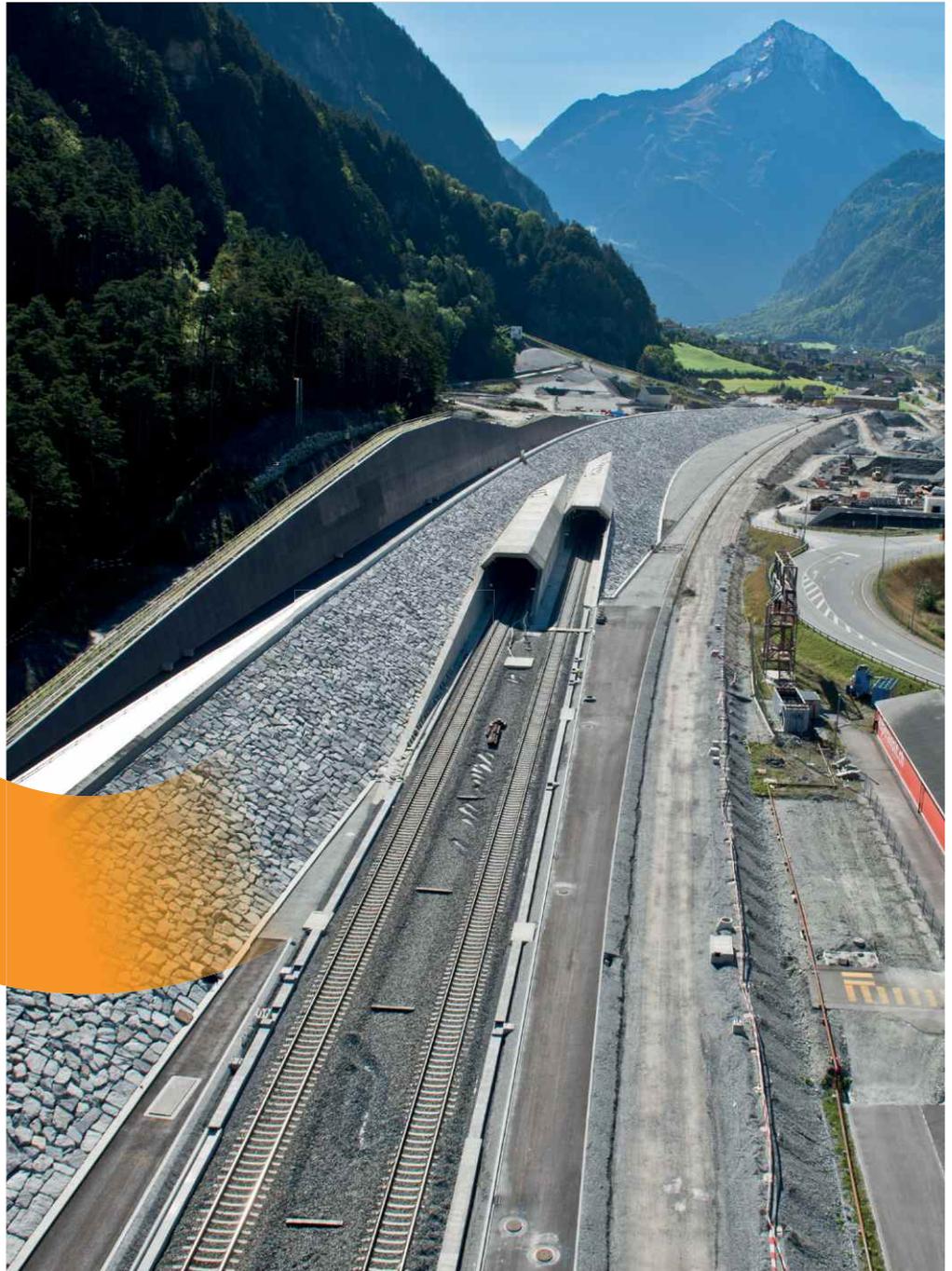


# ELASTICITY FOR SLAB TRACK IN GOTTHARD BASE TUNNEL

## CASE STUDY

Gotthard Base Tunnel (CH)

VIBRATION ISOLATION AND PROTECTION OF THE ENTIRE RAILWAY SUPERSTRUCTURE.



