

Floating Slab Track



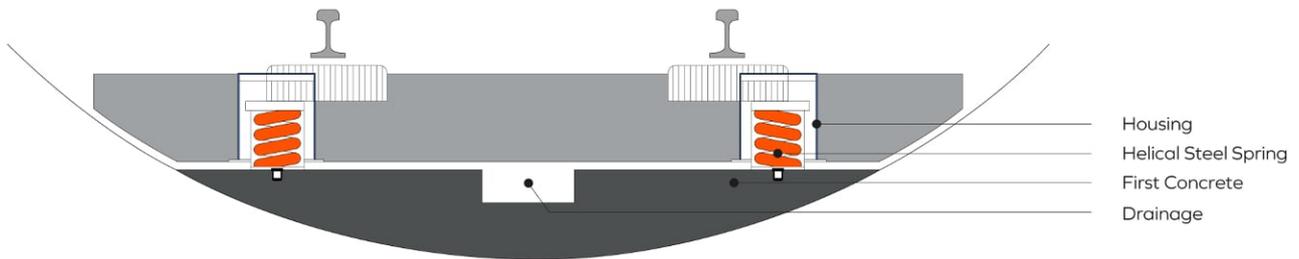
Metro
Commuter
Main Lines
High-Speed Lines

Applications

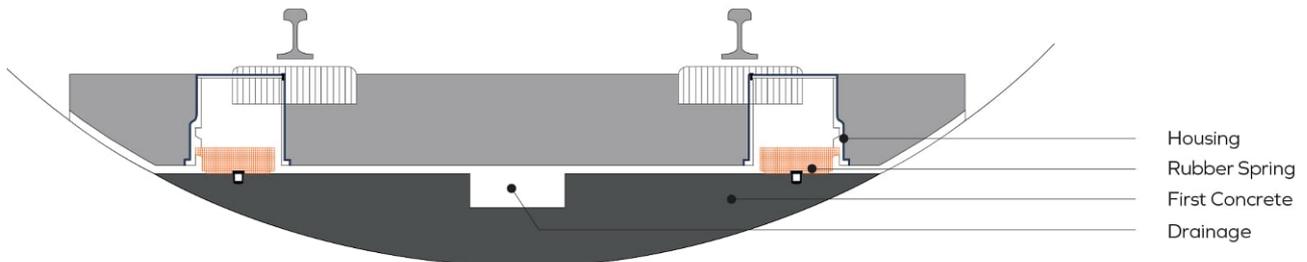
Floating Slab Track

Floating Slab Tracks, or Mass Spring Systems, are proven to provide the best vibration and noise mitigation for track systems. Mass Spring Systems (MSS) consist of floating concrete slabs with rails mounted on top. Slabs are typically constructed

of reinforced concrete. Combined with sleepers, the dead load of the rails, fasteners and ballast (if any), FST's form a dynamically active mass that is isolated from the sub-structure by means of steel springs or rubber bearings.



Floating Slab Track (FST) on Steel Springs

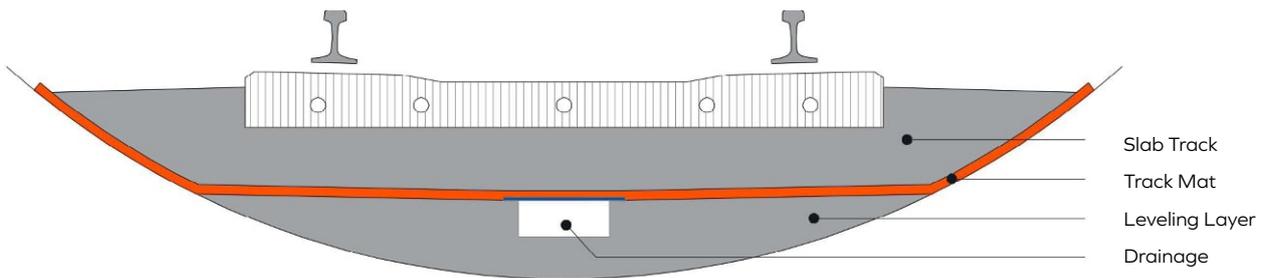


Floating Slab Track (FST) on Rubber Bearings

For optimum FST performance, Tiantie's product options include steel springs, rubber bearings and high resiliency slab track mats. Helical steel springs are integrated into the slab. Rubber bearings can either be mounted below the slab, or integrated. Depending on client specifications, FST system frequency can vary between 3 Hz and 15 Hz. High resiliency slab track mats are widely used today, at metro and light rail systems around the

world. Track mats are highly effective in applications where tunnels and/or bridges create ground-borne noise. Mats are installed on the concrete bed, and fresh concrete cast directly onto the mats. Tiantie's high resiliency track mats are the ideal solution.

