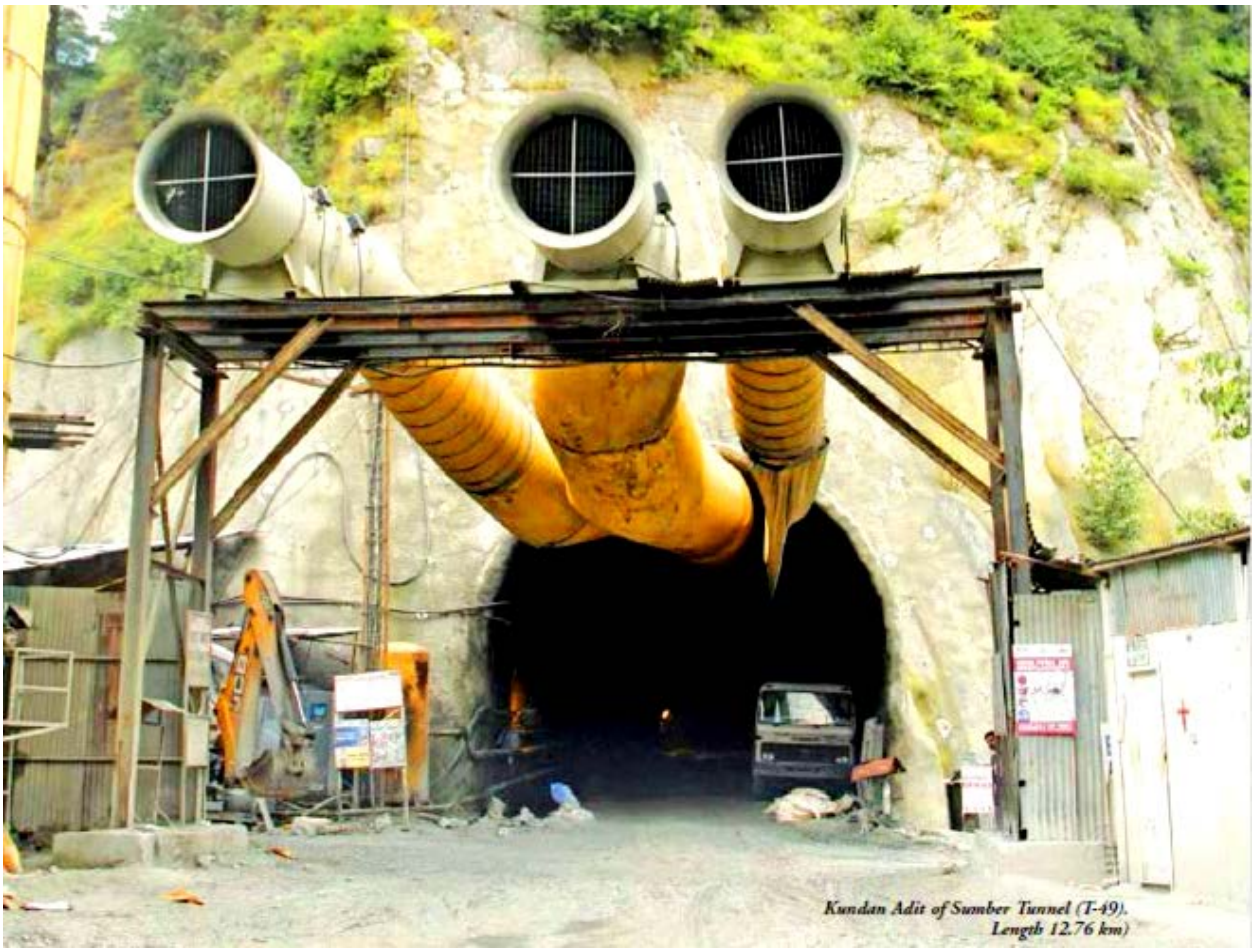
PROVIDING STEDEF/BÖZBERG/LVT/SONNEVILLE BOOTED BLOCK NON-BALLASTED TRACKS WITH A SECOND LIFE

Swiss SBB and Pandrol Procedures

By F.A. Wingler, April 2022

Booted Rail-Support Block technology for Non-Ballasted Tracks (NBT) is of interest in India for the new Katra-Banihal Line of the USBRL Project. The railtrack goes in a seismologic fragile zone through 80 tunnels (the longest with 12.5 km, Sumber Tunnel T-49), over several concrete bridges and as well on ground with curvatures.

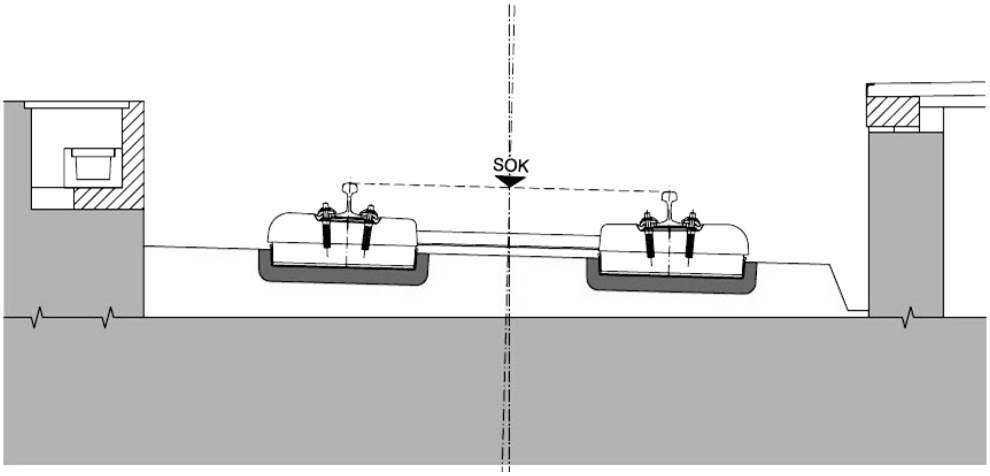
The demand has been for a system with straight and as well curved Non-Ballasted Track (NBT), which allows adjusting, repairing and retrofitting of tracks. NBT technology with rubber booted single rail support blocks fulfils those demands; far better than the monolithic Rheda 2000 NBT.