# ELASTIC SYLODYN® INSERTION PADS FOR SLEEPER BOOTS

## THE PROJECT

At 57 kilometres in length, the Gotthard Base Tunnel is currently the longest railway tunnel in the world. It links the Swiss communities of Erstfeld and Bodio. The tunnel forms part of the New Railway Link through the Alps (NRLA), which is at present the largest construction project in Switzerland.

### **Prestigious project with highest requirements in terms of railway technology**

With the construction of this major infrastructure project, north/south railway transit traffic will be further improved, helping shift transit traffic from roads to rail. Moreover, travel time for public transport services will be significantly reduced - in conjunction with the

Ceneri Base Tunnel which is currently being constructed - (the travel time from Zurich to Milan will be cut by one hour), thereby considerably increasing the attractiveness of railway travel compared with taking the car or plane. In future, passenger and freight trains will pass through the tunnel at speeds of up to 250 km/h.



The Gotthard Base Tunnel was opened in 2016 and is a model project that exceeds all previous dimensions in terms of tunnel length, engineering and logistics.

There were multiple reasons to choose a slab track for the superstructure in the Gotthard Base Tunnel: in terms of high availability (due to low maintenance requirements), resilience and longer service life, the slab track is significantly superior to the conventional ballast superstructure. Additionally, with a slab track the tunnel cross section can be smaller - meaning a considerable decrease in construction costs, as this form of superstructure requires a lower construction height compared to a ballast superstructure. Safety was also a key consideration. For this reason, the decision has been made to have two separate tunnels (evacuation

concept), permitting access for emergency vehicles if necessary.

In order to ensure that superstructure components can be used for a long time respectively to avoid excessive stress, a slab track must be fitted with elastic components - this compensates the lack of ballast elasticity.

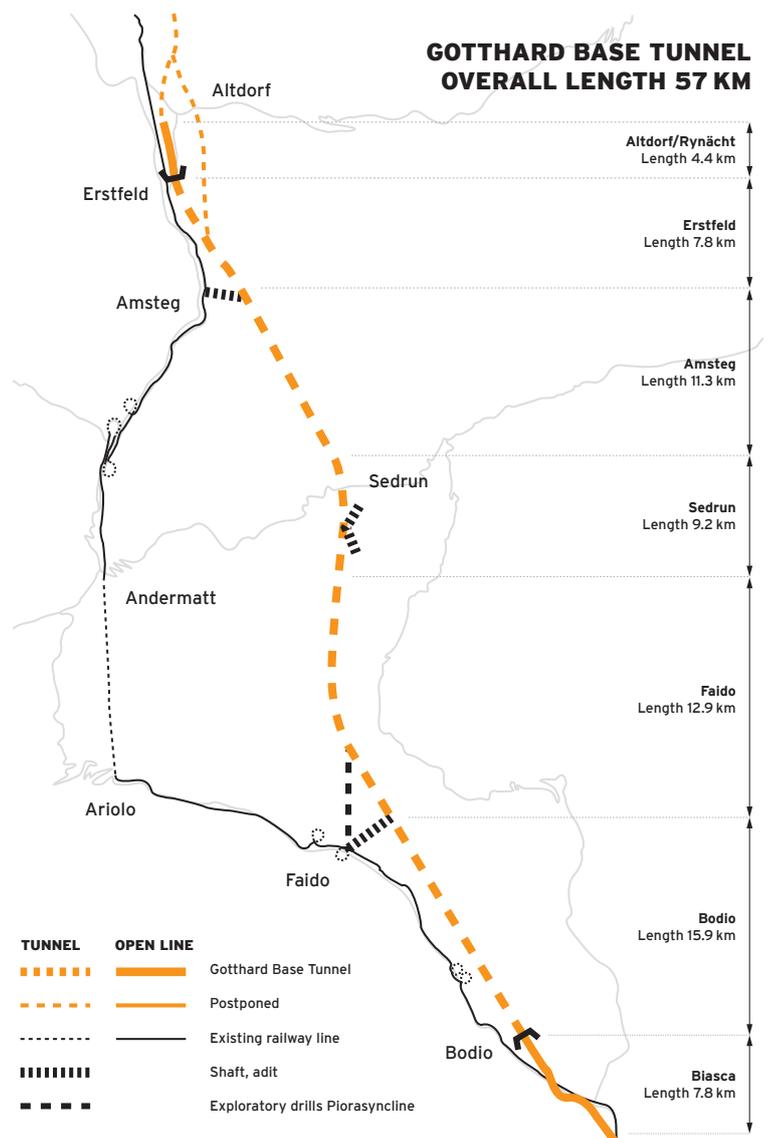
For this prestigious project, the requirements in terms of railway technology were already very high: particular environmental conditions are found in the tunnel, such as ambient temperatures of up to 40 °C and humidity as high as 70%. Moreover, strong pressure and suction forces are at work due to the high speed of the trains. Similarly, the extremely frequent use of the track, with up to 250 trains per day, also puts the line under above-average stress.



