



TSB CARGO

TSB CARGO

<i>Overburdened infrastructure</i>	<i>04</i>
Technology of the future	06
<i>TSB Cargo</i>	<i>08</i>
Advantages	10
<i>Guideway</i>	<i>12</i>
Advantages	14
Points configuration	16
Interfaces with container hoists	17
<i>Range of services</i>	<i>18</i>
Production and installation	20
Operational guidance technology	22
<i>Max Bögl</i>	
Demonstration system Hamburg	26
Environmental concrete	28
Innovations	30





Overburdened infrastructure

The constant increase in goods transport poses a huge challenge for the logistics industry. Current forecasts for 2030 predict an increase of 38% as compared with 2010. In order to counter this enormous increase in pressure, we will need innovative solutions that are low-emission, sustainable and reliable.

The seamless inflow and outflow of goods moving between domestic ports and logistics hubs is ensured by intermodal transport via inland waterways, rail and, largely, by HGV. Road transport in particular is associated with a higher environmental impact. Furthermore, continual maintenance and repairs on motorways and rail systems also have a negative impact on their performance and capacity.



Technology of the future

Since 2010, Max Bögl has been investigating maglev technology and has developed an innovative passenger transportation system, the Transport System Bögl, for efficient, quiet and flexible local transportation. The fully automatic operation of the TSB, whose linear drive technology is integrated into the fully electric vehicle and can travel at speeds of up to 150 kph, adapts flexibly to transportation requirements as they change. To date, the TSB has already successfully covered over 100,000 km in fully automatic mode and made 150,000 shuttle journeys on the company's own test track at its Sengenthal headquarters.

The system has been used on a 3.5-kilometre demonstration track in Chengdu, China, since early 2020. It was built in under two years and reaches a top speed of 169 kph in the test phase. In Germany, the TSB has also received the green light of approval from the German Federal Railway Authority. Max Bögl drew on maglev technology to develop the TSB Cargo as an adapted version of the TSB for the efficient, environmentally friendly transportation of shipping containers. In place of a passenger transportation pod, containers can be transported on a special supporting frame on the propulsion and maglev module.





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 Transport System Bögl Cargo, or TSB Cargo for short, offers the ideal solution. It can be used to transport individual containers independently and as required, quickly, flexibly and efficiently, at speeds of up to 150 kph. Thanks to the low-emission transportation on a separate track, this not only relieves the pressure on the roads but also on the environ-

ment 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.

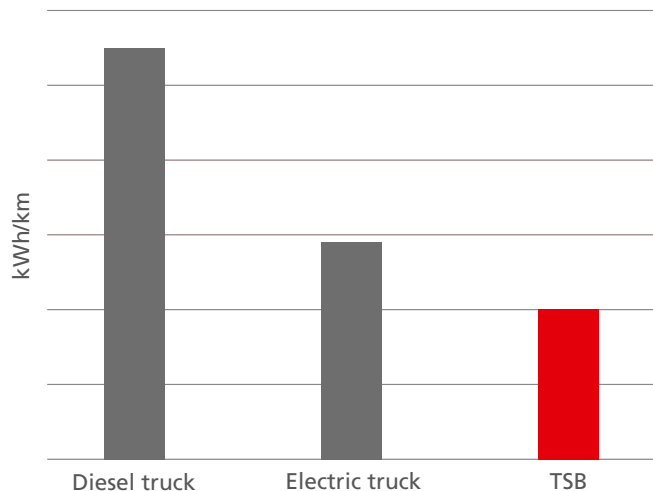
Individual transport journey

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.

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 kph
- Practically silent
- CO₂-neutral goods transport
- Fully automated operation with high flexibility

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





An aerial photograph showing a complex highway interchange. A concrete guideway structure, part of the TSB Cargo system, is integrated into the interchange, running parallel to the road lanes. The structure is elevated and has a series of support pillars. The surrounding area is green with grass and some trees. The road has white lane markings.