Constructing the 12.5 km Sumber Tunnel T-49 on Katra-Banihal

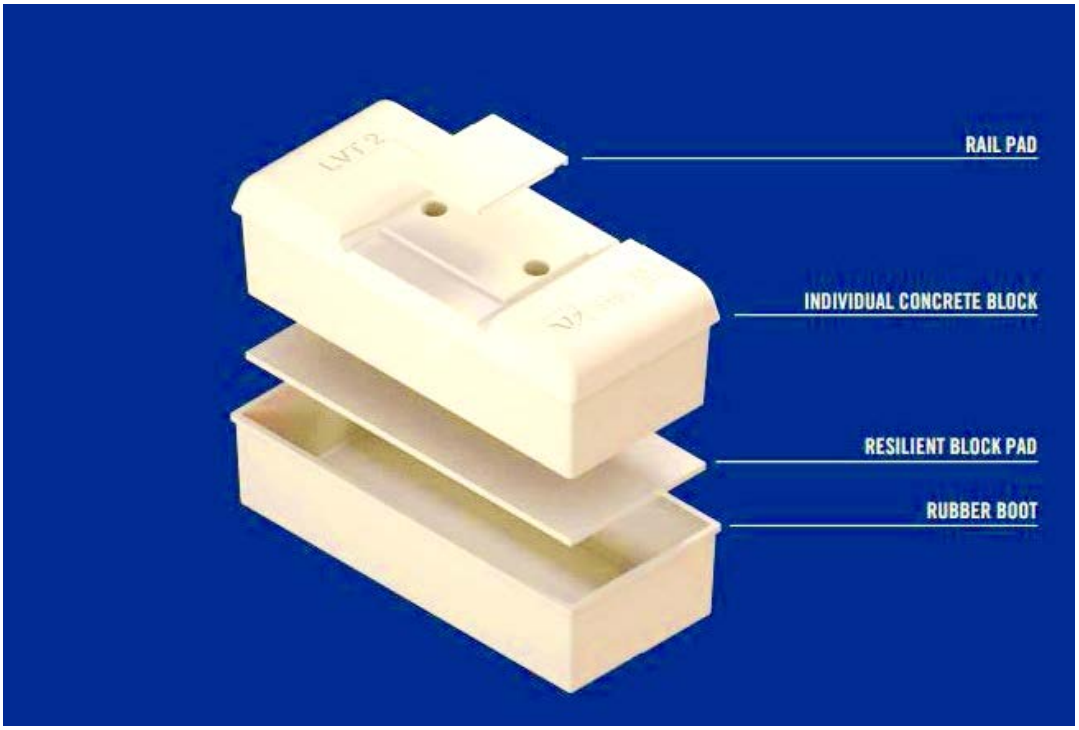
The Bözberg/STEDEF booted system consists of twin ties/sleepers, that are connected by a steel distance rod and rail support blocks enclosed in rubber shoes. All of its components

can be exchanged individually. Bözberg/STEDEF was first used by the Swiss Federal Railway in the Bözberg tunnel in 1966. In 1980 the booted block STEDEF system was installed in the Tunnel of the Zurich airport Line. STEDEF was further developed by SATEBA prior to the system's installation on the French LGV Méditeranée. The brand name of STEDEF stands now merged with Pandrol. Within Pandrol the booted block technology is being pioneered by PANDROL IBERICA, Spain, which was earlier called SUFETERA:



Cross Section of STEDEF Booted Block Non-Ballasted Track of Zurich Airport Line, 1980

The Low Vibration Track (LVT) system is similar to Bözberg/STEDEF in that it also uses sleeper support blocks enclosed in rubber shoes/boots:



LVT/SONNEVILLE Rubber Booted Sleeper Support Block for Non-Ballasted Track, NBT

However, LVT does not feature a tie distance rod. The system was developed and tested by Roger Sonneville together with the Swiss Federal Railways in the 1990s before the rights were sold to Vigier Rail in 2009. LVT has been in service in the Channel tunnel since 1994. Due to the tunnel's German name *Eurotunnel*, LVT is sometimes referred to as

“Euroblock”. LVT has been used for over 1300 km of track worldwide, including the Swiss Zimmerberg Tunnel, Weinberg Tunnel, Lötschberg, Gotthard and Ceneri base tunnels, for the South Korean high-speed Suin Line between Songdo and Incheon, for the Turkish Marmaray project and the London Overgound’s East London line, as well as on viaducts in urban areas. LVT has become the standard non-ballasted-track system in Switzerland:

LVT/Sonneville Track in Gotthard Tunnel

Railtech, France, had taken over STEDEF, France, and SUFETERA, Spain, including its booted ballast-less system. The fastening brand of the group (Railtech and Pandrol) now stands under the name Pandrol:

Pandrol Booted Block with SKL Fastening; Pict. by Patil Group, India

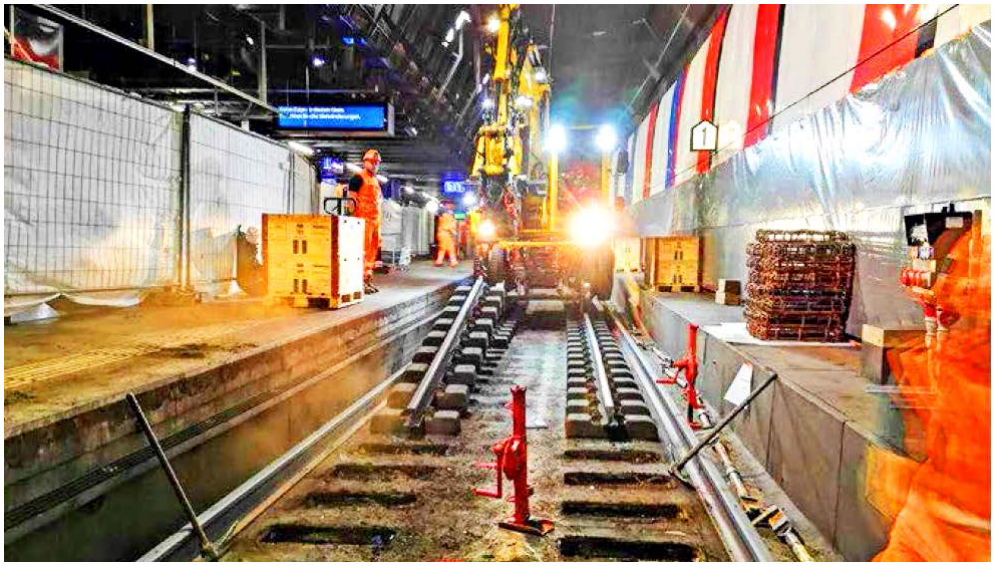
SWISS FEDERAL RAILWAY (SBB) and **PANDROL** have worked out two major methods for repair, rehabilitation and retrofitting providing booted block tracks a second life:

I. SWISS SSB Procedure with monolithic bounded Block-Bases of reduced Size and Retrofit with Vossloh DFF 304 SKL Fastening:

From DER EISENBAHNIGENIEUR, EI, 03/22, Page 7, Eurailpress

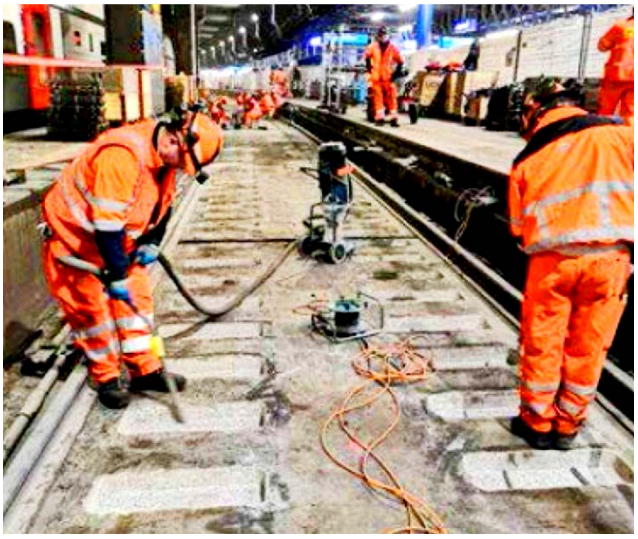
In the tunnel sections of the heavily used Swiss Zurich Airport Line of 1980 the STEDEF Low Vibration Track (LVT) had been installed. The booted support blocks developed cracks starting from the distance rods. The distance rods had been later removed. However this did not stopped the further growth of cracks. In addition the repair the geometry of the track at the platforms had to be altered.

It had been decided to remove the rails with the booted blocks:



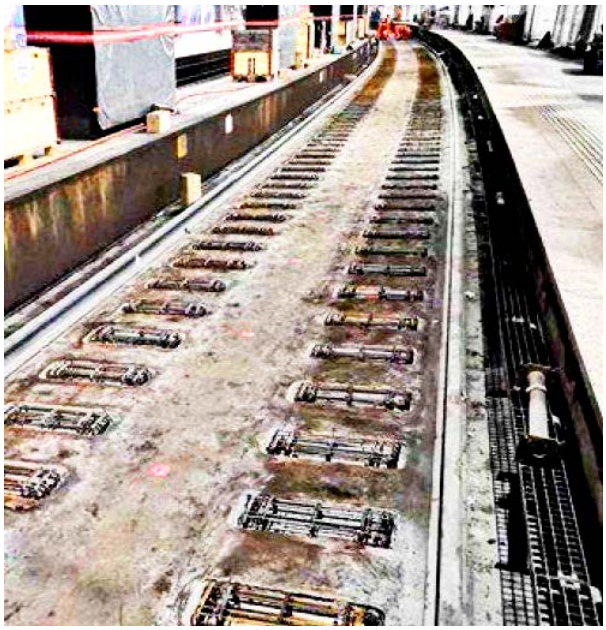
Removing the Rails with the Booted Blocks at Zurich Airport Railway Station

In the next step the cavities had been cleaned from debris and remains of the rubber boots:



Cleaning the Cavities

As next steps concrete enforcing steel mesh with the Pandrol Fastening DFF 304 had been provided and shuttering formwork placed, the rails threaded and aligned with the new geometry with temporary gadgets:



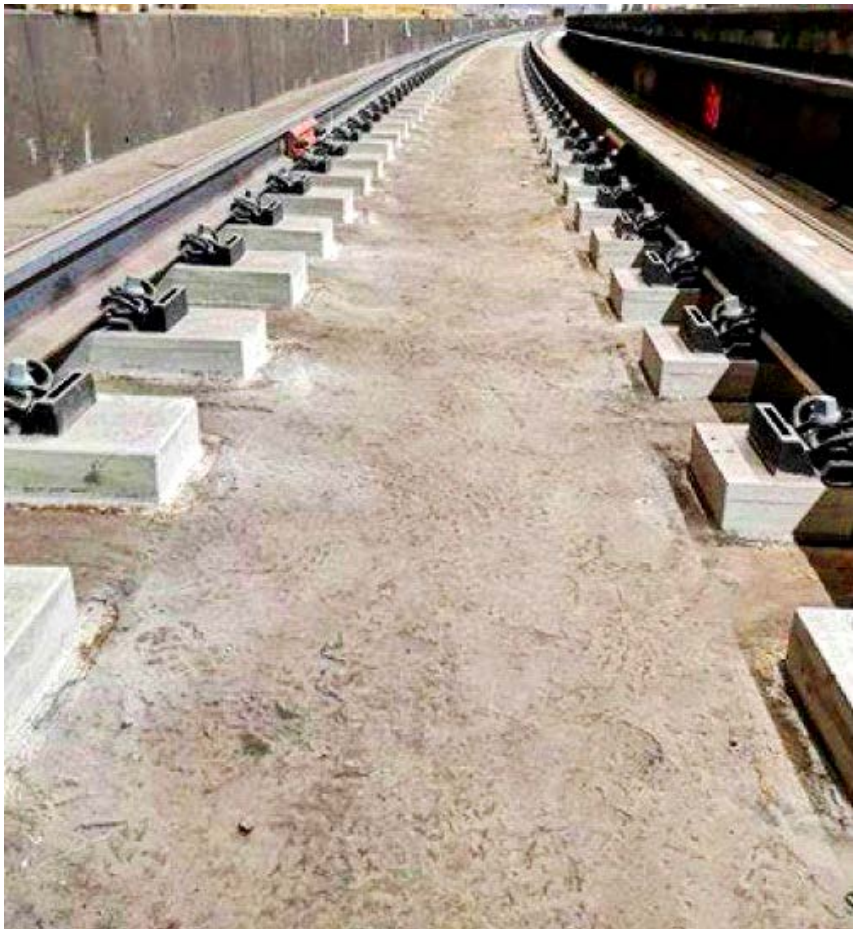
Preparing for Concreting of a new Base with aligned Rails on Pandrol DFF 304 Fastening

Vossloh DFF 304 Single Rail Support with SKl 21 Tension Clamps

The now missing elasticity component of the rubber boots is now provided by the Fastening System. The highly elastic fastening DFF 304 had been developed by Pandrol for the single support points on slab track systems. A highly elastic 5 lastomers-intermediate plate made of CELLENTIC (microcellular EPDM rubber) is used in order to achieve the result of the high elasticity.

For concreting the thus prepared base, a Ultra High Performance Quartz and Fibre reinforced Concrete Composite (UHFB) was casted/poured from an on-track funnel dosing unit. Now the track is ready for a second service life of at least 40 years:

Casting the Ultra High Performance Mortar Composite



NBT ready for a second Service Life

II. PANDROL Procedure with casted Non-Booted new Support Blocks with Pandrol VIPA DFC Fast Clips:

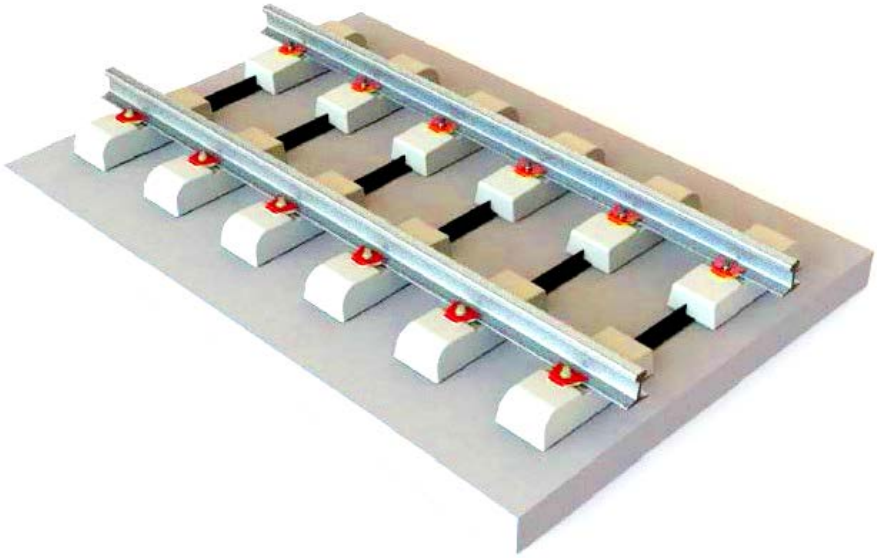
The **Pandrol VIPA DFC** is a base-plate system with Fast-Clip, and it has been designed with pre-cast applications in mind. This has allowed the engineers to design the system economically using long-proven embedded cast shoulder technology to transfer the lateral loading into the pre-cast element. Applications are on light rail, metro, high-speed and other non-ballasted tracks.

The Pandrol VIPA range of products uses 2 layers of resilience pads to provide attenuation of vibrations, a first layer of resilience pad under the base-plate and a second layer under the rail.

