
MAX BÖGL
TSB more mobility
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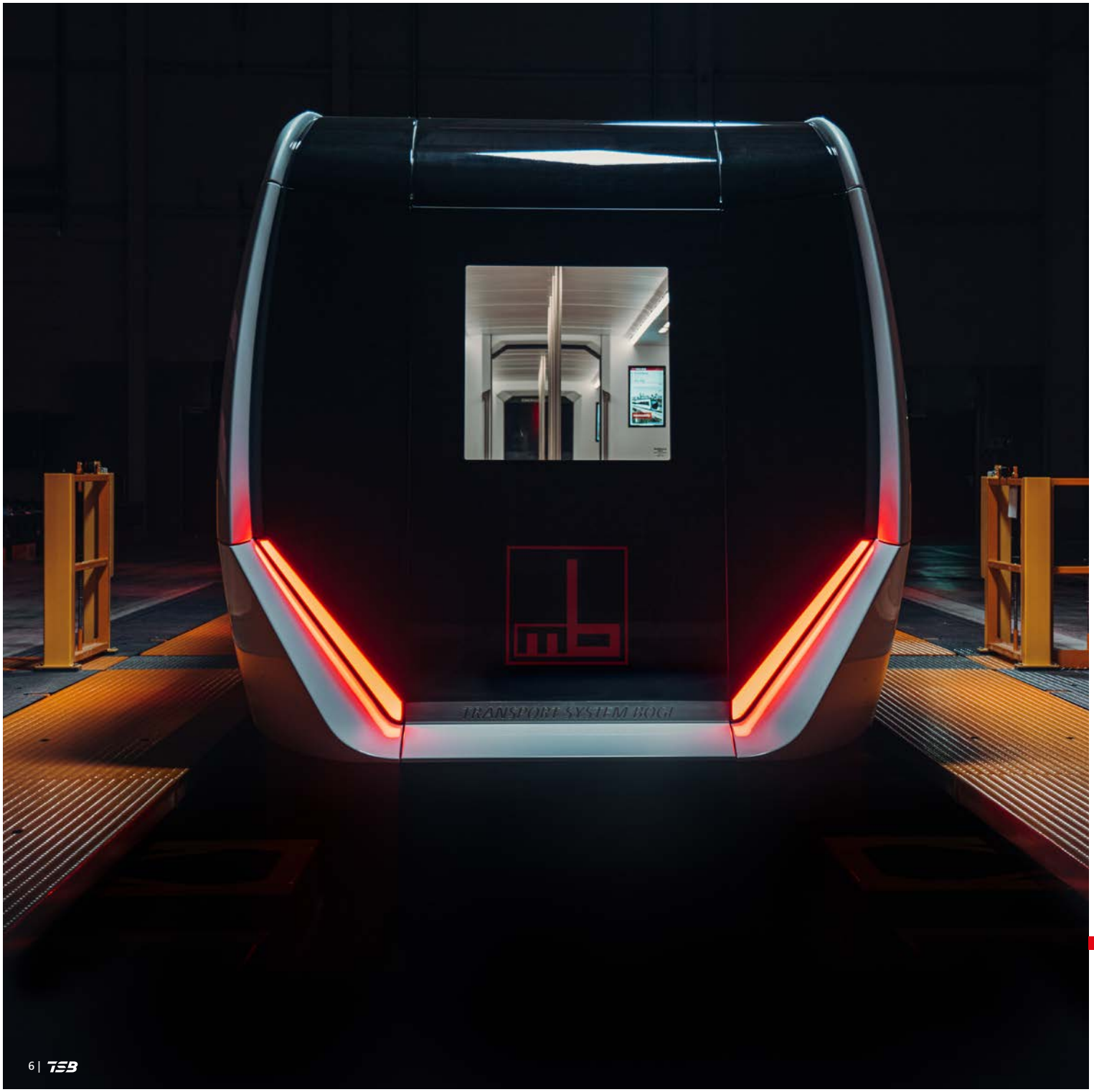
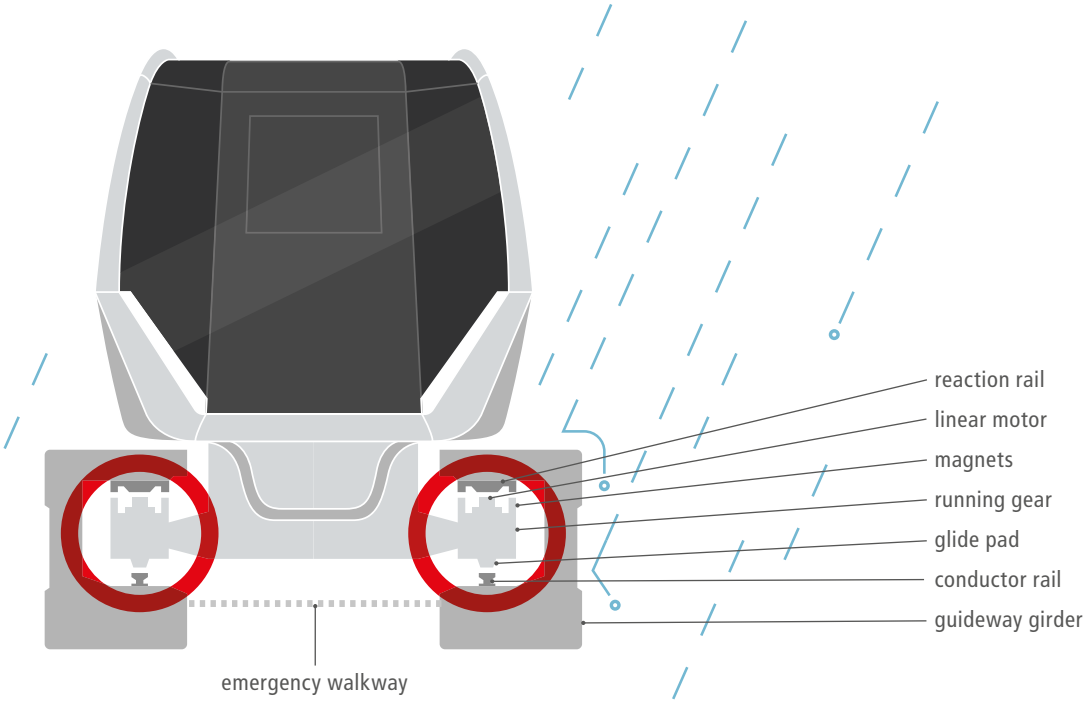
Fortschritt baut man aus Ideen.
TSB
Transport System Bögl

TSB – *Moving megacities*

Cities are growing and urbanization is accelerating throughout the world. Such growth brings with it higher building density and more traffic, noise, and air pollution. Smart public transportation concepts are therefore needed to meet the challenges of big cities and link neighborhoods together efficiently and with almost zero noise. With the Transport System Bögl (TSB), we have developed a public transportation system that is ready for the future.