TSB CARGO – *Guideway*

Transport systems of the future integrate seamlessly into existing mobility structures. Above ground, ports and logistics hubs are often limited by the infrastructure serving them (roads, railways), and office buildings are required to manage operating processes and gantry crane structures. Integrating them with underground logistics structures is

associated with high costs and implementation risks. This is a challenge for the integration of new transport systems intended to master capacity bottlenecks. As a result of its flexibility, the TSB Cargo guideway is specially designed and can be integrated in its elevated form almost imperceptibly into the existing infrastructure.

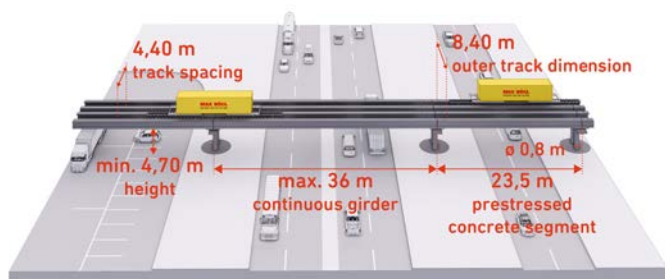
Smart integration into logistics infrastructure

TSB Cargo 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 so that it is 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.

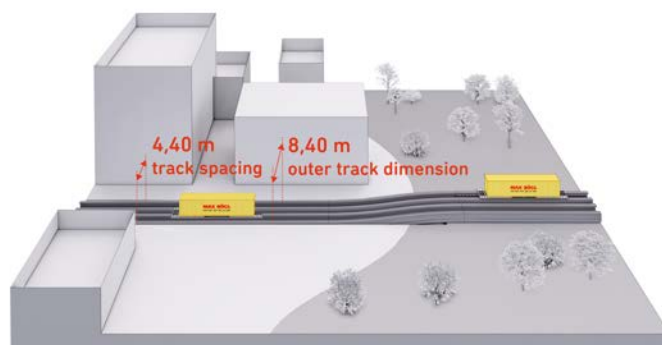
The guideway structure is industrially manufactured in the main factory in Sengenthal. As a result of its standardised length, the guideway elements fit into 40-foot containers and can be shipped all over the world from centralised manufacturing facilities. Industrial prefabrication results in short implementation times. The innovative guideway installation process also reduces the amount of space required. Future projects can be realised quickly, efficiently and economically with TSB Cargo.

Advantages of the guideway

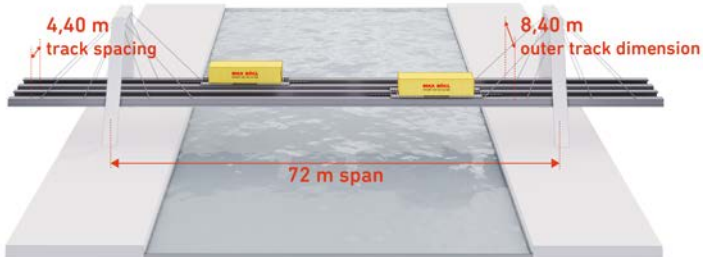
- Industrial manufacturing of fully equipped prefabricated parts
- Fast installation of the guideway structure
- Slimline primary supporting structure (H 1.2 m / L 23.5 m)
- Flexible usage thanks to different guideway options: elevated, ground-level or in tunnels
- No overhead power lines
- Little impact 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