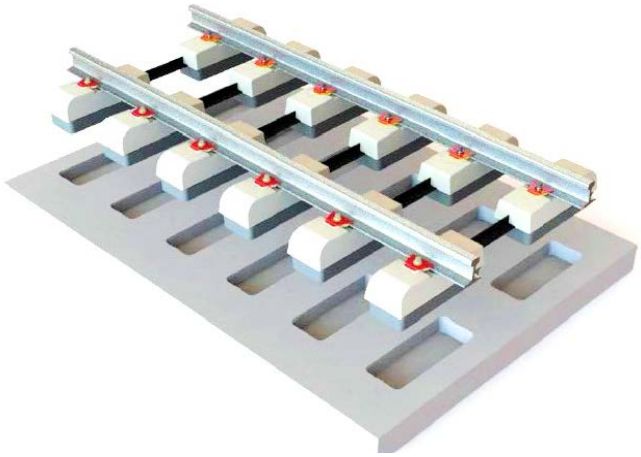
The system is an adjustable indirect base-plate type, ideally suited for installation on pre-cast blocks, sleepers or slabs, but can also be installed using the wet-pour top-down methods like Rheda 2000.

1. Cllip and Toe Insulator, 2. Baseplate, 4. Rail Pad, 5. Baseplate Pad, 6. Field-side Clamp, 7. Cast-in Field Side Shoulder, 8. Plastic Dowel surrounding bolded Gauge Side Fixture, 9. GS Clamp (not shown).

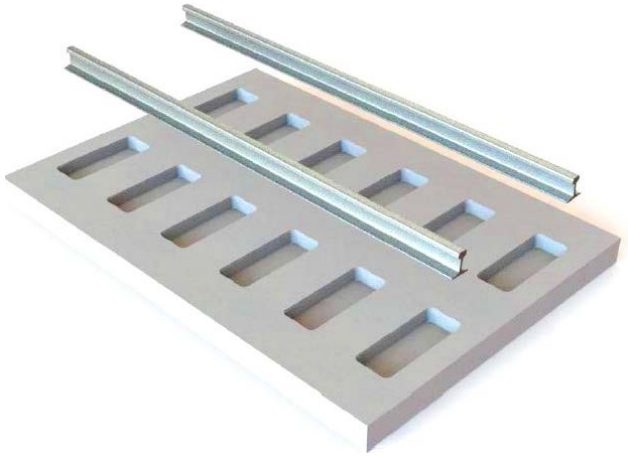
PANDROL has developed a construction procedure to retrofit elder STEDEF Booted Block NBT systems with VIPA DFC on new non-booted blocks of reduced size in the old pockets, replacing the old booted sleeper-blocks. In the new retrofit-system, the required resilience is provided above two individual blocks by the fastening, rather than through a direct replacement for the boots, that surround and support each end of the old twin-block sleepers. This puts the resilient elements where they are easier to inspect and maintain. The new individual blocks are smaller and easier to handle and can be rigidly grouted into pockets. This method had been used to refurbish and retrofit the Line 5 Metro of Barcelona, Spain; the lifetime of the old booted system had come to its end. The procedure is illustrated stepwise by the following picture sequence (source: Pandrol-Rahee Technologies, India; "***Pandrol makes light work of Line 5 for Barcelona Metro***" https://www.pandrol.com>line-5... and Pandrol Report 2018.



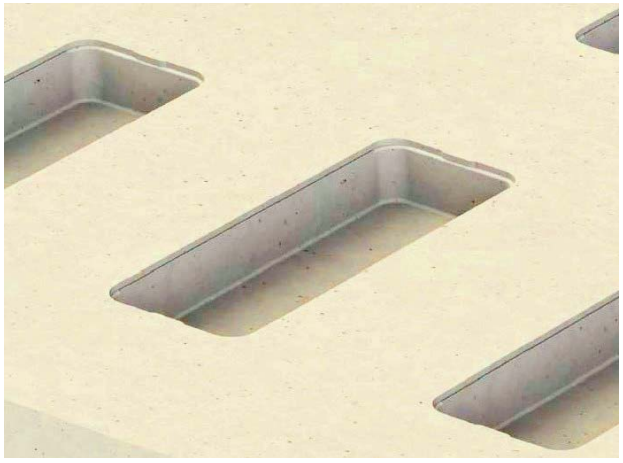
Sketch of STEDEF Booted Block NBT



Removing the Rails together with the Blocks



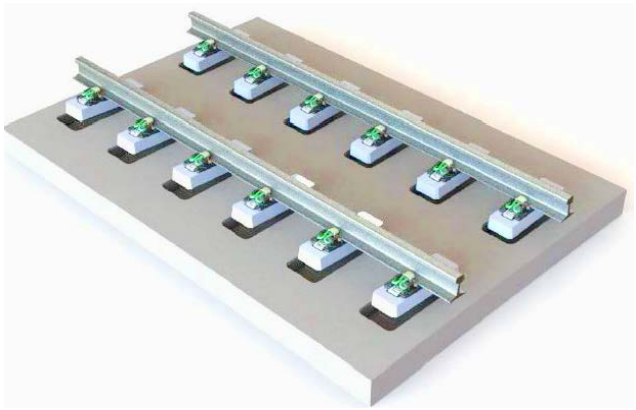
Removing the Blocks from the Rails



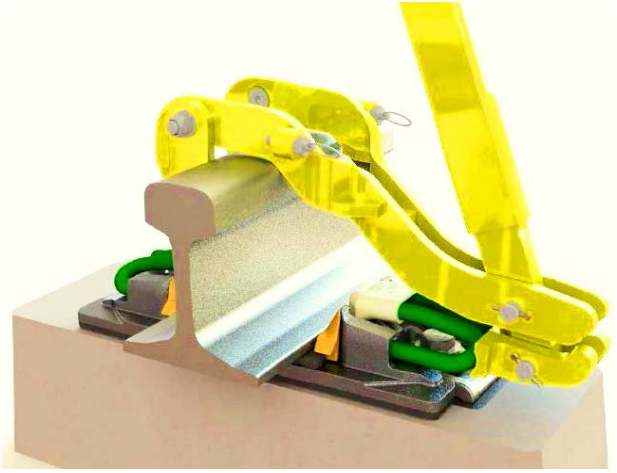
Cleaning the Pockets and preparing the Surface for Adhesion with the new Mortar