Thanks to maglev technology, this system is quiet, flexible and reliable while also saving space and lowering emissions. And with variable routing, the TSB can be integrated into any urban landscape or existing traffic infrastructure. From planning and the manufacturing of tracks and vehicles to on-site assembly and system operation, we deliver an efficient turnkey system that redefines the future of mobility.

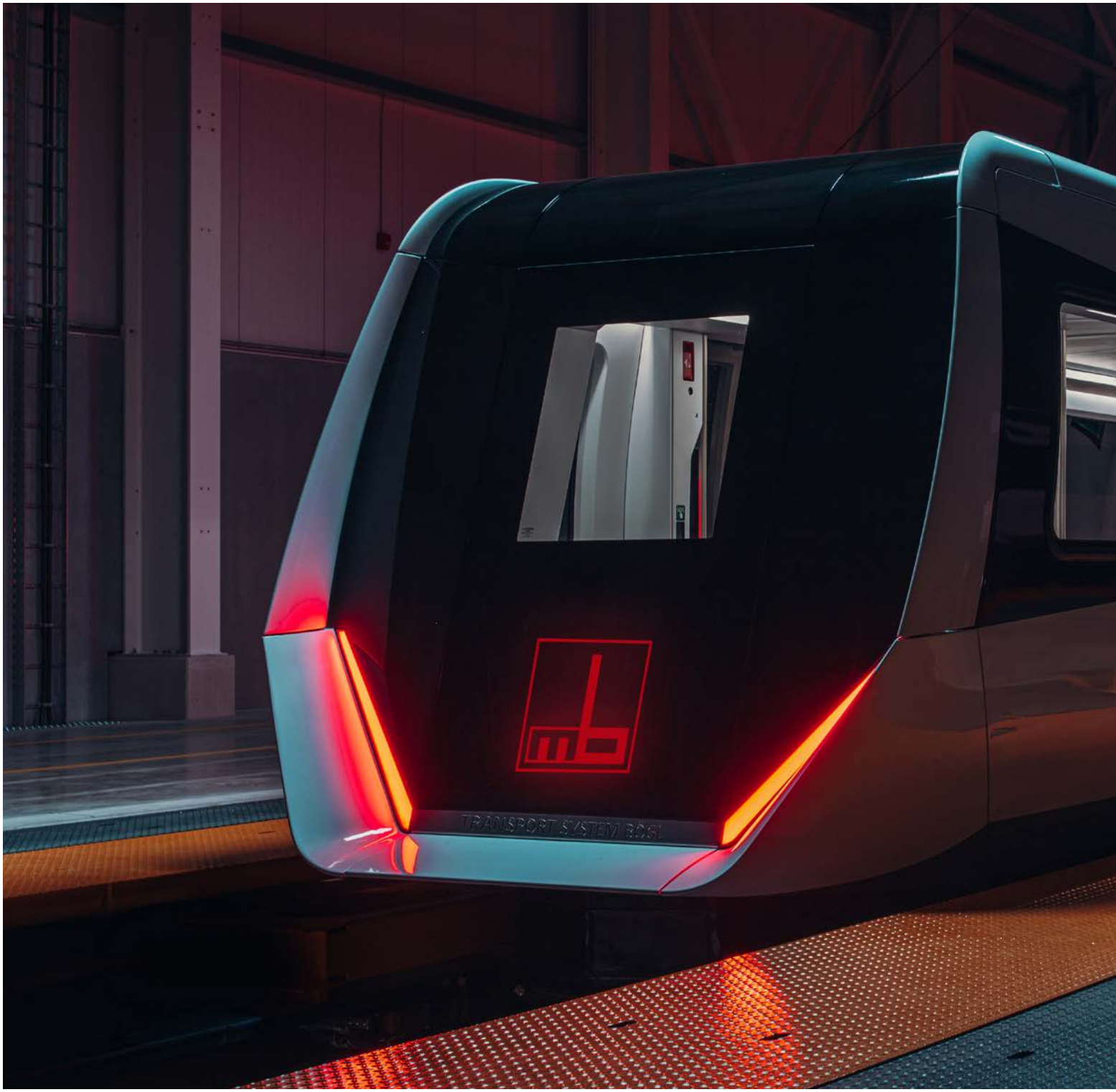

TRANSPORT SYSTEM BOGI

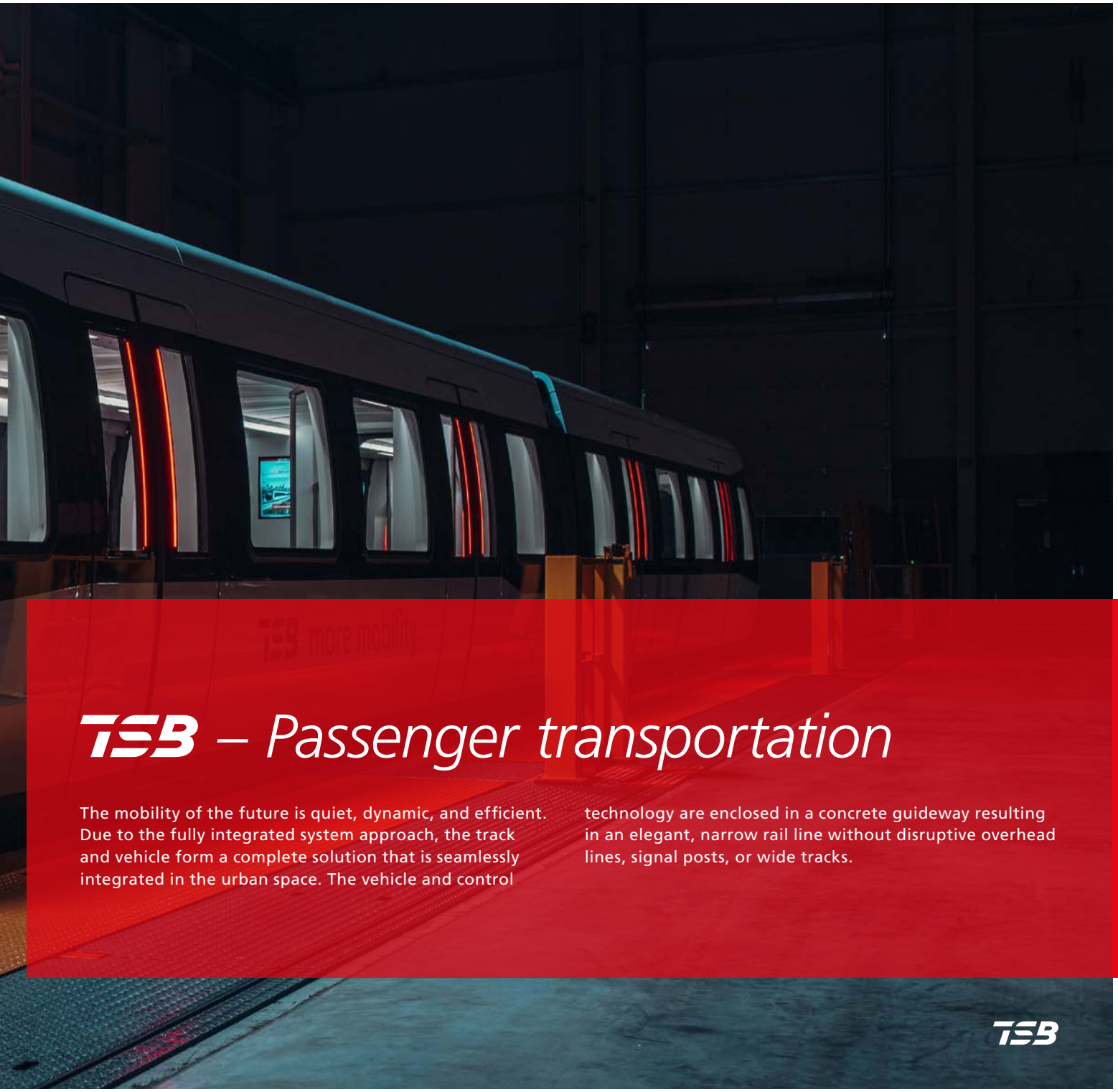


The system

The TSB relies on an electromagnetic levitation system that levitates the vehicle. Electromagnets with combined carrying and guiding functions are integrated in the vehicle that use the reaction rails installed in the track. This allows the vehicle to maintain a constant air gap of 7 mm between an electromagnet and reaction rail. To keep the air gap as precise as possible, the TSB relies on an intelligent control system that processes real-time data from gap sensors and readjusts the electromagnetic levitation system in real time.

For propulsion, the TSB uses an asynchronous short stator linear motor. Whereas conventional electric motors generate a rotary field, a linear motor produces a traveling field that drives the vehicle contactlessly. For the power supply, conductor rails are used that supply the vehicle with energy. The conductor rails are installed on the floor of the guideway on both sides and also serve as sliding rails on which the vehicle settles when the levitation system is turned off.


TRANSPORT SYSTEM BOGL



TSB – *Passenger transportation*