Motorway bridge



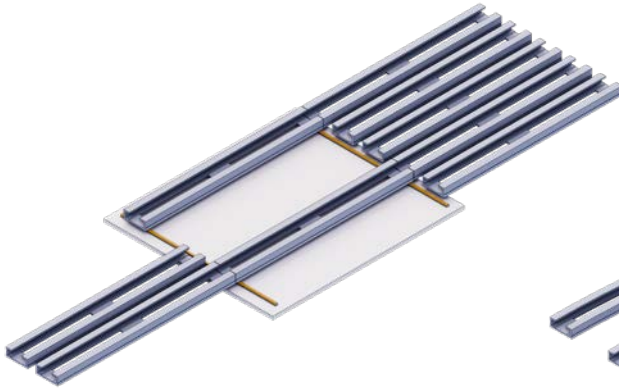
Flush



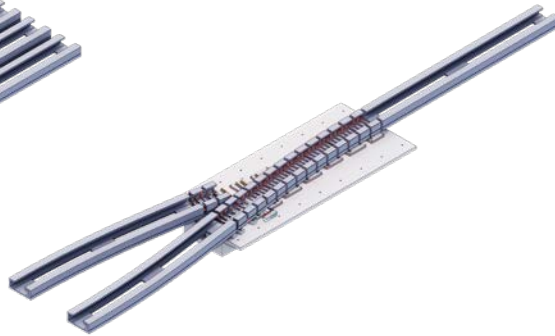
River bridge



Tunnel



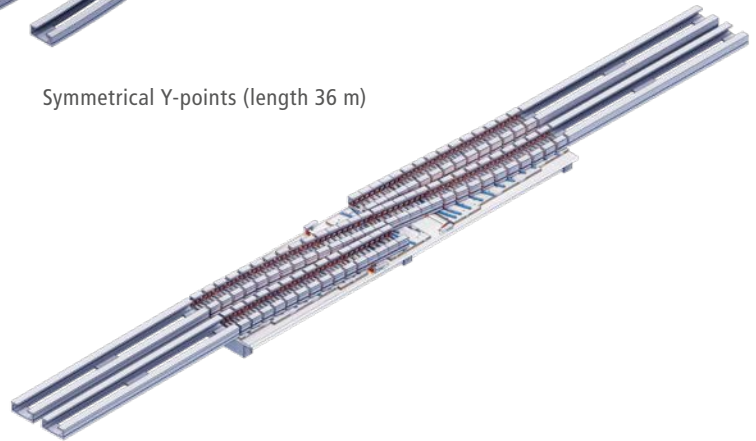
Switching points (length 25 m)



Symmetrical Y-points (length 36 m)



Asymmetrical Y-points (length 36 m)

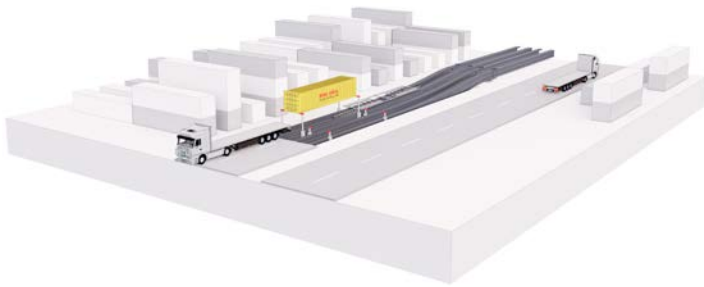


X-points (length 48 m)

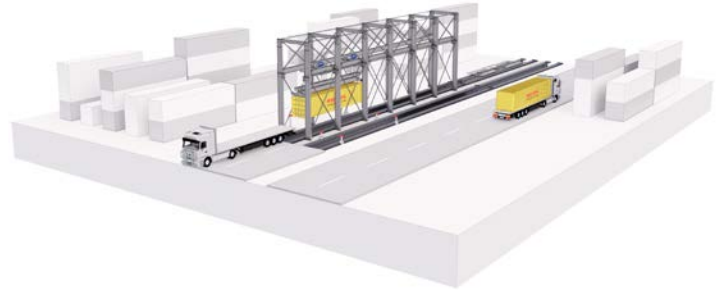
Points configuration

Particularly within heavily used logistics hubs, high-redundancy transportation systems are absolutely essential. Various points configurations ensure this high level of redundancy with TSB Cargo. 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 Cargo 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.