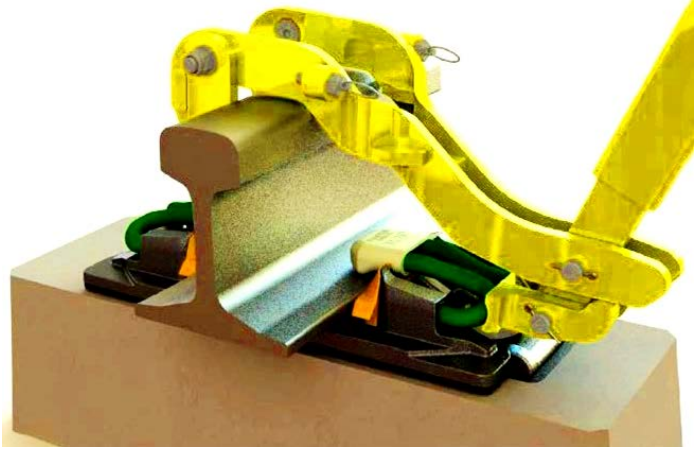
Placing of Wood in the Cavities and the new Blocks of reduced Size with VIPA DFC and Rails (Line 5 Metro Barcelona)

New Blocks with Pandrol Vipa DFC Fastening for Retrofit of Line 5 Metro, Barcelona, Spain