The mobility of the future is quiet, dynamic, and efficient. Due to the fully integrated system approach, the track and vehicle form a complete solution that is seamlessly integrated in the urban space. The vehicle and control technology are enclosed in a concrete guideway resulting in an elegant, narrow rail line without disruptive overhead lines, signal posts, or wide tracks.

More tomorrow, today

Due to increasing building density, city centers, suburbs, exhibition grounds, industrial areas and airports are growing closer together. The consequence of this is that more people want to travel reliably and flexibly in less space. Existing bus and tram systems are no longer able to meet frequency and capacity needs in many places. The TSB relies on advanced maglev technology. The magnets installed in the running allow to levitate the vehicle and at the same time ensure guidance on the track. For locomotion, a linear motor is built into the running gear that can accelerate the TSB up to 150 km/h (93 mph). A major advantage of maglev technology is the nearly silent propulsion and high reliability regardless of weather conditions. The running gear of the TSB lies protected inside the track so that movement is not impaired by snow or ice. These characteristics make the TSB a future-proof solution for constructing or expanding local transport infrastructure, especially in densely populated urban regions and surrounding areas.

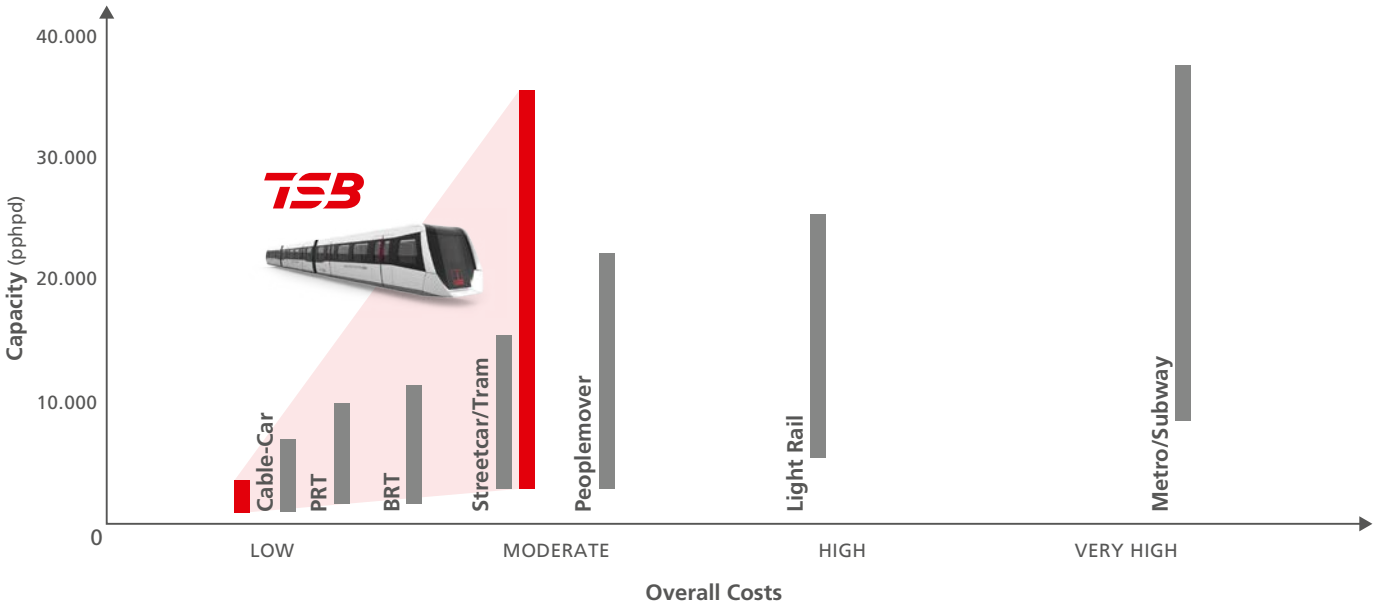
Local transport – fast and quiet

As a future-oriented maglev transportation system, the TSB is capable of fulfilling many of the needs that metropolitan areas must deal with in the future. It can bring over 35,000 people per hour per direction to their destination at an investment cost far below that of conventional subway systems.

