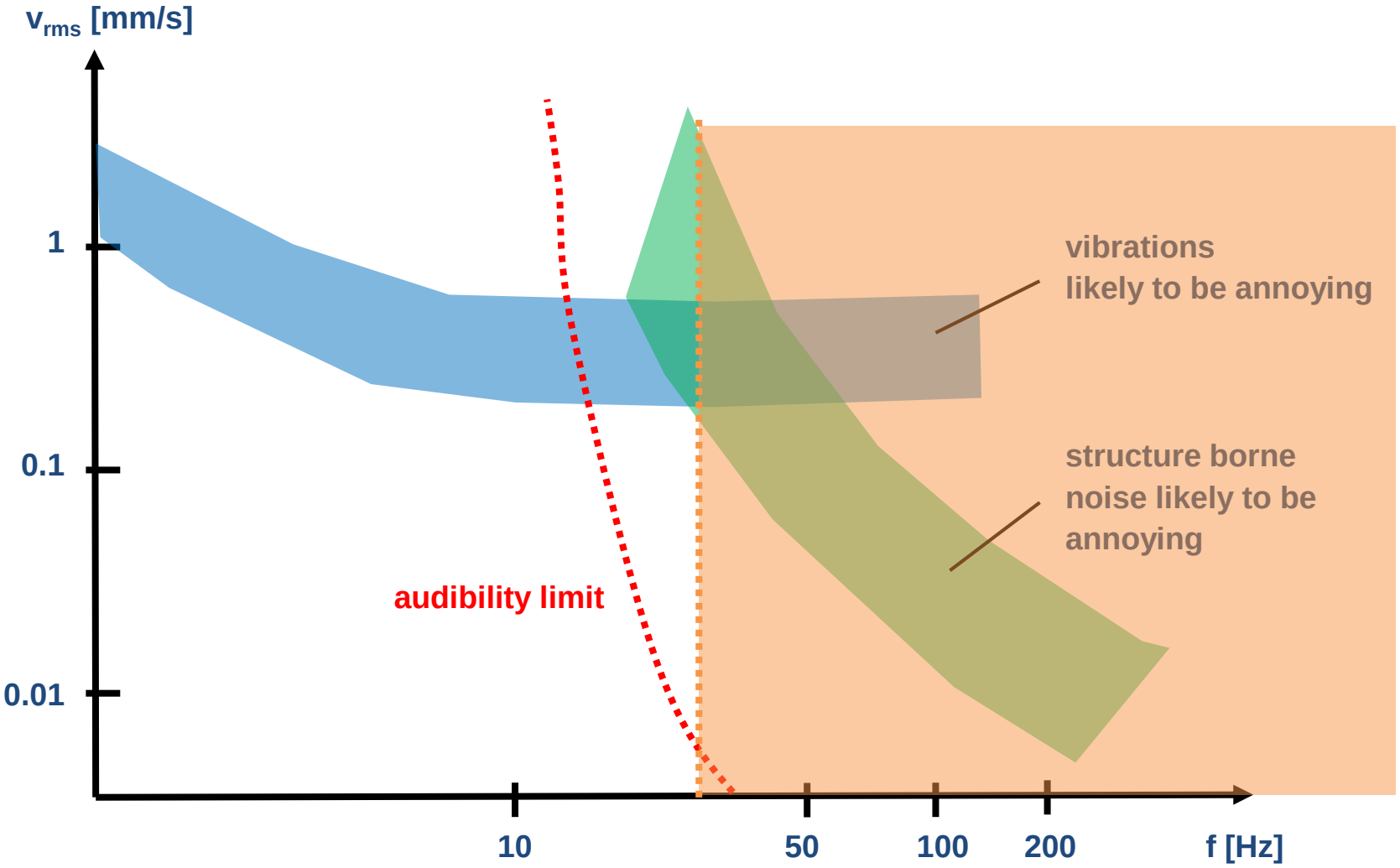
Vibration Reduction with USP SLS 1308

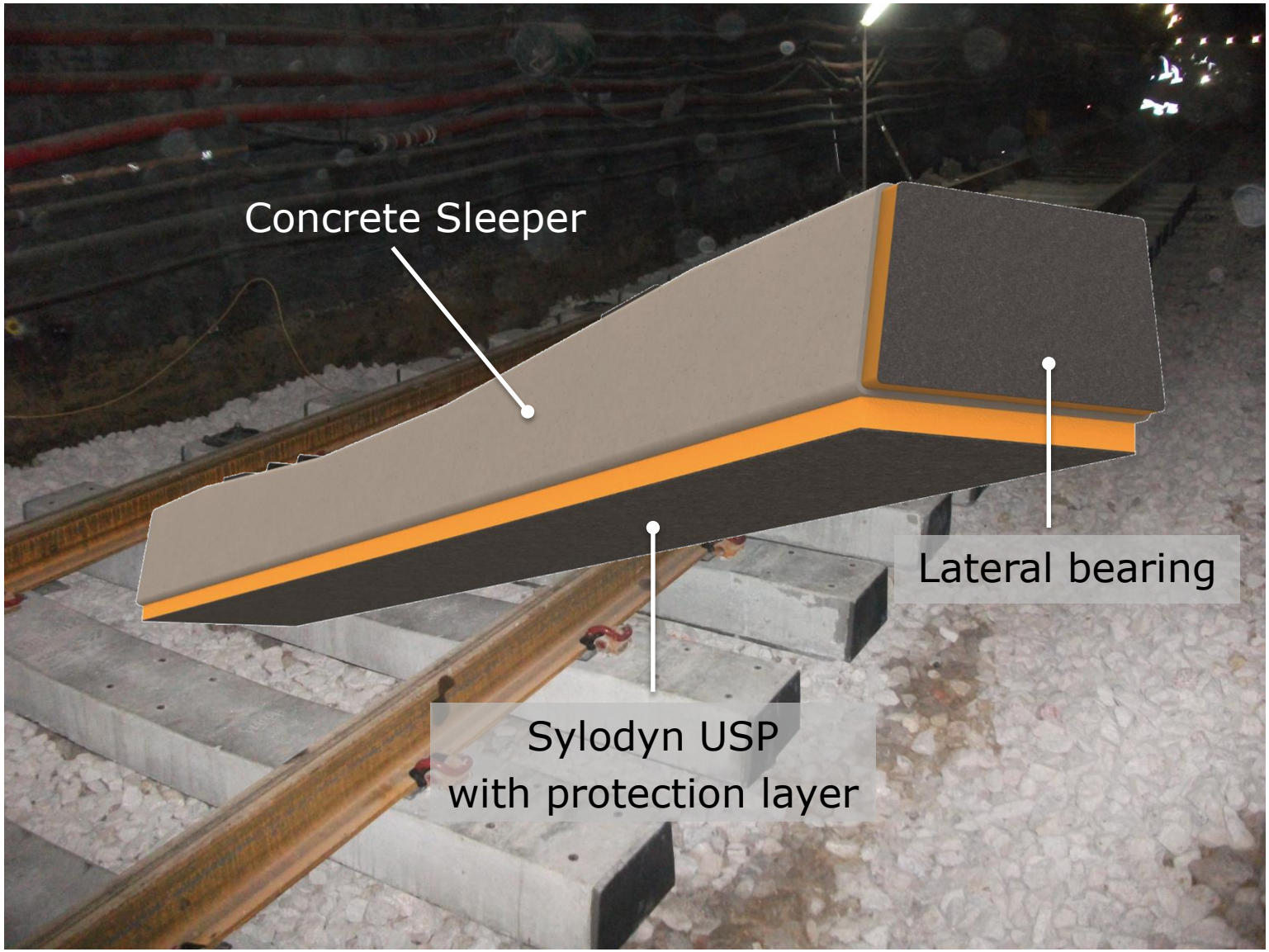