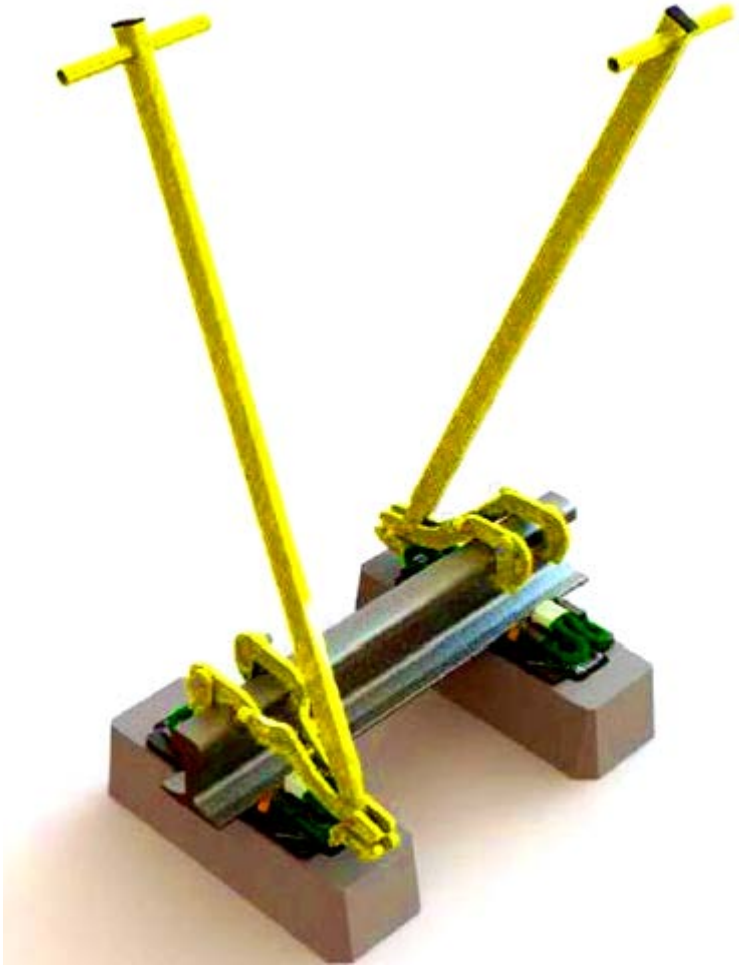


Threatening of the Rails into the Rail Seats

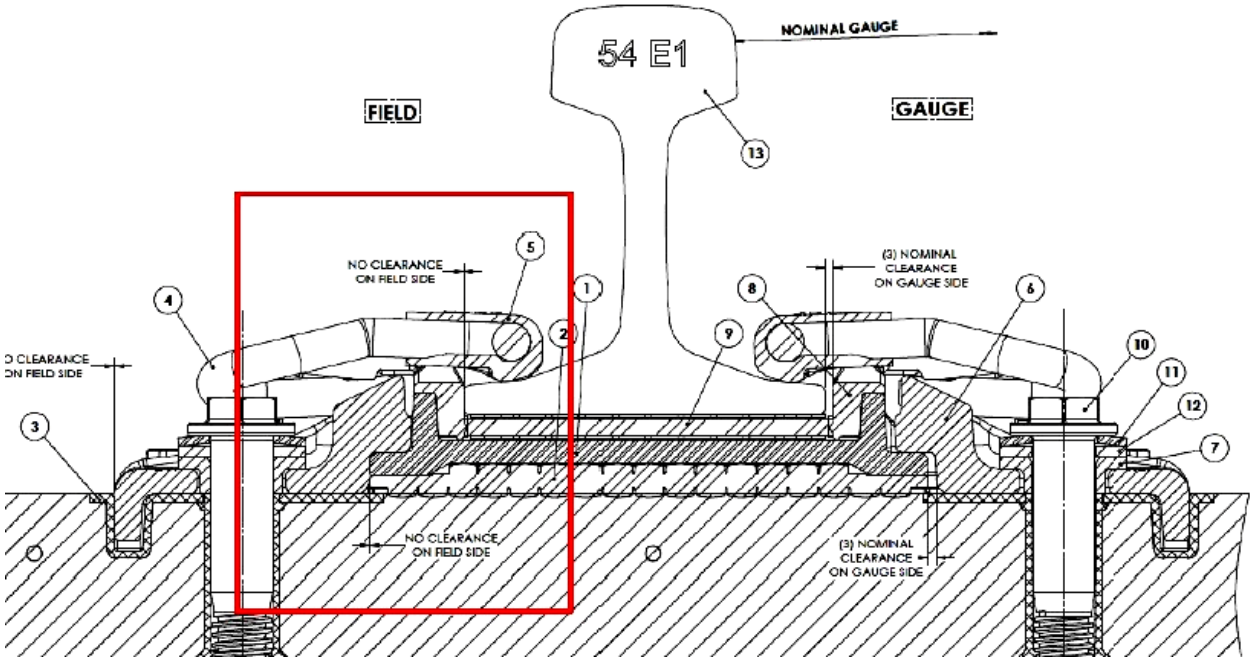




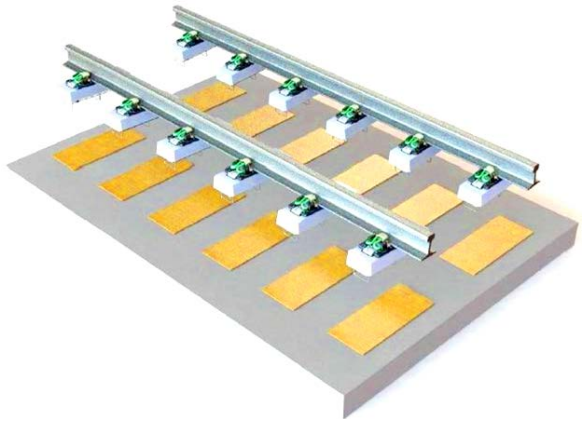
Driving the Clips with a Handtool into installed Position



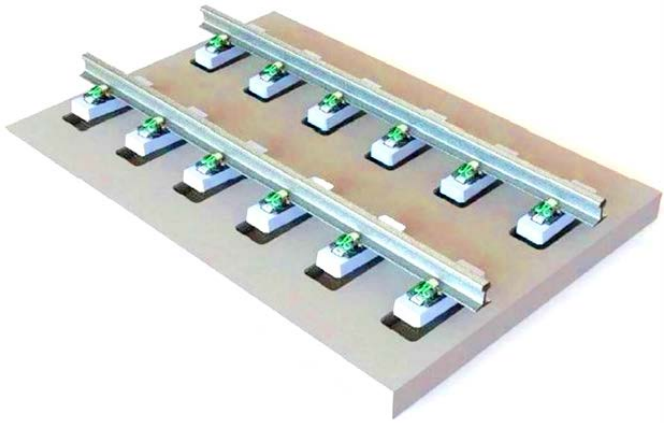
It is recommended to install the Clips in opposite Position to prevent the Rails to rotate



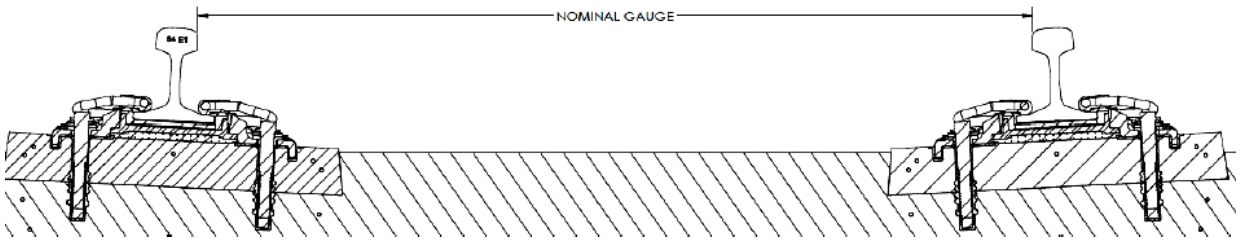
With a Track Bar or soft faced Hammer the Blocks can me manoeuvred to ensure the Rail is hard-up against the Field Side Insulators and to ensure there is no Clearance between the Baseplate and Field Side Clamp



