The way to go.

RHEDA 2000® BALLASTLESS TRACK SYSTEM

ON BALLASTLESS TRACK TOWARD RAILWAYS O

Our contribution to high-speed technology: the RHEDA 2000® ballastless track system is the direct way to railways of the future. For heavy loads. At top speeds. With a maximum of safety.

The basis for the RHEDA 2000® is a track design first implemented in 1972 on the line from Bielefeld to Hamm, Germany, at a station named Rheda. This original solution has continuously been further developed and optimized, without a change in basic principle. Over the past 10 ... 15 years, ballastless track has developed from a customized design for niche applications, to standard technology for railway tracks on lines used for transport at high speeds and with heavy loads.

The RHEDA 2000® ballastless track was used for the first time in Germany in 2000, as pilot project on the new rail line between Erfurt and Halle-Leipzig, with a total length of approx. 1,000 m. Subsequently, it was installed on a further section 3 km long. As a result of the positive experience gained in the project engineering, installation, and operation of the RHEDA 2000® sections, Deutsche Bahn decided to employ over 180,000 patented bi-block sleepers, based on RHEDA technology, for new construction of the high-speed line – with its demanding engineering requirements – between Cologne and the Frankfurt Airport complex. In addition, new construction of the section of line between Nuremberg and Ingolstadt, as part of the Nuremberg-Munich connection, was completed in good time for the FIFA World Football Cup events in 2006 in Germany. On this newly constructed section as well, approx. 75 km long, the RHEDA 2000® system from RAIL.ONE was installed. Fortunately, these national projects were quickly and satisfactorily followed by a breakthrough of ballastless track technology in the form of RHEDA 2000® on the international stage of rail transport. One of the largest railway infrastructure projects in Europe to date has been construction of the new Dutch high-speed rail line HSL-ZUID, from Amsterdam, via Rotterdam, to the Dutch-Belgian border. With the exception of a short section, the entire line – with a total length of 88 km – was constructed completely with RHEDA 2000®.

In 2006 RAIL.ONE won the contract for delivery of the bi-block sleepers required for the RHEDA 2000® ballastless track system installed as part of new construction of the 28 km of double track in the Guadarrama Tunnel on the high-speed line from Madrid to Valladolid, in Spain. On this same line, an additional 12 km of track was executed as RHEDA 2000® in the San Pedro Tunnel. Since February of 2008, this high-speed line has been in operation for speeds of 350 km/h. Likewise, 15 km was installed in RHEDA 2000® for the Sant Joan Despí Tunnel on the line from Madrid to Barcelona, which was placed into service in December of 2007. In ad-

F THE FUTURE

dition, a number of ballastless track projects with an estimated length of 15 to 20 km were completed in 2006 and 2007, as part of the Eje Atlantico Project. These lines can be later converted from the Spanish to the European gauge. For the section of the high-speed line from Perpignan to Figueras, RAIL.ONE delivered an additional 28,000 bi-block sleepers of the RHEDA 2000® system, as well as over 28,000 linear metres of turnout sleepers.

Launching of ballastless track for high-speed rail traffic on the Asian market succeeded in 2004 with application of RHEDA 2000® in new construction of the high-speed line from Taipei to Kaohsiung, in Taiwan. In addition to the installation of Japanese ballastless track technology on the open track sections, the demanding areas near and in the train stations (in a total of approx. 80 km track and 115 turnouts) were implemented with the RHEDA 2000® system. The RAIL.ONE Group additionally participated in construction of the double-track passenger-dedicated line (PDL) from Wuhan to Guangzhou in southeast China. Almost the entire line, with a length of approx. 1,000 km, was built with RHEDA 2000®. Since December of 2009, trains use this high-speed line at speeds of 350 km/h.

UNIFIED SYSTEMS ENGINEERING AND LOW TRACK STRUCTURAL HEIGHT

Use of RHEDA 2000® enables appreciable time and cost savings for project engineering and installation.

From the very beginning, RHEDA technology – as system solution for the most demanding of user requirements – has confirmed the advantages of monolithic track design. The crucial modifications of RHEDA 2000® with respect to the original system consist, first, of the employment of an especially integrated bi-block lattice-truss sleeper. Second, the latest version combines in situ concrete and a reinforced-concrete trough slab that are produced in one working step. The nonprestressed reinforcement bi-block sleeper, with optimized concrete elements, likewise forms a monolithic structure with the surrounding concrete of the track concrete layer. This structure can be uniformly implemented with extremely low structural height, on all kinds of suitable track substructure.