Slab track with LVT system



Lines feeding into the tunnel with ballast superstructure



# ELASTIC INSERTION PADS FOR SLEEPER BOOTS AND UNDER SLEEPER PADS

## THE GETZNER SOLUTION

All the materials in the Gotthard Base Tunnel and on the lines leading to the tunnel portals must provide outstanding performance over their entire service life.

For these special requirements, Sonnevile's LVT (Low Vibration Track) system was selected - one of the world's first slab track systems. In the case of the LVT system, the track is designed with single-block sleepers in rubber boots, with elastic Sylodyn® insertion pads from Getzner. The unreinforced track is laid directly on the inverted arch. The advantages of this special type of superstructure are that the individual components can be replaced (no rigid connection between the track panel and the slab), the high level of track accuracy, long service life and reliability, as well as the low maintenance costs.

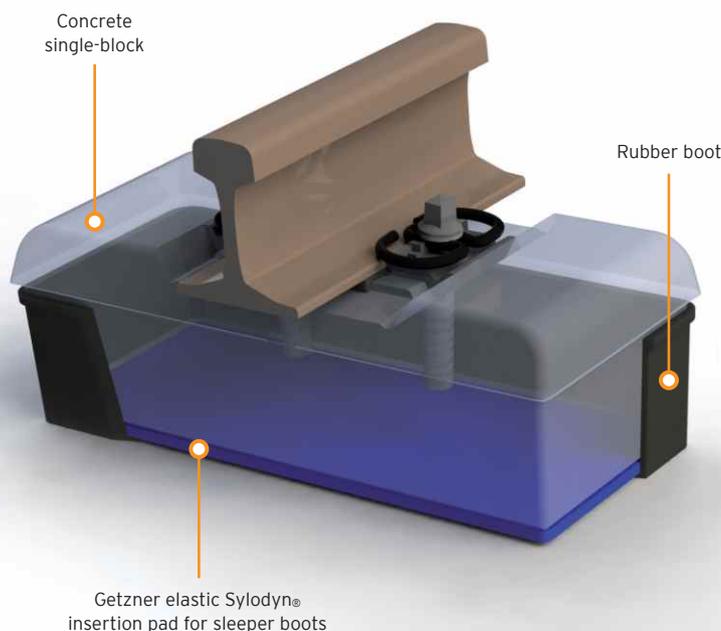
In addition, all the slab track turnouts (manufactured by voestalpine Weichensysteme GmbH) in the tunnel have been supported elastically with Sylodyn® material. Numerous turnouts and individual track sections with ballast superstructure on the main lines feeding into the tunnel have also been fitted with Getzner Under Sleeper Pads.

### Materials for the most stringent requirements

The award of this contract to Getzner is primarily due to the excellent material properties, but also to the company's technical knowledge and expertise and the LVT projects that have been demonstrably successful: this system has already proved its worth multiple times and is in successful use on five continents, with more than 1,000 kilometres of track in total.