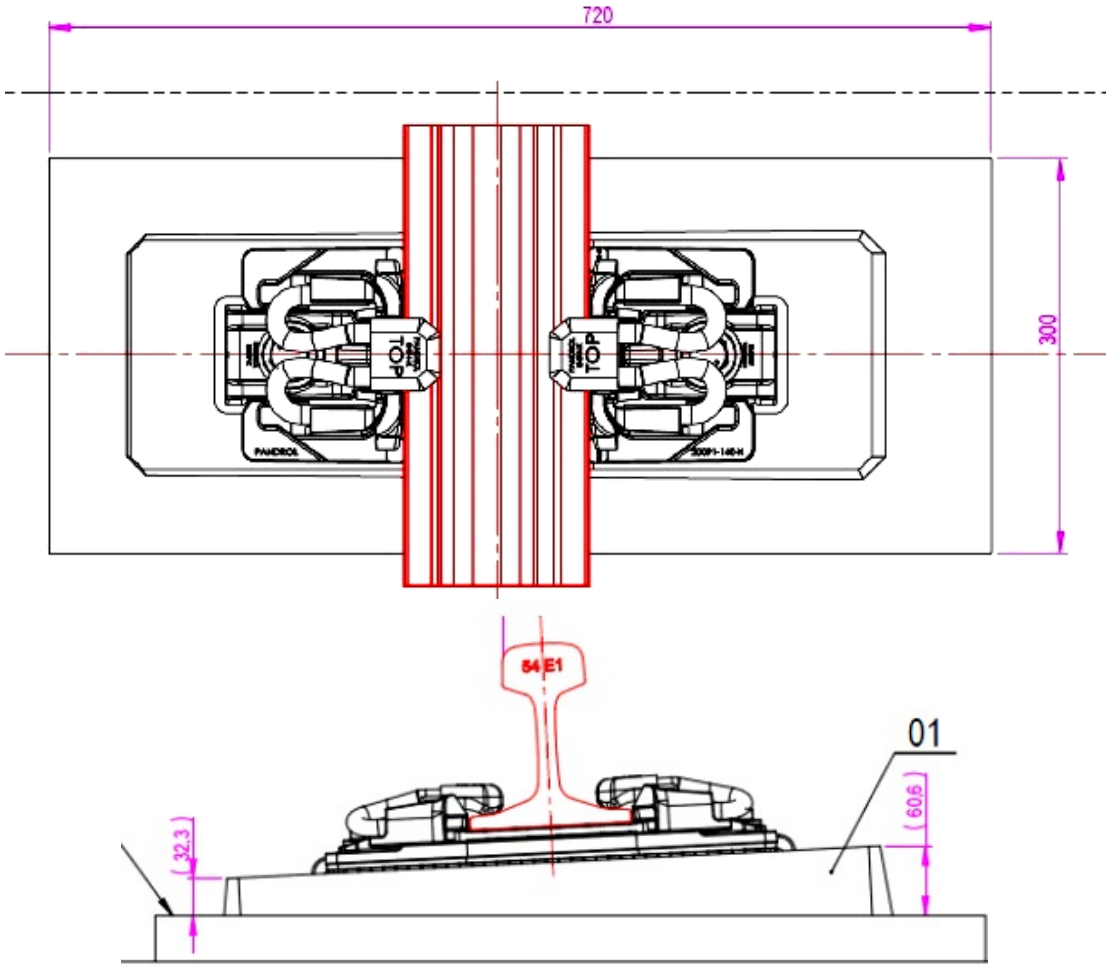
Lifting the Rails with the assembled Blocks attached from the Woos



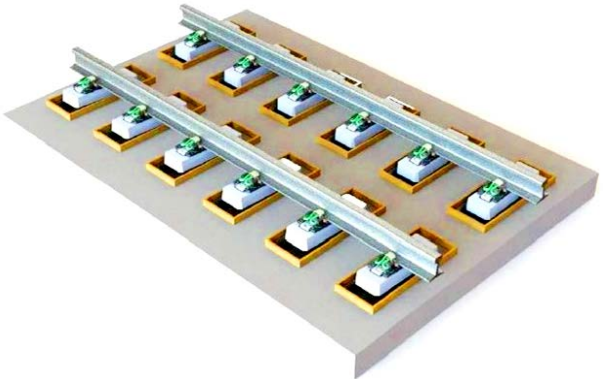
Removing the Wood and lowering the Rails ensuring the Blocks are in the Centre of the Cavities/Pockets



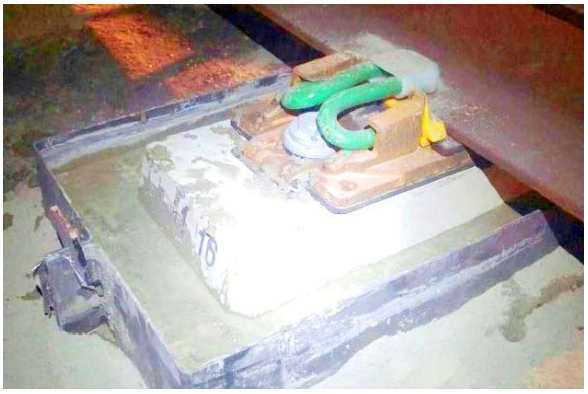
Checking and correcting Track Gauge, Alignment and Inclination of Rails and Blocks before pouring Cement Mortar



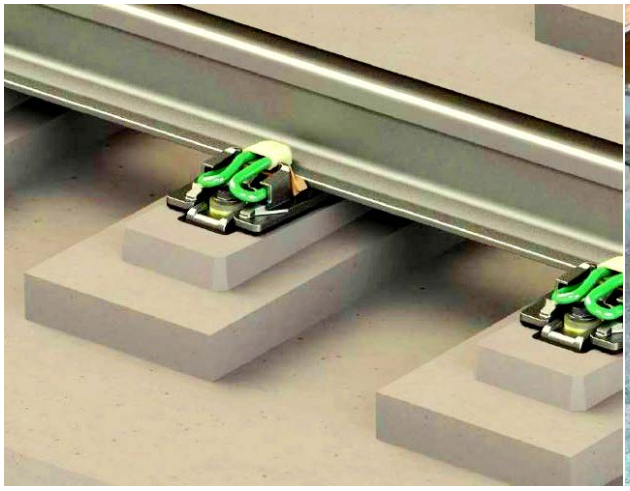
Shuttering Dimensions



Ready for Casting Concrete Mortar around the Shuttering and Block Fastening



Concrete Mortar casted in the Cavities being careful not to contaminate the Fastening Assembly with Concrete



Final Result of PANDROL Retrofit Procedure. Retrofitted Track has now a second Service Life (right: Line 5 Metro Barcelona, Spain)

Reference:

"*Pandrol makes light work of Line 5 for Barcelona Metro"* https://www.pandrol.com>line-5... and Pandrol Report 2018.

F.A. Wingler: ***QUO VADIS? COMPETITION BETWEEN BOLTED, SCREWED CLAMP & DRIVEN SELF-TENSIONING CLIP RAIL FASTENENINGS*** ; published on October 10, 2021; ***Advanced Rail Fastenings in India***; published on February 18, 2021 in http://www.drwingler.com.