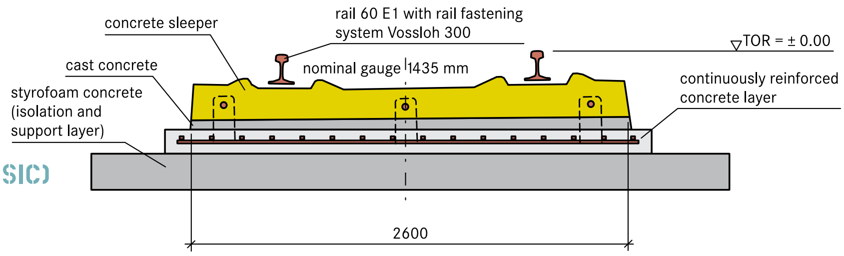
OFFICIAL APPROVAL AND PROVEN SYSTEMS

RHEDA 2000® combines high levels of safety and long-term track positioning, with favourable construction costs and low maintenance expenses. The system accordingly fulfils all requirements for application on heavily travelled high-speed rail lines, and simultaneously assures optimal ride comfort. RAMS analyses conducted according to international standards confirm these benefits. In addition, RHEDA 2000® can be easily modified to optimally fit all types of substructure. RHEDA 2000® has obtained General Approval from the German Federal Bureau of Railways (EBA), as well as the User Declaration from Deutsche Bahn AG, for application in high-speed traffic. In February of 2006, RHEDA 2000® furthermore achieved initial quality approval, in accordance with European Union Directive 96/48 EG for high-speed rail traffic. These qualifications highlight the innovation capability and the performance of RAIL.ONE as an international provider of high-tech for railway track design and construction.

The flexible way for all applications The RHEDA 2000® ballastless track system is ideal for applications on embankments, on bridges, in tunnels, as well as for turnouts and with vibration-optimized mass-spring systems. Installation of noise absorbers attenuates noise from wheel-rail rolling and vehicle power-plant operation.

DEVELOPMENT STAGES OF THE RHEDA DESIGN

RHEDA (CLASSIC)



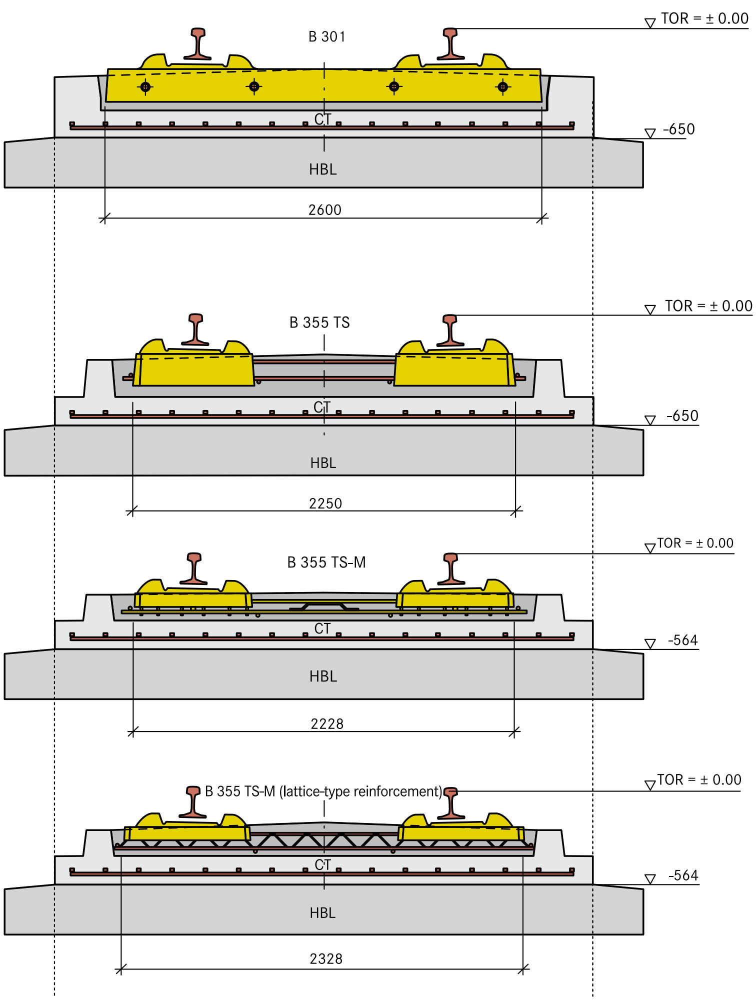
The stages of development of RHEDA technology become evident in comparison of the various track cross-sections.