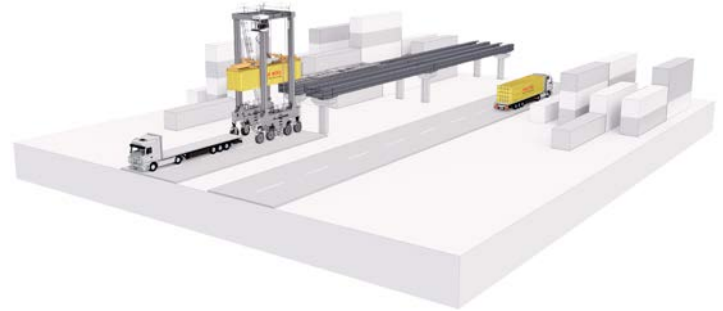
Direct transshipment HGV–TSB, ground-level



Crane transshipment HGV–TSB, ground-level



Crane transshipment HGV–TSB, elevated



Carrier transshipment HGV–TSB, elevated

Interfaces with container hoists

As a result of the elevated guideway, TSB Cargo can be integrated flexibly and intelligently into existing infrastructure. A transshipment solution specially configured for TSB Cargo makes it possible to load and unload the individual pods 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.





TSB CARGO – *From a single source*

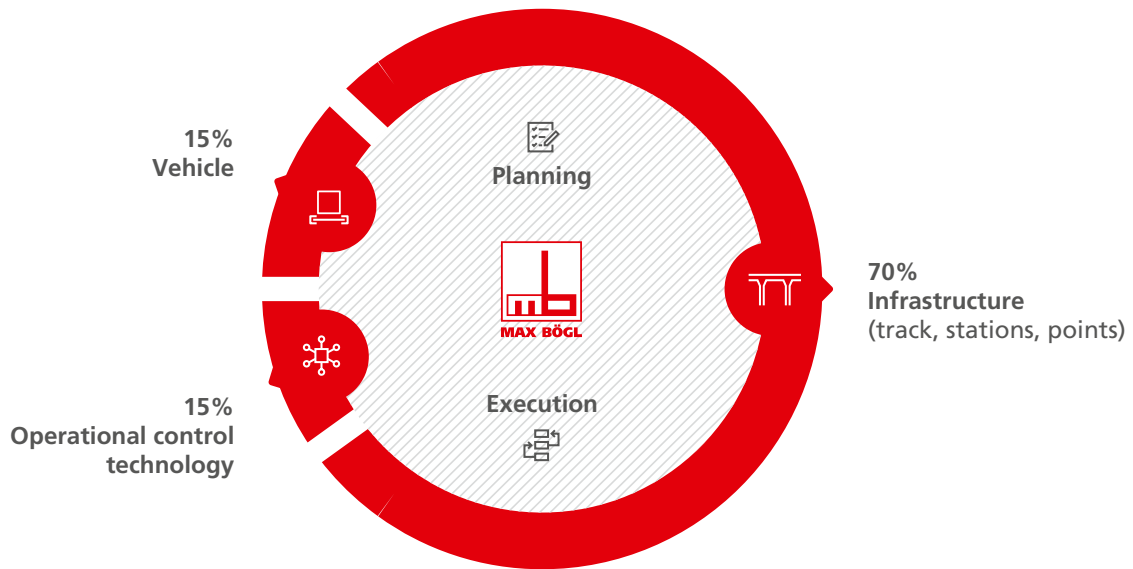
Complex infrastructure projects are particularly cost-efficient when as many individual work steps as possible are provided by a single source. As a full-service provider of TSB Cargo, we implement all processes in a standardised, coordinated way: from the planning to the industrial manufacturing of the guideway and the vehicle to the realisation of the construction measures and implementation of our in-house operational guidance technology. We can also take care of

the operation of the transportation system if requested. As an experienced construction company, we can draw on in-depth expertise and many years of experience in infrastructure projects. Our engineers have been working with maglev technology itself since 2010. Since then, the Transport System Bögl has been submitted to the acid test on our test track at our Sengenthal headquarters, with over 150,000 individual journeys and over 100,000 test kilometres travelled.

Top-quality manufacturing and installation

TSB Cargo, with its vehicle, guideway and operational guidance technology subsystems, is manufactured and pre-assembled to the highest quality standards in Sengenthal. The concrete segments of the guideway are manufactured using flexible formwork and then ground precisely to within under a millimetre using a CNC milling machine. Using cutting-edge technology, experts assemble the chassis and pod structure to create the vehicles used in the TSB Cargo

system. A digital, intelligent inventory management system guarantees the material availability for each step of the manufacturing process. The individual components are then transferred into standard shipping containers and shipped around the world ready for use. As a turnkey solution, TSB Cargo is an efficient alternative to logistics applications. The slimline, mass-produced guideway that is still flexible in its positioning is a decisive factor.



