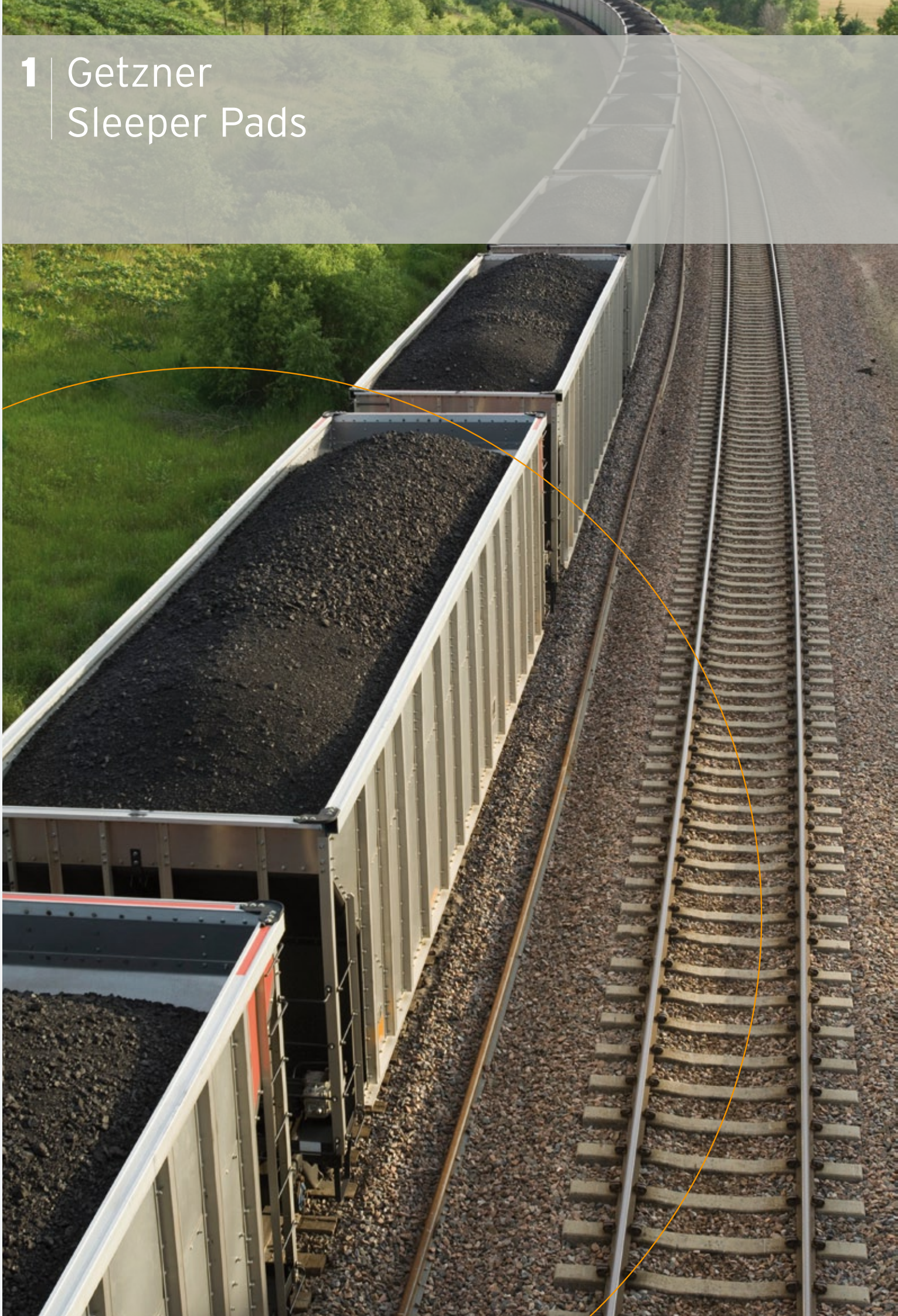
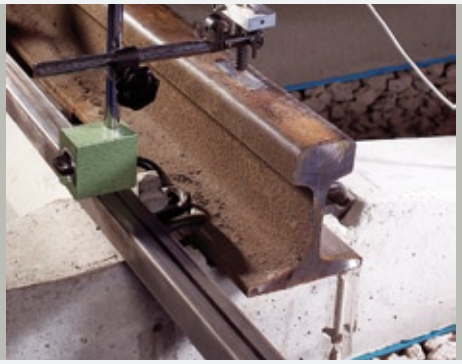
Sleeper Pads
for Ballasted Track

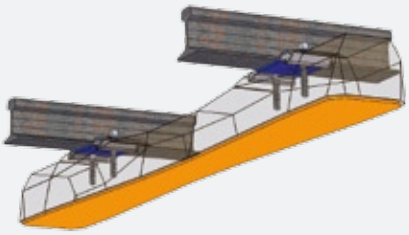
getzner
the good vibrations company

1 Getzner Sleeper Pads





The elastic solution for ballasted tracks and switches



Increasing operational loads and speeds in modern railway traffic present new technical and economic challenges to railway managers around the world.