RHEDA (SENGEBERG)

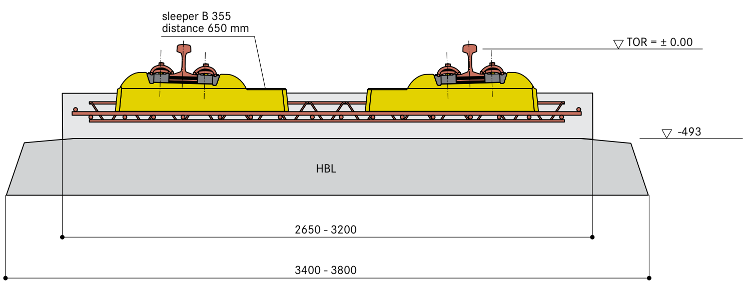
RHEDA-BERLIN HGV V1

V2

V3

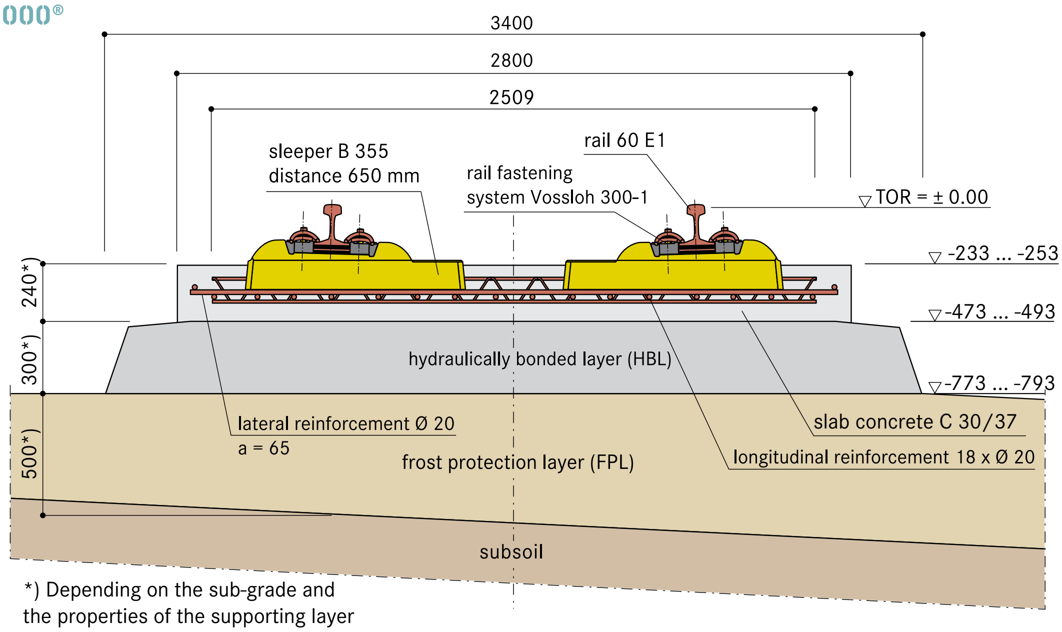


RHEDA 2000®



SYSTEM DESIGN AND COMPONENTS

RHEDA 2000®



*) Depending on the sub-grade and the properties of the supporting layer

RHEDA 2000® is a flexible system that can be individually adapted to the specific requirements and the individual constraints of each project. The basic system structure, however, always consists of modified bi-block sleepers which are securely and reliably embedded in a monolithic concrete slab. Highly elastic rail fastenings are essential to achieve the vertical rail deflection required for load distribution and for smooth train travel.