Distribution of investment costs in an average overall project





Efficient operational guidance technology for automated driving

The TSB Cargo operational guidance technology comprises the components and functions that secure, monitor and control its operation. It functionally unites the vehicle, points, transshipment points and energy supply subsystems as a turnkey comprehensive system and permits fully automated operation with short headways between trains.

TSB operational guidance technology also offers standardised interfaces, for example, with terminal operating systems. This means that TSB can be perfectly integrated into the overall operations of logistics hubs.

From the control centre, all subsystems can be fully controlled and monitored. Its core functions include safety technology that fulfils the highest requirements of the railway standard SIL4, and a highly available transmission system. In addition to a multiple-redundancy fibre-optic network infrastructure along the guideway, the transmission system includes a multi-channel radio system that covers the entire route. This means there is a continual, redundant link between the vehicles and the control centre. A backup computer for the operational guidance technology is integrated into each subsystem, which can automatically establish a safe state if there is a critical malfunction.

The mobile vehicle backup computer is equipped with geolocation technology and can determine the position and braking distance down to the meter, irrespective of the block. The local points backup computer reports the passability of the points to the central computer. This means that no signals are actually required along the route itself. The technology thus complies with the highest ETCS Level 3 (European Train Control System).

In addition to the fully automated secure operation, the automatic system also ensures the energy-efficient operation of the vehicle. While a vehicle is braking and recovering energy, the intelligent automatic system can simultaneously launch a vehicle so that the braking energy is used directly by the vehicle just being launched.

The electronics on board are based on rail technology and are thus easy to maintain by experienced operating staff. The linear motor guarantees a reliable service during any weather conditions.