With speeds of up to 150 km/h (93 mph), the TSB is virtually noise-free in urban areas, and their surroundings and can easily handle various passenger loads thanks to a high cycle frequency of up to 80 seconds' train headway. The track length can range from one kilometer (0.50 miles) to over 50 kilometers (30 miles).

Advantages of the TSB

- Hardly any wear on the vehicle and track
- Driverless operation (GOA4) with high timetable flexibility for optimal capacity utilization
- System at ground level, in tunnels, or elevated with up to 10% gradeability and a horizontal curve radius of 45 m (148 ft)
- Implementation as turnkey project: planning; production of track, vehicle, and operational control system; construction; operation



Design meets functionality

The exterior of the TSB vehicle is designed with a view to an optimal passenger space that can be flexibly adapted to requirements and to aerodynamics. The car body is made of lightweight aluminum. The TSB deliberately stands out from the conventional design language of trains, trolleys, and buses. It features interior components that appear to float and a novel lighting scheme that enriches the feeling of floating in silence. Modern standing and seating areas combined with vibration-free transport ensure maximum comfort. The interior spatial design sets new standards for this vehicle class.

General

- Automatic driverless passenger transportation system with asynchronous short stator linear drive
- Electromagnetic levitation system with combined carrying and guiding function
- Vehicle made up of two to six powered cars

Vehicle data per car	
Length	12 m (40 ft)
Width	2.85 m (9.35 ft)
Power distribution system	750 V DC
Unloaded weight	18.5 t
Payload	9.5 t
Max. capacity	up to 127 passengers
Headway	min. 80 s

Technical data	
Maximum operating speed	up to 150 km/h (93 mph)
Acceleration/deceleration	1.3 m/s² (0.13 g)
Maximum grade	10%
Min. horizontal curve radius	45 m (148 ft)
Max. superelevation	8°
Overall capacity	up to max. 35.000 pphpd (passengers per hour per direction)


12 m (40 ft)
12 m (40 ft)
12 m (40 ft)
12 m (40 ft)
12 m (40 ft)
12 m (40 ft)

Optimal Passenger Experience

The TSB offers passengers standing areas or comfortable seating areas depending on car variant and furnishings. The interior design emphasizes high comfort and efficient use of space.

This is aided by lighting strips whose color temperature adjusts to the available daylight. A powerful and particularly quiet air conditioning system creates a pleasant atmosphere inside the sections.

Details on interior design

- Ergonomic standing areas
- Various seating and standing areas depending on the interior configuration
- Powerful and silent air conditioning system
- Floor covered with non-slip natural rubber
- Monitors, passenger-counting devices, cameras, loudspeakers, and emergency intercoms

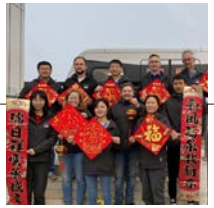
2018

Signing the licence agreement including supply of the 3.5 km long demonstration track

2019

Production of the guideway elements and a three-section vehicle

2019



Qualification of local staff for construction and operation

2019

Delivery of system components via rail and air freight

TSB – Demonstration track in Chengdu, China

A long-term licence agreement with the Chinese partner company Xinzhu Road & Bridge Machinery Co., Ltd. was concluded by Max Bögl in 2018 to ensure the successful introduction of the TSB on the Chinese market. A 3.5 km long demonstration track has been in operation in Chengdu, the capital of Sichuan Province, since the beginning of 2020. The first track section was completed just nine months after supplying the first guideway structures. The aim of the demonstration track is to convince Chinese customers of the technology and performance of the TSB and provide the evidence needed for approval in China.

The guideway structure required for the construction of the track was produced at the Group's headquarters in Sengenthal and transported by train in over 650 containers to Chengdu on the new Silk Road.

Following the overall commissioning of the demonstration track in 2020, the three-section TSB vehicle set a new record for medium-low-speed maglev trains there in February 2021 with a top speed of 169 km/h that climbed to 181 km/h in April 2024. This was another major step towards having the first operational track in China as well as in Germany.

2020

Commissioning of track nine months after construction commenced

2020

Delivery of series production vehicle

2020

Operation of a three-section vehicle on a 3.5 km long track

2024

Speed record for public transport maglev trains 181 km/h (April 2024)

TSB – Feasibility study of the German Federal Ministry for Digital and Transport

The TSB, developed by Max Bögl, was the focus of a feasibility study commissioned by the German Federal Ministry for Digital and Transport (BMDV) on the use of new public transportation technology in February 2020. To assess and evaluate the sustainable local transport system, the TSB was compared with the classic railway-based public transportation systems – trams, the underground metro system and rapid transit. In the second part of the study, the possible use of the TSB at Munich Airport was investigated as a specific use case.

At the end of 2021, the feasibility study concluded that the TSB is ideally suited as a cost-effective and quickly realisable alternative to classic railway transportation systems and is the better alternative in many applications. The low emissions due to the quiet and needs-optimised drive mode stood out in particular as advantages of the system.

Equally, the TSB can be built faster and more cost effectively than conventional systems under difficult topographical conditions and with demanding route layouts thanks to its gradeability, which is up to 10 per cent higher than other systems. In addition, the study concluded that the possible use of the TSB to develop and connect the airport infrastructure in Munich was worthwhile in order to make passenger transport routes sustainable, efficient and comfortable.

Another study by the Münchner Verkehrs- und Tarifverbund (MVV) transport network, together with the counties and the state capital, certified in 2021 that the TSB is economically viable for several extension and tangential connections of the Munich underground rail network. This means that the TSB provides a further innovative and climate-friendly mode of transport that satisfies the growing demands of public transportation systems through its ability to be implemented quickly.

Gefördert durch:

Bundesministerium
für Digitales
und Verkehr

aufgrund eines Beschlusses
des Deutschen Bundestages

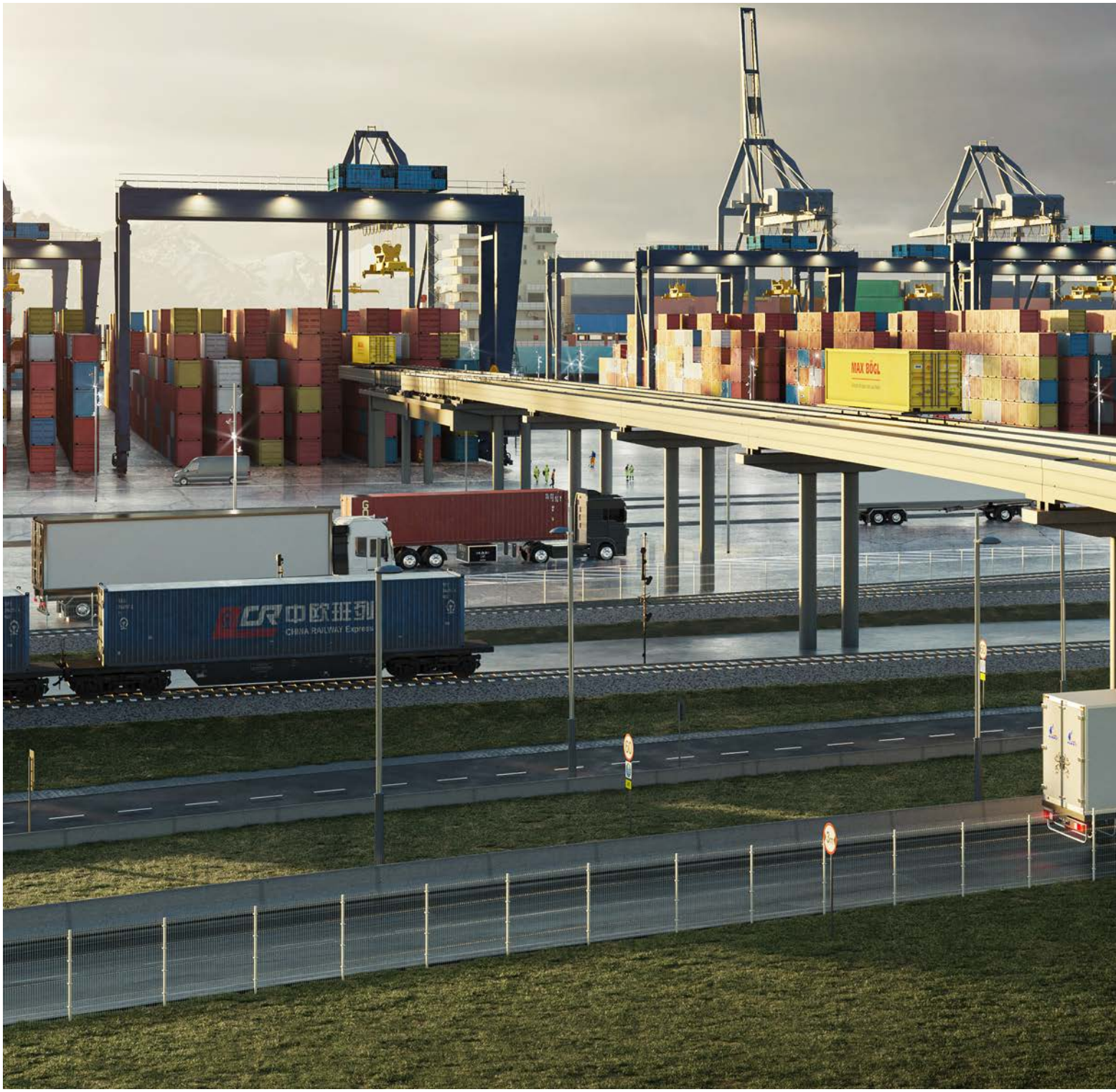
Supported by:
The Federal Ministry for
Digital and Transport
based on a resolution by
the Bundestag

Read the complete feasibility study for alternative transportation systems in railway-based public transportation systems:

https://www.bmvi.de/SharedDocs/DE/Artikel/E/magnetschwebebahn-studienergebnisse.html

Criteria	TSB	Tram	Underground train	Rapid transit train
Flexibility	✓	✓	✓	○
Capacity	✓	✗	○	✓
Energy consumption	✓	✓	✓	✓
Fine particulate emissions	✓	✓	✓	✓
Noise emissions	✓	○	✓	○
Automatability	✓	✗	✓	○
Extendability	✓	○	✗	○
Networking	○	✓	○	✓
Vehicle maintenance	○	✗	✗	✓
Infrastructure maintenance	✓	✓	✗	✗
Benefits	✓	✓	✓	✓
Vehicle costs	✗	✗	○	○
Infrastructure costs	✓	✓	✗	✗
Eligibility	○	✓	✓	✓
Legal framework	○	✓	✓	✓

✓ Positive ○ Neutral ✗ Negative


MAX BÖGL
CR 中欧班列
CHINA RAILWAY Express

TSB CARGO – *The future of goods transport*

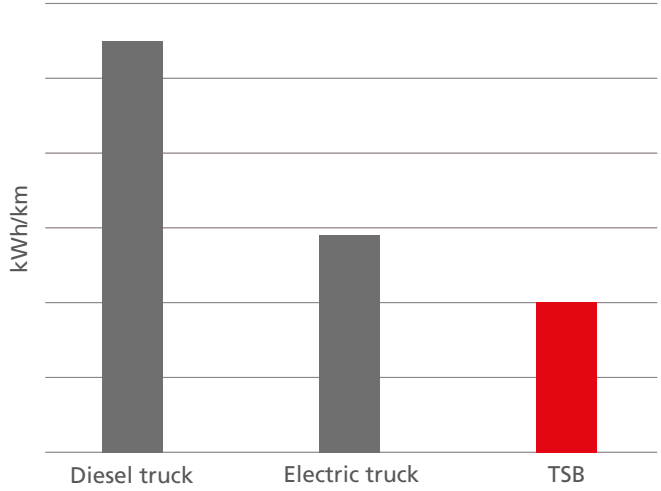
For efficient transport of goods between heavily used container hubs, port terminals and their links with surrounding distribution centres, rail transport systems can be a sustainable alternative. Thanks to cutting-edge maglev technology, the TSB Cargo offers the ideal solution. It can be used to transport individual containers independently and as required at short intervals, quickly, flexibly, and efficiently. Thanks to the low-emission transportation on a separate track, this not only relieves the pressure on the roads but also on the environment and on people living in densely populated areas. Fully automated processes guarantee high performance with the highest level of redundancy. The tracks use existing transport corridors, which means they can be integrated into densely built-up areas in a space-saving way. From planning to the industrial manufacture of the components, installation on site and the operation of the system, Max Bögl has redefined goods transport with an efficient, turnkey complete system – TSB Cargo.

TSB CARGO

Individual transport journey

Efficient handling, short cycle times: Where containers have to be distributed and transported as efficiently as possible from A to B, TSB Cargo is a high-performance, low-emission and space-saving alternative to standard goods transportation systems. With its high frequency of up to 180 containers per hour and direction, it can adapt to the usage rates, making it ideal for the demand-oriented distribution of goods. By integrating the drive unit directly into the pod structure, each container has its own means of transportation, which means that trains do not have to be formed as part of the transportation process. The frequency is based on demand at the time and, depending on the requirements, may amount to as little as 20 seconds.