Sleeper pads offer one opportunity to meet these challenges: They preserve the superstructure, improve the quality of the track geometry and reduce disruptive vibrations, both in the track and in the switch.

Sleeper pads offer the following advantages:

- Reduction of maintenance expenses
- Lengthening of the service life of the track structure
- Reduction of disruptive vibrations

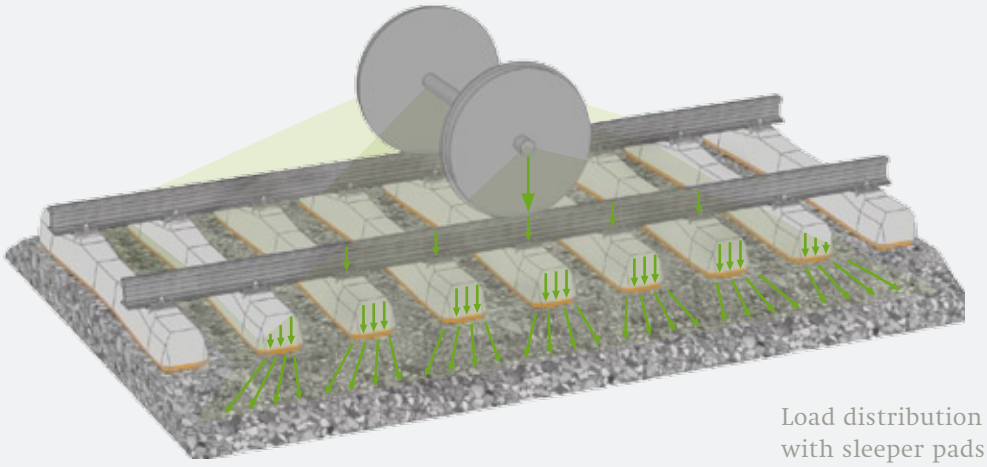
Sleeper pads offer operators the opportunity to significantly reduce the annual maintenance costs for tracks and switches.

Elastic sleeper pads from Getzner are a further development of the classic railway superstructure. The products are placed directly beneath the track sleepers and increase the vertical elasticity in the superstructure. With sleeper pads, the load of the rail cars is evenly distributed over the elastic components in the subsoil. Sleeper pads with defined elastic properties significantly reduce wear on the rail line.

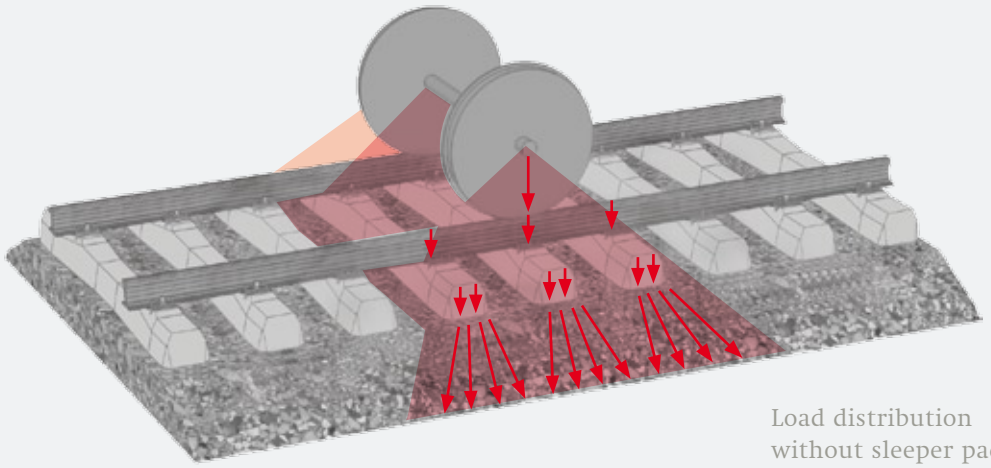
Highly elastic sleeper pads can also represent an economical alternative to sub-ballast mats as a vibration-isolating measure.