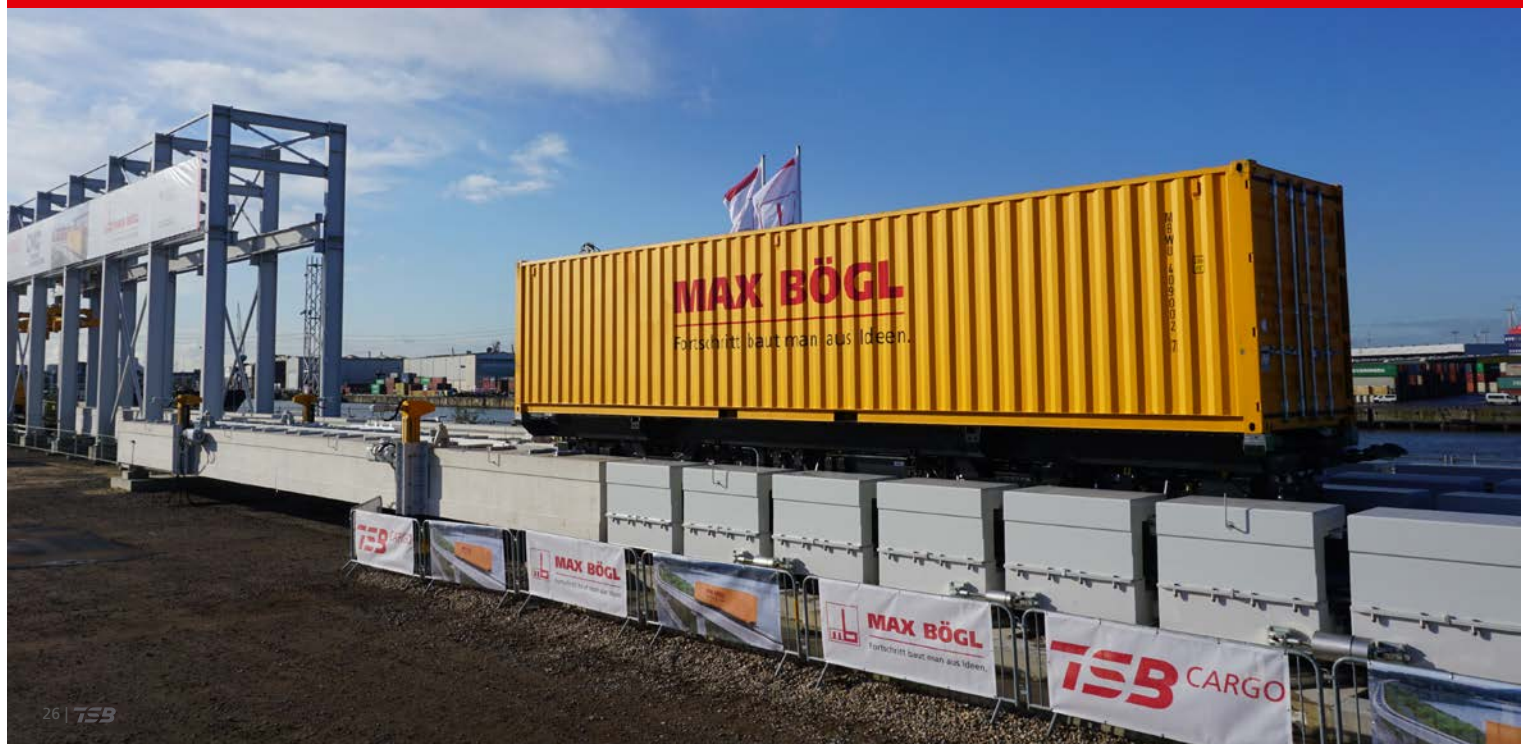




TSB Cargo – demonstration system in Hamburg

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 in 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 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 Verkehr und
digitale Infrastruktur

aufgrund eines Beschlusses
des Deutschen Bundestages

Supported by:

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



Environmentally friendly concrete

The Max Bögl group of companies has been using Bögl environmental concrete for years as part of the sustainable production of high-quality reinforced concrete components. The concrete is characterised by short transport routes, the use of regional materials and the reduction of the proportion of cement in the concrete. This means the construction material has on average a **39 per cent smaller CO₂ footprint (kilogram of CO₂ per cubic metre of concrete)** than traditional concrete, meaning that its ecological composition and processing makes a positive contribution to reducing CO₂ emissions in the construction industry.

The environmental concretes developed by Max Bögl don't just boast excellent durability; the component cross-sections can also be reduced to an optimum. This ensures significantly lower consumption of raw materials when compared to traditional construction methods. Long-lasting, certified and sustainable building products are thus created in ultra-modern production facilities using the latest technologies, which are always produced using state-of-the-art techniques thanks to the excellent performance of Bögl environmental concrete.



Innovations that make history

With pioneering innovations addressing the issues of our time, such as urbanisation, mobility, renewable energies and infrastructure, we at Max Bögl are already developing the innovative solutions to the megatrends of our globalised world. Based on the many years of experience and expertise in high-precision concrete prefab construction, we also position ourselves as a major trendsetter in the development of innovative construction processes, technologies

and products. With around 6,500 highly qualified employees at over 40 sites around the world and annual turnover of over EUR 2.0 billion, the Max Bögl Group is one of the biggest companies in the German construction industry. Since being founded in 1929, the company history has been defined by its innovative prowess in research and technology – from client-specific products to structural and sustainable comprehensive solutions.

die-jaeger.de Status 09/21

Photo credits: Max Bögl Group (cover, p. 6, 8/9, 15, 16, 17, 26, 27, 28),
graupause (p. 18/19), iStock.com (p. 4/5), Oliver Kerner (p. 11, 24, 25),
Reinhard Mederer (p. 12/13, 21, 30), Shutterstock (p. 22)



**Max Bögl Bauservice
GmbH & Co. KG**

Max-Bögl-Strasse 1
92369 Sengenthal
Germany

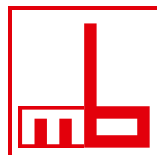
PO Box 11 20
92301 Neumarkt i. d. OPf.
Germany

P +49 9181 909-0

info@transportsystemboegl.com
transportsystemboegl.com



Transport System Bögl



MAX BÖGL

Progress is built on ideas.