Floating slab tracks can be constructed as a pre-cast system or cast at the site.



Installation of Track mat at a slab track

Technical Product Information

The floating slab springs divided into two systems: Rubber bearings and mats and helical steel springs.

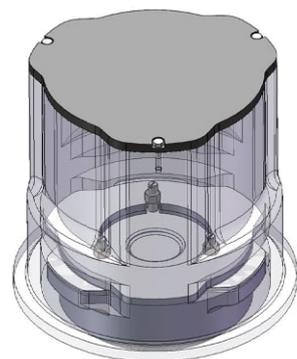
Rubber Springs | Bearings Type I,II,III:

For FST systems with rubber bearings, system frequency can vary between 7 Hz and 15 Hz.



Rubber Bearing Type I, Mounted Below The Slab Track

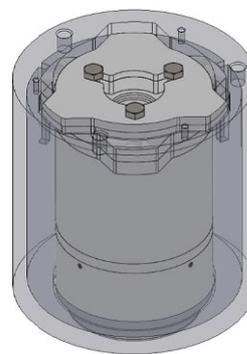
Rubber bearing Type I consist of a natural rubber disc, inside a rigid steel ring. Rubber bearing elements are positioned on the surface of the concrete base and aligned with dowel pins. For on-site height adjustments, shims can be placed at the top of the steel ring.



Rubber Bearing Type II - integrated within the Slab

Rubber bearing Type II is fully integrated in a steel housing, for permanent access from above. The shape of the steel housing ensures stable connection to the slab. Height adjustments can be made on-site, using shims.

Bearing Type III is also fully integrated in a rigid steel housing, allowing permanent access from above. To accommodate a greater range of system frequencies, these housings are designed for use with rubber bearings, or helical steel springs.



Rubber Bearing Type III - for Rubber and Steel Springs

Features and Benefits

- Highest Isolation Efficiency
- Optimum Horizontal Stiffness
- Stiffness Range: 6 kN/mm to 12 kN/mm
- Natural Rubber provides optimum Spring Characteristics
- System Frequency Range: 7 Hz - 15 Hz
- Project-specific, Customized Solutions
- Low Profile Design
- Long Service Life

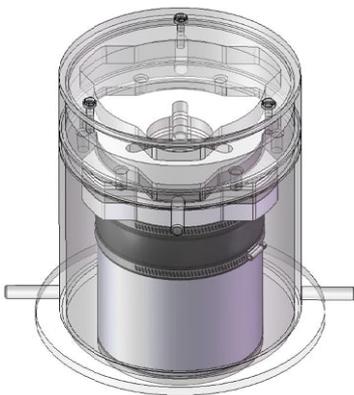
Helical Steel Springs

System frequencies for helical steel spring supported FST, range from 3 Hz to 9 Hz.

Type	Spring Rate	
	CV [kN/mm]	CH [kN/mm]
TS-FST-1.0-3600-15	5.4	6.9
TS-FST-1.1-3617-15	6.9	7.8
TS-FST-1.0-4400-24	5.3	4.5
TS-FST-1.1-4420-24	6.6	4.9
TS-FST-1.0-4400-26	4.6	3.3
TS-FST-1.1-4420-26	5.6	3.6
TS-FST-1.0-4400-32	4,0	2.3
TS-FST-1.1-4420-32	4.9	2.4

Steel Spring Elements Series

The system consists of a cylinder-shaped housing and a spring unit. The can is also fully embedded in the track slab.