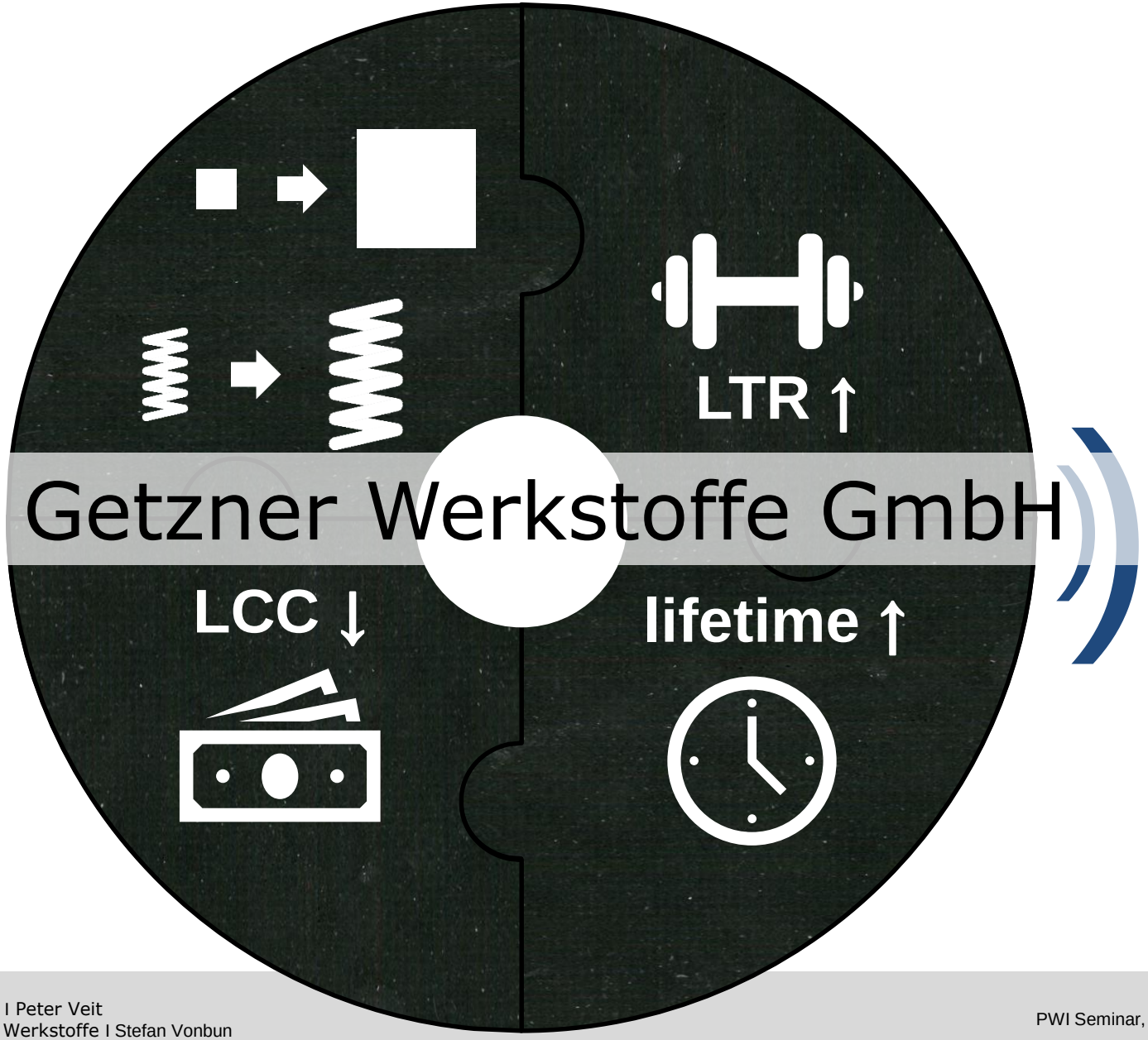
Avg. insertion loss: -11.6dBv

Reduction of vibrations: -74%


v_{rms} [mm/s]
1
0.1
0.01
vibrations
likely to be annoying
structure borne
noise likely to be
annoying
audibility limit
10
50
100
200
f [Hz]