Example of energy consumption in comparison



- Comparison of energy consumption using the example
- Averaged values across necessary throughput
- Charging times for electric HGVs not taken into consideration

Advantages of TSB Cargo

- Fully automated, demand-oriented transportation of individual container units
- Capacity adapted to demand
- Up to 180 containers per hour/direction
- Speeds of up to 150 km/h (93 mph)
- Almost noise-free
- CO_2-neutral transportation of goods
- Fully automated operation with high flexibility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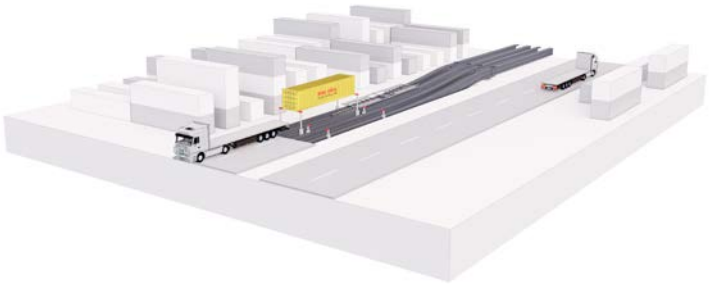
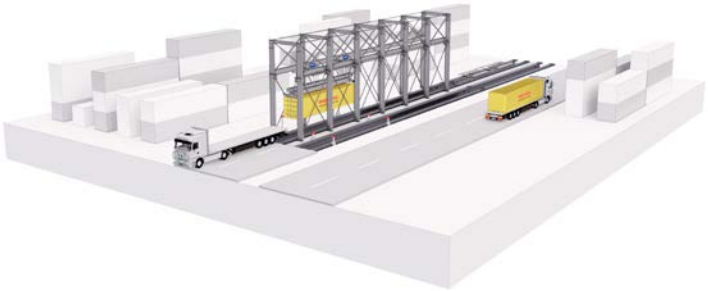
Interfaces with container hoists

As a result of the elevated guideway, TSB Cargo can be integrated flexibly and intelligently into existing infrastructure. In addition to loading using conventional hoisting and handling equipment like cranes, carriers, or forklifts, a transshipment solution specially configured for TSB Cargo makes it possible to efficiently load and unload the individual vehicles using existing hoists – without any delays to the transshipment process. As a result of the modular parallelisation of several transshipment points, the frequency of the transshipment process can be adapted perfectly to the demand-oriented frequency of the vehicles. A hydraulic system separates the interfaces between the hoist equipment and the TSB Cargo vehicles at the transshipment point. This also serves as an additional buffer, with the advantage that, throughout the entire transportation process, the vehicle does not directly depend on the hoist. Conventional transport HGVs can be unloaded directly using this system.

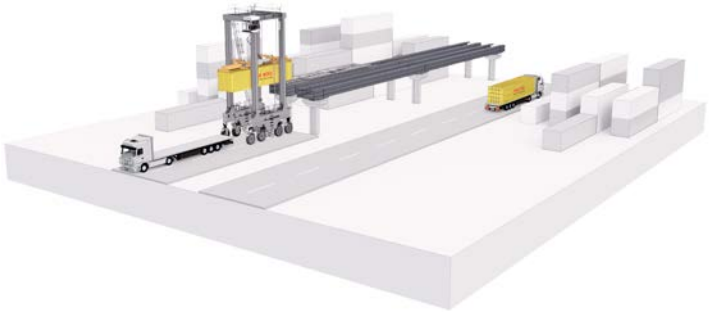


Direct transshipment HGV–TSB, ground-level



Crane transshipment HGV–TSB, ground-level

Crane transshipment HGV–TSB, elevated



Carrier transshipment HGV–TSB, elevated

TSB Cargo – Demonstration system in Hamburg

The TSB Cargo was first presented to the international community of experts at a specially created demonstration circuit under real conditions at the ITS World Congress in Hamburg at October 2021. In an area of the Cruise Center Steinwerder in the Port of Hamburg, Max Bögl demonstrated the performance and reliability of the TSB Cargo on a track measuring around 120 m – including fully automated driving, switching between tracks via points and container transfer to other transport modalities such as trucks. With the project taking four months from the planning stage to the commissioning of the demonstration circuit, the integrated planning approach and the modularised construction for the infrastructure demonstrated their advantages.

The German Federal Ministry for Digital and Transport (BMDV) funded the project to develop and test an alternative technology for reliable, environmentally friendly, sustainable and efficient freight transport. Possible fields of application are being investigated together with the Port of Hamburg in a feasibility study.

Gefördert durch:

Bundesministerium
für Digitales
und Verkehr

aufgrund eines Beschlusses
des Deutschen Bundestages

Supported by:
The Federal Ministry for
Digital and Transport
based on a resolution by
the Bundestag

TSB – Track

Imagine a transport route that not only transports people, but also redefines the skyline. The TSB is much more than just tracks. It's a vibrant element in the urban landscape. Whether floating above streets and squares or subtly integrated into existing mobility structures, the guideway flexibly adapts to any environment. New open areas are created under the elevated tracks that enhance urban life by providing green oases, bike paths, or meeting places. The TSB transforms the idea of a simple traffic route into a multifunctional lifeline for the metropolis of the future.

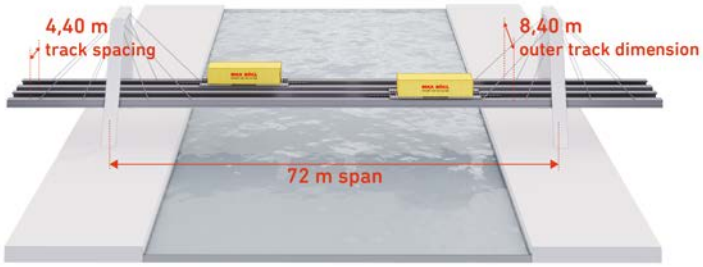
Smart integration into logistics infrastructure

TSB can be integrated flexibly into existing environments. The aesthetically pleasing guideway adapts to its surroundings and no bothersome overhead wires are needed. The guideway can be installed at ground level, below-ground or elevated. The load transmission takes place through the entire length of the vehicle, thus facilitating a slimline, cost-efficient primary supporting structure.

Max Bögl produces the guideway structures in a construction factory. As a result of its standardised length, the guideway elements fit into 40-foot containers and can be shipped all over the world from centralised manufacturing facilities. Industrial prefabrication results in short implementation times. The innovative guideway installation process also reduces the amount of space required. With the TSB, future public transport or cargo projects can be implemented in a way that is fast, resource-saving, and cost-efficient.