Getzner has produced sleeper pads since 1990. Today, they are used successfully around the world on all types of railway lines, from high-speed networks to regional transport.

2 Functioning Principle



Load distribution
with sleeper pads



Load distribution
without sleeper pads

Padded sleepers

The most common type of superstructure used in the world is ballasted track. Ballast, as the weakest link in the system, is subject to latent dynamic shifting. Constant loads (ballast compression) lead to wear and breaking up of the rocks. These effects diminish the quality of the track geometry, and the track bed must be tamped.

The effective installation of sleeper pads slows down this process in the following ways:

Distribution of the axle load over a larger number of sleepers

The elastic properties of the sleeper pads lengthen the bending line of the rails. The load from the train is distributed over a larger number of sleepers and therefore over a larger area. This reduced average compression also reduces the load on the ballast.

Increase of the contact surface between sleeper and ballast

The unique properties of the polyurethane material from Getzner result in an ideal embedding of the ballast in the surface of the sleeper pads, stabilizing the top-most ballast layer. This yields an increase in the contact surface between sleeper and ballast from about 8% (without padding) to up to 35% (with padding).

Weakening of the dynamic forces and vibrations in the ballast

Sleeper pads from Getzner reduce the direct dynamic load on the ballast. They reduce shifting of the ballast as well as settling of the track.

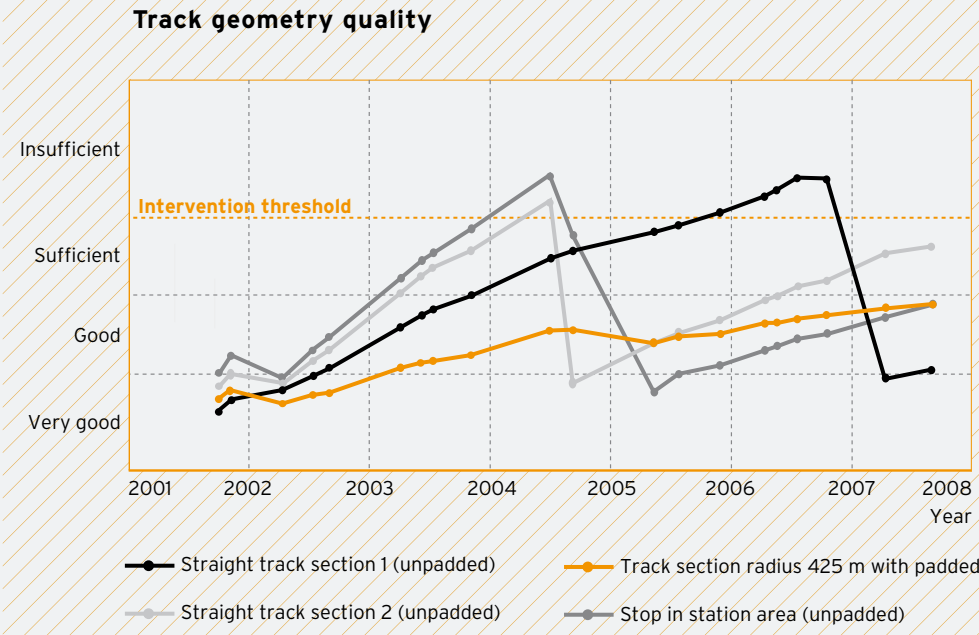
3 Applications

Improvement in the long-term behavior of ballasted track

The effective use of sleeper pads from Getzner results in a reduced load on the ballast. This in turn reduces ballast break-up and abrasion.

The ballast is optimally embedded thanks to the plastic properties of the pad, resulting in decreased ballast shifting. This method directly helps preserve the ballast bed and slows settling of the track considerably. Experiences in recent years have shown that the length of tamping intervals can be at least doubled with this procedure. The positive effect of sleeper padding becomes clear particularly quickly in areas subject to heavy loads, such as switches, structures or track sections with very small curve radii.

The advantages of padded sleepers are particularly impressive on heavy-laden sections with up to 37 tons of axle load.



Changes in track geometry quality on a test stretch in Austria since 2001.

The improvements in track quality in track sections 1 and 2 as well as the station area were achieved through tamping.

Vibration protection and reduction of secondary air-borne sound

Highly elastic pads offer a simple method for reducing vibrations on railway lines that is cost-effective in comparison with sub-ballast mats. In addition, they exhibit all the positive properties of elastoplastic padding.