Steel Spring Elements Series

Features and Benefits

- Greatest Isolation Efficiency
- Approved Specifications according to DIN EN 13906
- Steel Spring Design Prevents Stiffening
- Linear Load-deflection Curve
- System Frequency Range: 3 Hz – 9 Hz
- No lateral positioning restraints required, due to inherent spring-stiffness

- Project-specific, Customized Solutions
- Low Profile Design
- Fatigue-proved

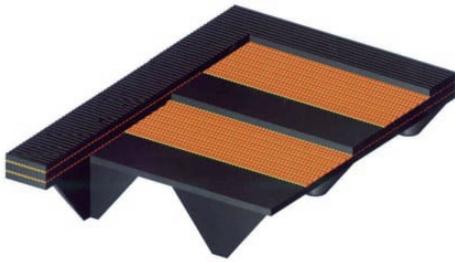
With an embedded system, the installation process starts after achieving the desired design strength. Helical steel springs and/or rubber bearings are compressed, using a hydraulic jack. For this operation, Tiantie provides a special tool. The slab is lifted, positioned in place and lowered over the steel springs/rubber bearings, to its final position elevation. After installation, slabs can be vertically adjusted with an accuracy of ± 1 mm.

High-resiliency Natural Rubber Mats

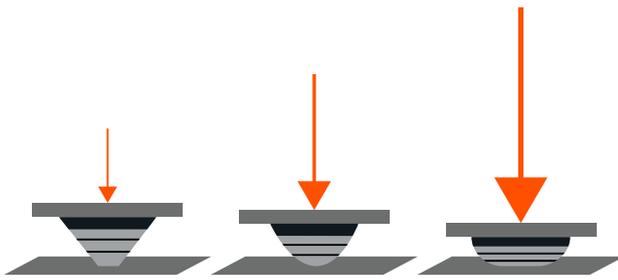
Flat sheet high-resiliency track mats, or USM-series studded mats, are used to provide elastic support for slabs. FST systems supported by high-resiliency track mats have a frequency range from 15 Hz to 30 Hz.

USM-Series track mats feature truncated cones, or cylindrical shaped spring elements on the mat underside. Air spaces created by these shapes allow unrestricted sub-surface drainage in all directions.

For improved overall trackbed stability, the top surface is textured to help keep ballast material in place. This improves load distribution and protects against contaminants that may filter through ballast material over time. Reinforced fabric provides additional strength on the sub-surface. Key features of Tiantie's USM-series profiled track mats include their ability to maintain a constant system frequency and isolation efficiency, regardless of traffic load.



Profiled Sheet (conical stud)



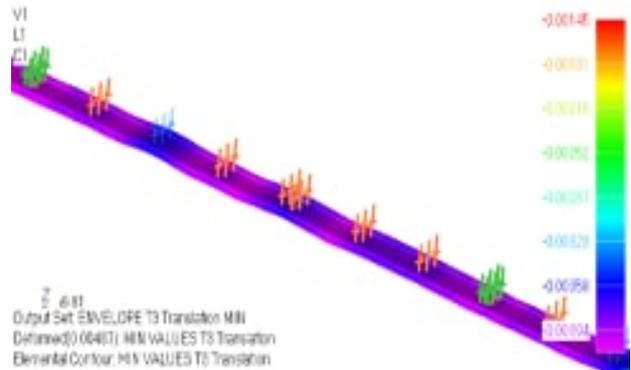
Deflection of conical studs under loading

Mat Type	Width (mm)	Thickness (mm)	Static Bedding modulus (N/mm ³)
USM 1000	1550	30	0.019
USM 1000W	1550	30	0.016
USM 2020	1550	27	0.02
USM 2025	1550	27	0.025
USM 2030	1550	27	0.030
USM 3000	1550	27	0.041
USM 3060	1550	27	0.06
USM 3080	1550	27	0.08
USM 4010	1550	14	0.1
USM 4015	1550	14	0.15

USM Series: Track mats for FST application

Engineering Services

Tiantie engineers use highly specialized computer modelling to reliably predict achievable vibration reduction and optimum track dynamics, including rail deflection under various loads.



Dynamic analysis of a railway track

Tiantie offers R&D, design and calculations from concept to final design, including reinforcement and formwork design.

Static Analysis

- Dead Load
- Live Load, W1 to W4
- Dynamic Load Factor
- Seismic Analysis
- Reinforcement
- Shear dowels

Dynamic Analysis

- System Frequency
- Bending Frequency
- Transfer Mobility
- Noise Radiation

Features and Benefits

- Profiled Sheet Technology from Germany
- Enhanced acoustical performance
- Dynamic stiffening only $c_{dyn}/c_{stat}=1.4$
- Reduces degradation of ballast by more than 50%
- Reduces stress on structures
- Provides bridge deck and waterproofing protection
- Reduces maintenance costs

In addition to engineering, design and production of high-tech steel and rubber components for FST applications, Tiantie also offers expert installation and supervision services.