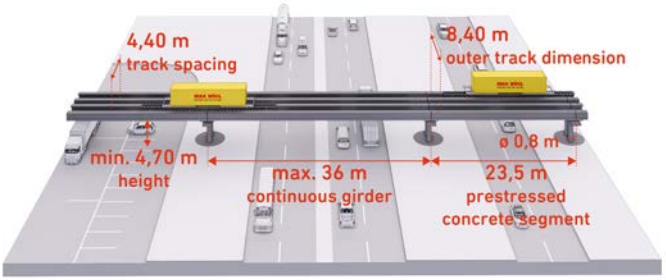
Advantages of the guideway

- Industrial manufacturing of fully equipped prefabricated parts
- Fast installation of the guideway structure
- Slimline primary supporting structure (H 1.2 m / L 23.5 m)
- Flexible usage thanks to different guideway options: elevated, ground-level or in tunnels
- No overhead power lines
- Little impact on local residents thanks to short construction times
- Ideal solution for routes measuring 1 km to over 50 km
- Implementation times of under 2 years from start of construction

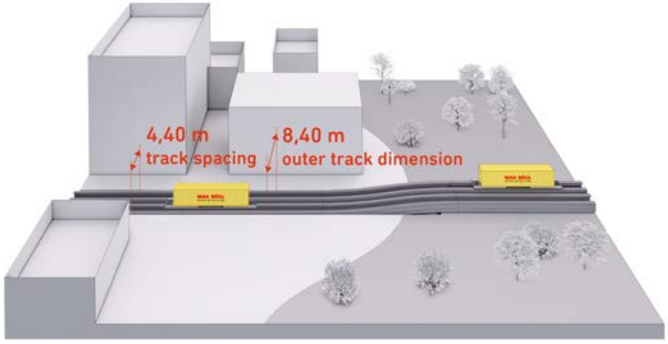


River bridge

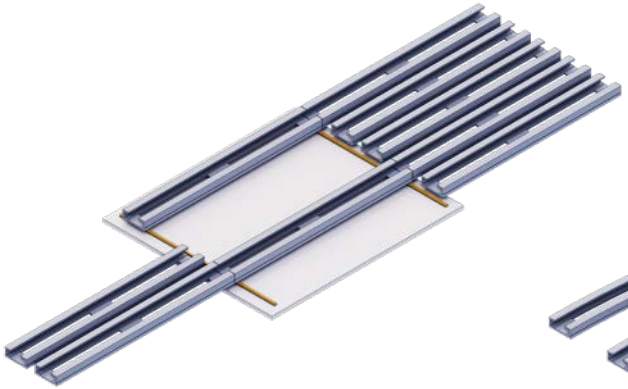
Tunnel



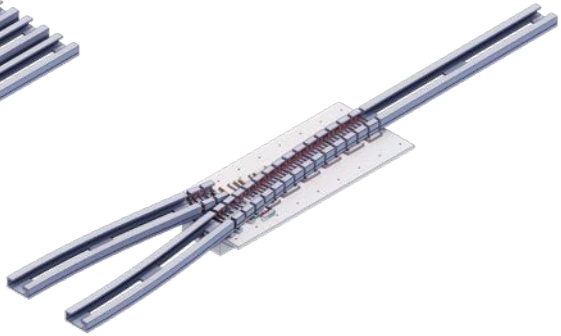
Motorway bridge



Flush

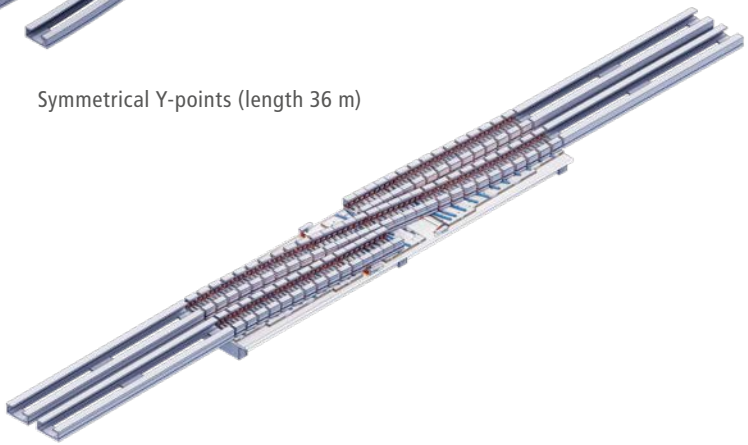


Switching points (length 25 m)



Symmetrical Y-points (length 36 m)

Asymmetrical Y-points (length 36 m)



X-points (length 48 m)

Points configuration

On heavily used transport arteries, track changes to increase capacity and reliability are unavoidable. Various points configurations ensure this high level of redundancy with TSB. The use of various points elements not only permits the flexible routing of the guideway but also the modular expansion of the route if required.

The TSB points concept was developed specifically for the TSB guideway profile. It is characterised by the fact that each pair of rails in the points can be moved using electricity, enabling the vehicle to change track quickly and efficiently. The points concepts and elements have already been tested under a wide variety of weather conditions.


TEB more mobility


Curved position


Moving process


Straight position


TEB more mobility
TEB

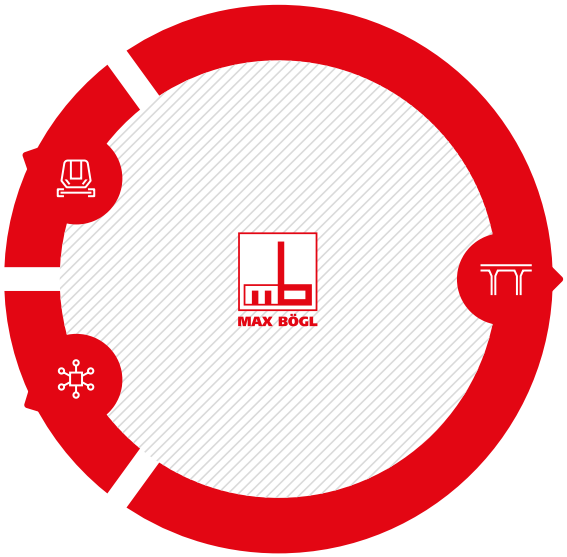
TSB – *From a single source*

Complex infrastructure projects can be very cost-effective if most of the individual work is carried out by a single source. As the full-service provider of the Transport System Bögl, we are able to implement all processes in a standardized and coordinated manner – from planning and the industrial manufacturing of guideways and vehicles to the application of structural measures and implementation of our own operational control technology. We are a professional construction company which relies on sound expertise and long-standing experience in infrastructure projects. Our engineers have been working with maglev technology since 2010.