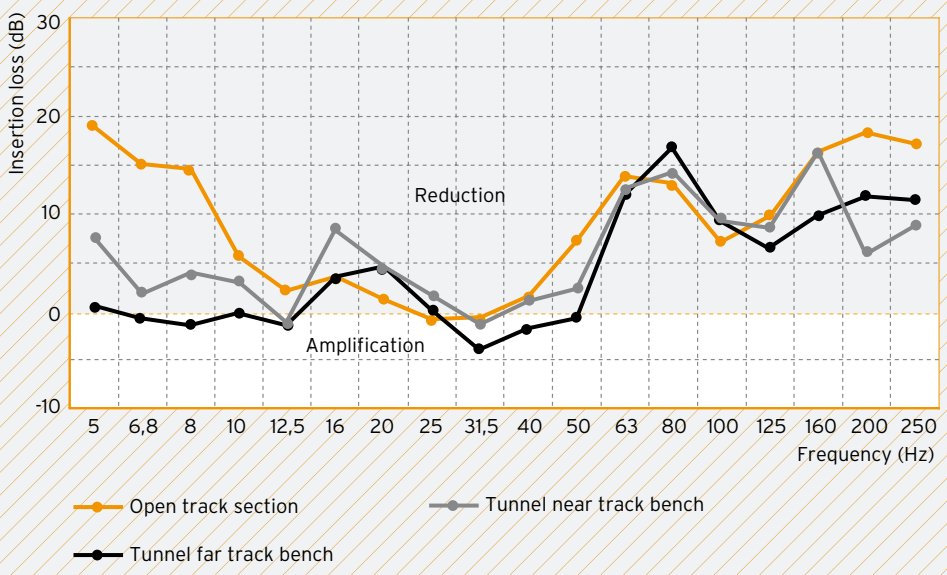
Depending on the maximum permissible rail deflection, padded sleepers achieve insertion losses on the order of 10 dB(v) to 15 dB(v) (at 63 Hz).

No significant changes to the directly emitted air-borne noise have yet been identified.

Secondary air-borne noise arises due to the sound emission of a structure that is stimulated to vibrate, for instance by a passing train.

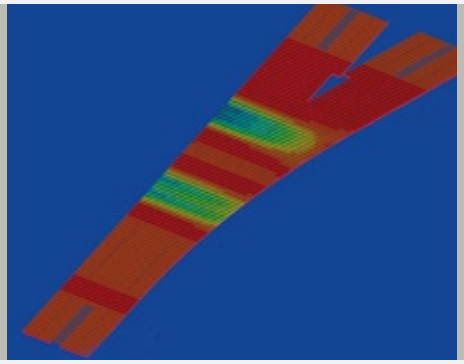
This applies in particular to metal structures, such as steel bridges and viaducts. Elastic sleeper pads with vibration-isolating characteristics are a very effective measure for reducing secondary air-borne noise.

Effect of sleeper padding



The vibrations are reduced in the critical frequency range, which also reduces the emissions to the neighboring environment.

Source: Köstli K.; Sleeper Padding for Reduction of Structure-Borne Noise Immissions; p. 10; conference articles, 10th Symposium on Structural Dynamics and Vibration Measurements, Ziegler Consultants 2007.



Reduction of short wave formation

Short waves are periodic bumps in the track surface.

Multi-year studies have shown that sleeper pads significantly slow the occurrence of such track damage. This is particularly noticeable on narrow track bends that are susceptible to short waves.

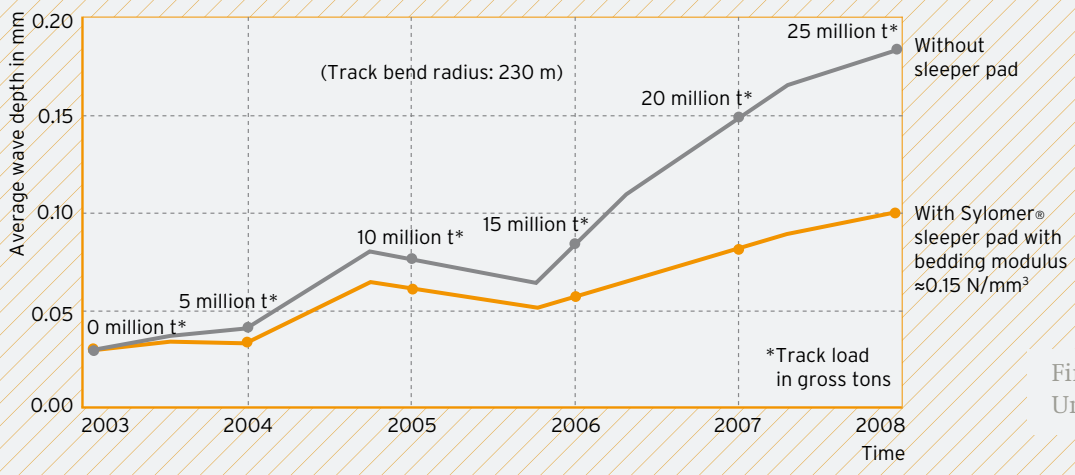
Specifically defined elasticity for padded switches