Highly qualified and experienced engineers are available for installation and commissioning of all Tiantie products, including on-site performance monitoring and final system adjustments. Installation reports detailing “as-built” characteristics can also be provided.



Product Testing

Innovation and product development are the essence of Tiantie's corporate philosophy. Engineering experts actively participate in national and international committees and are working in close collaboration with universities, consulting firms and customers.

Product and performance testing is carried out at our in-house test lab. This allows for fast turn-around and quick response to customers. To keep pace with technical requirements and latest industry trends and innovations, Tiantie's lab and test facilities are continuously expanded with new equipment and processes.



Production

Wholly-owned Zhejiang Tiantie production plants are large-scale manufacturing facilities. State-of-the-art production equipment and processes ensure highest

quality products that meet customer needs, on-time delivery, as well as regulatory requirements for the protection of the environment.



Production Lines



Quality Control

Global markets require compliance with a variety of different standards. Tiantie's Quality Management System ensures that product and process standards are consistent and in compliance and documented in accordance with standards. Test reports, certifications and customer testimonials are

available on request.

Building on continuous product improvement, Tiantie engineers collaborate with technical institutes and design consultants, to conduct product performance assessments, on an ongoing basis.



Environmental Management System according to ISO 14001



Quality Management System according to ISO 9001



Occupational Health and Safety System according to ISO 45001

References

Covering a distance of over 510 km, Tiantie FST has been successfully installed at high-speed lines, main lines, commuter and metro lines.



Precast FST on Mats



FST on Steel Spring: Kunming



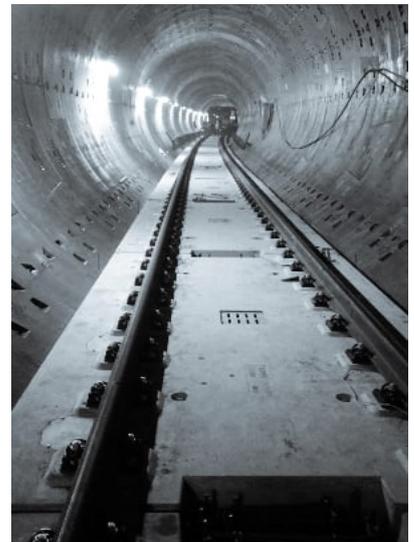
FST on Track Mats: Hangzhou Metro Line 1



FST on Rubber Bearings: Shenzhen Metro Line 6



FST on Rubber Bearings: Ningbo Fenghua Line



FST on Rubber Bearings: Wuhan Metro

Tiantie FST - Selected Projects

FST on Steel Springs

Type	City	Design speed (km/h)	Axle Load (t)	System Frequency (Hz)	Length (m)
Metro	Kunming	100	14	9	2500
Metro	Kunming	100	14	9	1000
Metro	Luoyang	100	14	9	2206
Metro	Zhengzhou	100	14	9	2571
Metro	Luoyang	100	14	9	1325

FST on Rubber Bearings

Type	City	Design speed (km/h)	Axle Load (t)	System Frequency (Hz)	Length (m)
Metro	Chengdu	80	16	10	1280
Metro	Ningbo	80	14	13	2331
Metro	Shenzhen	100	16	17	8500
Metro	Shenzhen	100	16	17	5300
Metro	Ningbo	80	14	13	7000

FST on Track Mats

Type	City	Design speed (km/h)	Axle Load (t)	System Frequency (Hz)	Length (m)
Highspeed railway	Guangzhou, Shenzhen, Hong Kong	350	17	16-25	21800
Metro	Hangzhou	80	14	14	21711
Metro	Fuzhou	80	14	16	16250
Metro	Beijing	100	14	16	25216
Metro	Wenzhou	140	17	15	14600



Corporate Offices, Tiantai Zhejiang

Company

Zhejiang Tiantie Science & Technology Co Ltd.

Founded

2003

Revenue

\$ 267 Mio. USD (Group) 2021

Employees

940 (Group)

Competences

Noise and Vibration Control, Rubber Technology

Industries

Railway, Buildings, Industry

Headquarters

Tiantai, China

Affiliates

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