Premium quality production and assembly

The TSB and its individual components, track, vehicle, and control technology are produced and assembled in Sengenthal. The concrete segments of the track are cast in flexible formworks and then machined with sub-millimeter precision using a CNC grinding machine. With the help of expert personnel and state-of-the-art technology, the running gear and car bodies are assembled here to form the TSB. The magnet unit – the heart of the vehicle – is also assembled during this stage of production. A smart digital storage system ensures the availability of components for each individual production step. The individual components are then loaded into standard shipping containers and delivered for use around the world. As a turnkey solution, the TSB is the most cost-effective option for public transportation. This is in large part due to its narrow and efficient track system that is serially produced yet flexibly routable.

Distribution of investment costs
in an average overall project



15 %
Vehicle

70 %
Infrastructure
(track, stations, switches)

15 %
Operational control technology

Additional services:

Execution **Planning** **Operation**


H17
MAX BÖGL
MAN
NM MB 548


龙潭
Longtan
下坝
Xiashu
高资
Gaozi
常州
Changzhou
常州东
Changzhou East
新闸镇
Xinsha Zhen
许墅关
Xushu Guan
苏州西
Suzhou West
Nanxiang Down Receiving Yard
江桥镇
Jiangqiao Zhen
Nanxiang Up Departure Yard

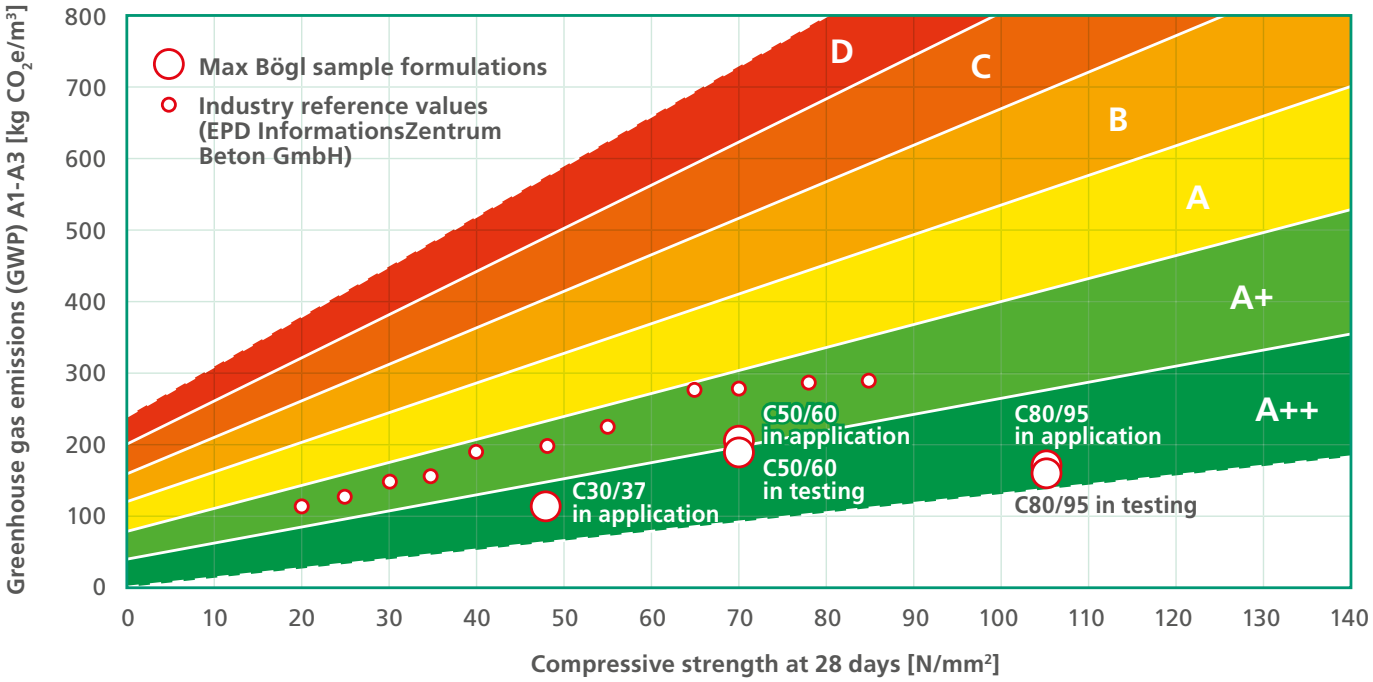
Efficient operational control technology for automatic driving

The operational control system of the TSB includes components and functions for safeguarding, monitoring, and controlling operation. It links the vehicle, guideway switch, station and power supply subsystems to form a complete system that is ready for operation and allows fully automatic operation with short train headway times. All subsystems can be completely controlled and monitored from the control center. Core functions are the safety features, which meet the highest safety integrity level (SIL 4) for railway standards, and a high-availability data transmission system. The data transmission system includes a multi-redundant fiber-optic network infrastructure on the track and a two-channel radio system covering the entire route. This means there is a continuous and redundant connection between the vehicle and the control center. Each subsystem comes with a safety controller that can automatically establish a fail-safe state in the event of a critical malfunction. The mobile vehicle safety computer is equipped with a locating system, determines the position block-independently and computes the braking distance with meter accuracy. The local safety computer at the guideway switch reports the locked switch position to the central computer. This eliminates the need for signaling on the route itself. On a technological level, this matches the highest ETCS Level 3 (European Train Control System). Besides fully automatic operation, the automation system also enables energy-efficient driving. When a vehicle brakes and feeds back its energy, the smart automation system can start a vehicle at the same time so that the braking energy is absorbed directly by the starting vehicle.


ENVIRONMENTAL CONCRTE
MAX BÖGL

Environmentally friendly concrete

Concrete has played a central role since our company was founded over 90 years ago and is firmly written into our DNA. As a technology and innovation leader for sustainable high-performance concretes, we are shaping the future of this amazing building material and thus the future of Max Bögl. Most of the greenhouse gas emissions in concrete come from the cement, which acts as a binder to hold the aggregates together. We therefore strive to keep the cement content in our concretes as low as possible and use our own cement substitutes. Various rock flours and high-quality secondary raw materials from other industries, including ground blast furnace slag from the steel industry, can be used as cement substitutes. In some areas of concrete construction, it might even be possible to achieve a 100% substitution rate. We have already produced successful prototypes.



Innovations are making history

Thanks to our own future-oriented innovations for the core issues of our time – urbanization, mobility, renewable energies, and infrastructure – we at the Max Bögl Group are implementing solutions for the megatrends of our globalized world. Based on long-standing experience and expertise in high-precision precast concrete construction, we have been able to establish ourselves as an important leader in the development of innovative products, technologies, and construction methods. With over 6,500 highly qualified employees at more than 40 locations worldwide and an annual turnover of over 2.6 billion euros, the Max Bögl Group is one of the largest construction companies in Germany. Ever since its founding in 1929, the company has been known for its innovative strength in research and technology – from tailor-made custom solutions to complete and sustainable construction engineering solutions.

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