Case Study: London Underground


Concrete Sleeper
Lateral bearing
Sylodyn USP
with protection layer


LTR ↑
Getzner Werkstoffe GmbH
LCC ↓
lifetime ↑

standard superstructure

PUR padded sleepers

30+ years

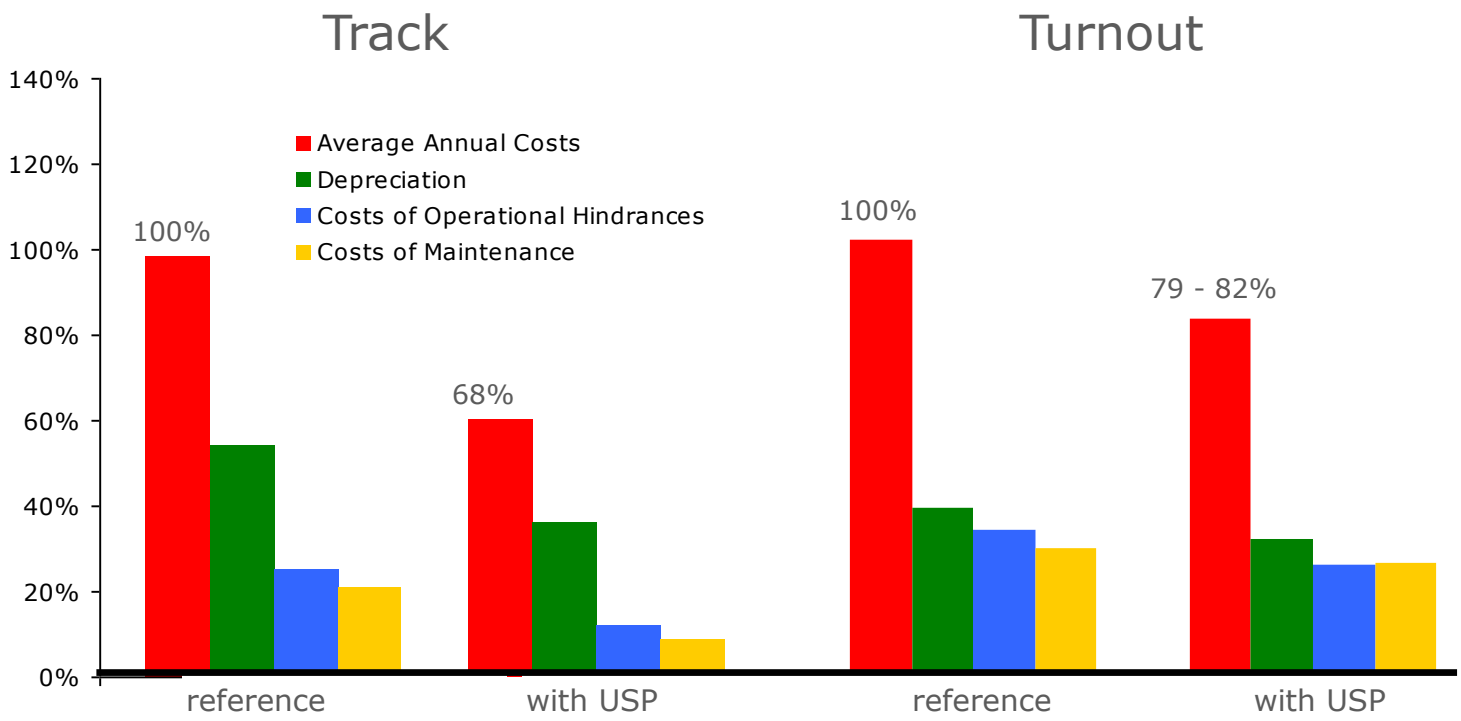
Lifetime sleeper = lifetime USP

more sustainable & more silent superstructure

Summary

There is nothing more expensive than short term savings.

There is nothing more economic than high quality.



Thank You for Listening!

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