The bedding stiffness varies over the course of a switch. This is due to the different sleeper lengths and stiffening components, such as the frog, check rails or wing rails.

The different bedding stiffness values result in a dynamic load when a train passes. This leads to a rapid wearing of the track, which increases maintenance costs and reduces passenger comfort. In addition, vibrations are transmitted to nearby buildings via the subsoil.

Getzner offers a combination of different sleeper pads (stiffnesses) specifically for switches. The load transmission to the superstructure can be homogenized with these pads. Differences in deflection are minimized, resulting in smoothing of the switch.

Short wave development in track bends over time



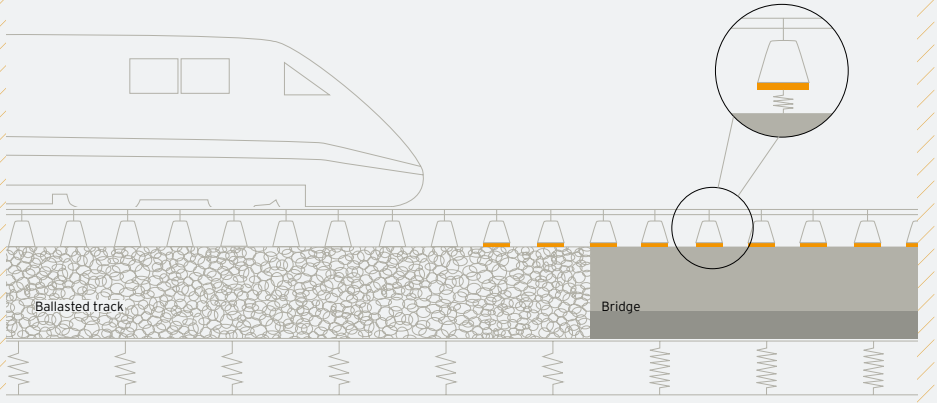
Final report Hieflau, University of Innsbruck 2001

An even load pattern is also produced, which helps preserve the ballast.

Sleeper pads from Getzner also contribute here to lengthening the intervals between tamping and maintenance work. Increased passenger comfort and lower life-cycle costs make sleeper pads from Getzner a popular solution among railway managers.

- Smoothing of deflection during train passes
- Increased passenger comfort
- Preservation of the ballast
- Reduction of disruptive vibrations
- Reduction of life-cycle costs (LCC)

The deflection during train passes can be simulated with a specially developed computer model and optimized through the effective use of Getzner pads.



Adaptation of track stiffness at transitions

Sleeper padding helps to decrease large jumps in stiffness and thereby deflection as well as to reduce voids under the sleepers. These occur primarily at transitions where superstructures with different stiffness values meet. The sleeper padding results in a more homogenous train passage as well as preservation of the superstructure components.

4 Using Sleeper Pads Pays Off

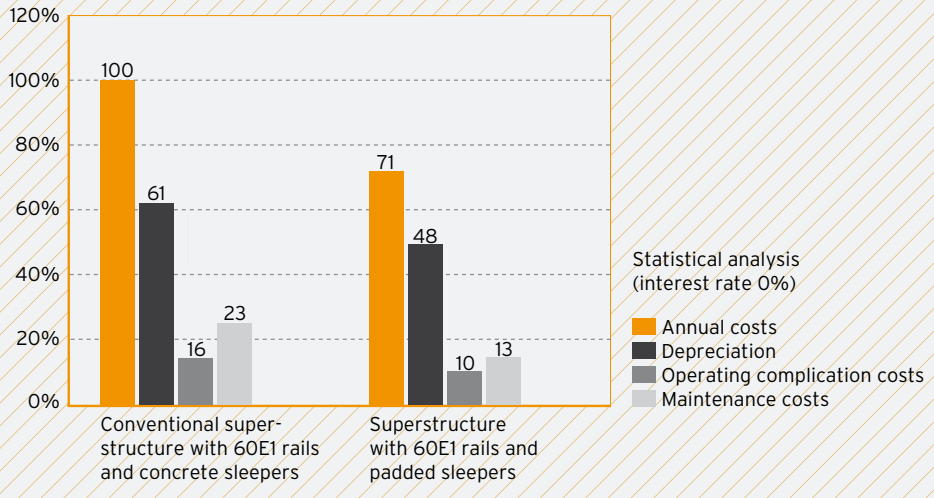
Consideration of the life-cycle costs (LCC) when using sleeper pads