Even in the early stages, within the framework of project planning, the materials were required to withstand tests with high permanent load and also artificial ageing tests. "Our slab track system products have proven their reliability for over 25 years - this is not only confirmed by the test results, but also by multiple well-known references and measurements on actual tracks", explains Helmut Bertsch, Project Manager at Getzner Werkstoffe. Getzner calculated the optimum choice of materials and the extent of rail deflection of the turnouts using its own "finite element calculation".

Sylodyn®, the material used, is a closed cellular elastomer that only has very low dynamic stiffening, even in the high frequency range.



LVT System

Getzner materials have now been successfully used in railway superstructures for more than 40 years - as shown by numerous long-term references.

**Increase of track stability and service life**

It is important that all components fulfil the most stringent requirements, particularly in case of the high-speed turnouts in the tunnel: Various types of highly-elastic Sylodyn® inserts ensure even deflection as the train passes over, along the entire length of the turnout and in the transition area between the straight line and the turnout.

"High-speed turnouts were developed especially for this project, based on the latest technology. The high requirements placed on the materials and in terms of execution represent a major challenge for all manufacturers.

Getzner Werkstoffe convinced us with their high-quality materials and excellent international references", explains Erich Wipfler, Director of Engineering at voestalpine Weichensysteme GmbH.

A conventional ballast superstructure with padded monoblock sleepers and bearers has been installed on the lines feeding in to the tunnel portals. The Getzner Under Sleeper Pads are used to protect the ballast and extend the tamping intervals required, as well as the service life of the superstructure. The special elastoplastic material properties of the under sleeper pads result in the ballast embedding into the padding, thereby increasing the contact surface and reducing the stress on the ballast. This property has a proven positive effect on track stability and the service life of the superstructure. Moreover, the dynamic deflection properties of the turnouts when a train traverses them have been optimised with the aid of in-house "finite element calculations".



**Pre-assembly**



**Aligned track**



**Measurement**



### **High supply availability and optimum quality**

Even if we consider only the particular requirements in terms of quality and logistics, the Gotthard Base Tunnel is an extraordinary project: "Getzner had to ensure high supply availability for the whole duration of the project, and guarantee a consistent extremely high level of quality - for the entire period of use", explains Anabel Hengelmann, the Chief Executive Officer of Sonneville AG. Getzner not only provides clients with individual support, but also offers comprehensive, professional project support - from material selection and detailed installation plans to tailor-made just-in-time deliveries. This project was no different in this respect, being supported by highly-qualified Getzner employees from the areas of systems development, product management, application technology, quality assurance and production.



Photo credits: AlpTransit Gotthard AG, Getzner Werkstoffe



# ADVANTAGES



**Under Ballast Mats**



**Under Sleeper Pads**



**Sleeper Boot Insertion Pads**

Elastic track solutions in the Gotthard Base Tunnel provide reliable vibration isolation and long-term protection of the entire railway superstructure under extremely demanding operating conditions. Precisely tuned Sylodyn<sup>®</sup> materials compensate for the missing elasticity of the slab track, ensuring uniform load distribution and reducing mechanical stress on rails, sleepers and high-speed turnouts. This results in high track stability, excellent ride quality and consistently low maintenance requirements, even with up to 250 trains per day travelling at speeds of up to 250 km/h. At the same time, the elastic system withstands extreme tunnel conditions such as high temperatures, humidity and pressure fluctuations, supporting maximum availability, safety and a long service life in the world's longest railway tunnel.

<b>Operator</b>	Schweizerische Bundesbahnen (SBB) [Swiss Federal Railways]
<b>Customer</b>	ARGE Transtec Gotthard
<b>Solution</b>	114 km track, including two 57 km tunnels Elastic components: - Sleeper boot insertion pads for LVT system (approx. 400,000 pieces) - Under sleeper pads for 33 ballasted turnouts and 30,000 sleepers - Under ballast mats
<b>Services</b>	Model and forecast calculations using finite element calculation, installation plans, quality assurance

**Additional references can be found on our website:**



[getzner.com/  
references](https://www.getzner.com/references)

[getzner.com](https://www.getzner.com)

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