The extent to which the use of sleeper pads alters the track geometry quality has been systematically recorded for several years. The results are continuously influencing development work.

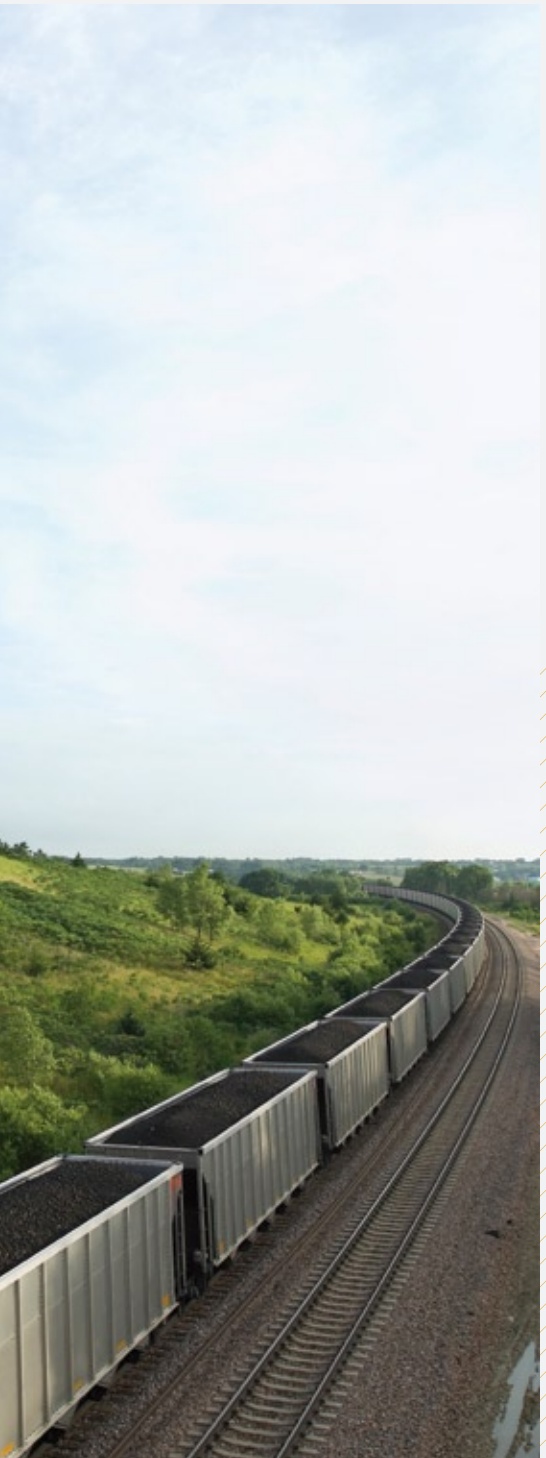
One observation is a lengthening of intervals between tamping work by a factor of 2 to 2.5 thanks to the use of sleeper pads. If one considers the tamping cycle as an indicator for the achievable service life of a track, longer periods between tamping work point to a significant lengthening of the life of the entire track bed.

In addition, if costs for operating complications that arise from track closures for maintenance work are considered, sleeper pads are an extremely economical investment, particularly on track sections subject to heavy loads.

Composition of the normalized annual costs (heavily used track)



5 Experience with Sleeper Soles



Widely proven

Almost all major railway companies in Europe have successfully used sleeper pads from Getzner for over 18 years.

Sleeper pads are used for vibration protection, to provide elasticity for large bridge structures, to improve track geometry quality and to reduce track maintenance costs.

The sleeper pads from Getzner have outstanding long-term properties. This is demonstrated by sleepers with Getzner pads that have been removed for testing. In addition, measurements taken on padded track sections also verify the excellent quality of the sleeper pads.

To ensure a long service life for sleepers, the durability of all types is inspected according to BN 918 145-1. These tests are either performed externally at a certified testing agency (e.g. Munich University of Technology) or internally on Getzner's large test bench.

Getzner's large test bench

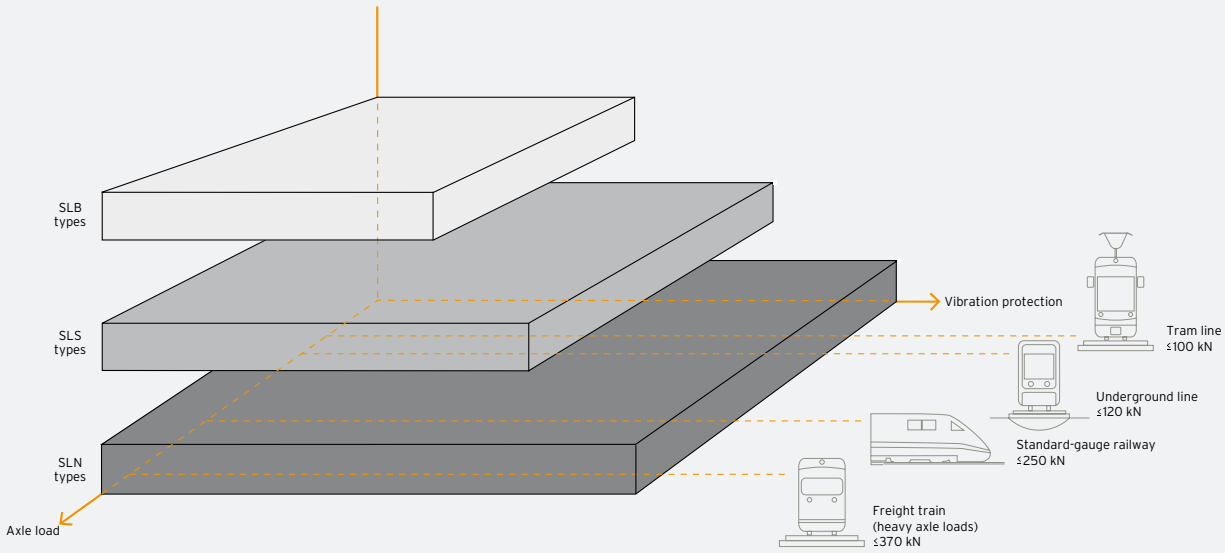
Getzner padding SLB 2210G after 190 million total tons. The plastic impressions in the material prevent shifting by the top ballast layer. No cracks or perforations can be seen in the padding.

6 Sleeper Selection – The Right Getzner Pads for Every Application

Getzner sleeper pads, the broad product selection

Three materials – available with different stiffness values – completely cover the application spectrum from highly effective vibration protection to improvement of track geometry quality.

The three materials:
SLB – Elastoplastic material
SLS – Elastic material with damping properties
SLN – Highly elastic material without damping



Oresund Bridge

The right pad for every track

Getzner's specialty is microcellular polyurethane elastomers with a wide range of properties for railway superstructures. Sylomer® and Sylodyn® components have proven themselves for decades under extreme conditions in a wide range of industries.

Getzner offers the optimal sleeper pad for every application: from the elastoplastic SLB types exclusively for improvement of track geometry quality to the highly elastic pads made of Sylomer® (SLS types) and Sylodyn® (SLN types) for effective reduction of vibrations.

SLB-type elastoplastic pads are used to reduce the load on the ballast. The optimized material properties of these types permit a particularly stable embedding of the ballast. The high damping of these pad types has a positive effect on the vibration behavior of the sleeper.

Elastoplastic pads reduce the annual maintenance costs and lengthen the service life of a track.

If a reduction of vibrations is the primary aim, SLS-type (Sylomer®) elastic pads and the highly effective SLN (Sylodyn®) types are used.

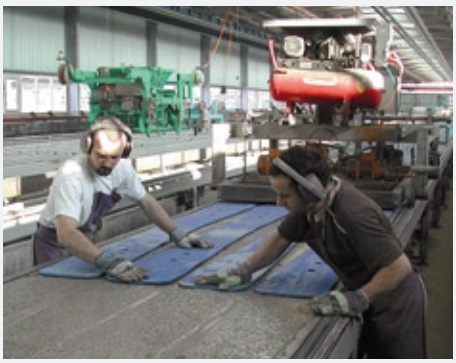
While pads made of Sylomer® still exhibit certain damping properties, solutions with Sylodyn® achieve a nearly identical relationship between static and dynamic stiffness. This makes an extremely effective solution possible even with minimal additional rail deflection.

Selection of the ideal Getzner pad

Getzner has the optimal pad type for every application. The appropriate types are selected according to the maximum permissible rail deflection under a defined load.

The individual pad types within a material group differ primarily in terms of their elasticity. The elasticity is determined using the bedding modulus. This takes place according to DIN 45673-1 in a test on a ballast profile slab (standard ballast slab). Getzner provides optimized pad types for tram lines, underground lines, rapid transit, standard-gauge railways, high-speed tracks and special applications, such as heavy axle loads of up to 37 tons.

7 Secure Fastening



Sleeper production

Installation train with switch padding

Assembly at the sleeper plant

Sleeper pads from Getzner can be adapted to every sleeper type.

Pads for concrete sleepers are typically manufactured with an installation grate ("G" at the end of the type designation). This unique installation grate from Getzner is integrated into the padding and permits a full-surface attachment of the pad to the sleeper. The installation grate is pressed into the concrete while it is still moist during the production of the sleepers. The form-fitting, full-surface connection ensures a lasting bond between the pad and the concrete sleeper independent of the production process and concrete consistency.

The connection process requires no additives or extensive preliminary work while fulfilling even the very high requirements of the standard BN 918 145-1. If desired by the customer, pads can also be attached to concrete sleepers that have already hardened. In such cases, the sleeper pads are delivered without an integrated installation grate. The pads are glued on with a suitable adhesive, which Getzner can also supply, if desired.

Installation of padded concrete sleepers

Padded sleepers can be installed using all typical methods.

Due to the relatively low weight of the pads, the number of sleepers per car can remain unchanged. There are also no restrictions on track maintenance work.

At the transitions between padded and unpadded tracks, it may be necessary to change the stiffness in stages. This applies primarily to soft pads (bedding modulus < 0.15 N/mm^3). Getzner recommends using padding with a higher stiffness over a length of 20 to 30 meters for such stiffness adaptation.

8 International References

Getzner projects speak for themselves

Getzner solutions can be found around the world – as can the Getzner team.

Getzner Werkstoffe is present in the most strategically important parts of the world with its four branch offices. The company serves practically all of the relevant markets in the world through numerous sales partners.

"Sleeper Padding for Ballasted Track" reference list (excerpt):

Goal: Ballast preservation and improvement of track geometry quality

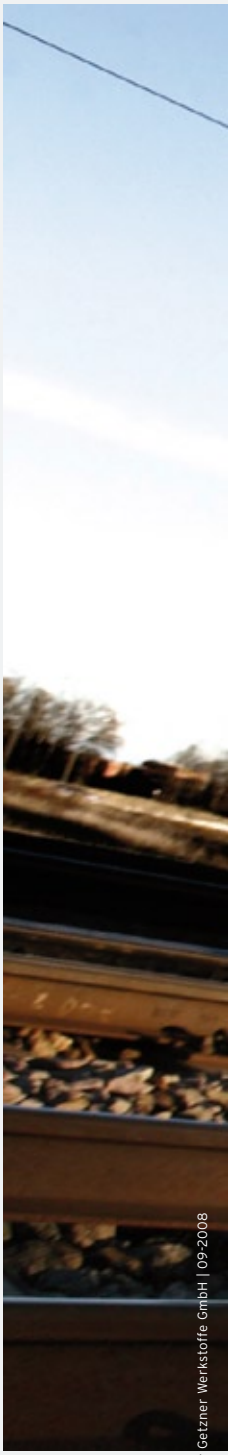
- ÖBB, Austria
- DB, Germany
- SBB, Switzerland
- SNCF, France
- Bane Denmark, Denmark
- KR, Korea
- Jernbaneverket, Norway
- CR, Czech Republic
- Infrabel, Belgium
- ADIF, Spain

Goal: Sleeper pads for vibration isolation

- Metro Amsterdam East Line, Netherlands
- Bruchsal Tunnel, Germany
- Umega Oka Line, Japan
- Britomart Station, New Zealand
- Matstetten-Rothrist, Switzerland
- Timelkam, Feldkirch and Hallwang, Austria

Goal: Elastically supported switches

- ÖBB, Austria
- DB, Germany
- SBB, Switzerland
- CR, Czech Republic
- Pro Rail, Netherlands
- Jernbaneverket, Norway



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