THE B 355-M SLEEPER

The B 355-M sleeper represents the core of the RHEDA 2000® system. Due to mass production of these precast components, the sleeper provides both maximum concrete quality and highest precision, especially at the most critical rail seat area. The concrete blocks can be individually designed to enable use of all conventional elastic fastening systems and anchor fittings. The lattice truss reinforcement between the concrete sleeper blocks, the result of long years of development, takes full account of the stability aspects of transport and construction, and of effective embedding – for great system reliability and durability.

THE CONCRETE TRACK-SUPPORTING LAYER

The concrete track-supporting layer is the major load-distributing element of the system. Since it is cast-in-place, it can be individually adapted to any substructure type and condition. For embankments, it is designed as a continuous slab with free crack formation. For highly compacted soil – which is strongly advised for ballastless tracks to prevent settlement – the slab can be constructed in unit dimensions of 2.8 m x 0.24 m.

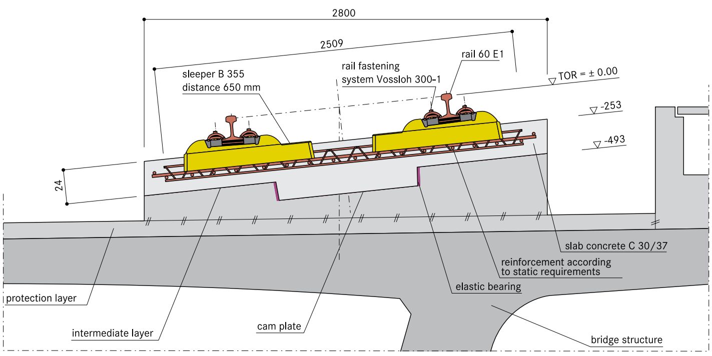
To assure the required durability, the minimum strength of the concrete layer must be 30/37 MPa (cube/cylinder). After almost 40 years of experience and countless applications of various Rheda track types, the concrete mix design of RHEDA 2000® has now reached a very high degree of perfection. It fulfils even the most stringent demands for durability and reliability under a great variety of climatic conditions and applicable concrete standards.

END-TO-END SYSTEM STRUCTURE ON EMBANKMENTS, IN TUNNELS, AND ON BRIDGES

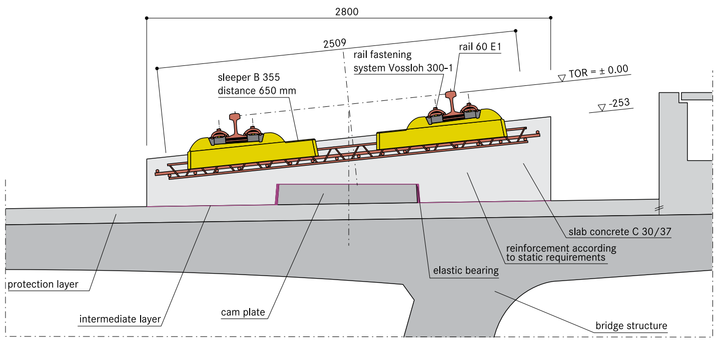
Uniform track concrete layers with low structural height ensure simplified line routing and installation.

RHEDA 2000® is characterized by a maximum degree of flexibility. Throughout this track family, the common components are the basic system structure, the modified bi-block sleepers, and the monolithic cast-in-place supporting concrete slab. This basic system is varied in accordance with various sub-grade types, structural-engineering requirements, rail-support conditions, as well as cost-effective installation processes.
On embankments, an additional bonded support layer – often a hydraulically bonded layer – is installed in order to conform to the permitted levels of stress in the supporting layers and on the subgrade.
In tunnels, with the great stiffness of the tunnel floors, only very slight stresses develop in the track structure by the mere nature of the configuration. As a result, no additional track supporting layers are required. In such cases, the concrete track-supporting layer is installed directly onto the track substructure. Further optimisation measures are possible both in the concrete layer-thickness as well as in the content of reinforcement. The end-to-end characteristics of the basic system ensure, during installation, that neither the fundamental construction procedures nor the components must be exchanged or modified. This assures a constant high level of quality, throughout, including the construction work as well.
In most cases, dilatation joints are provided at the ends of bridges, and the track itself is also interrupted over these joints. In addition, economical and technical considerations often make it advantageous to decouple the track from the bridge supporting structure. In such cases, RHEDA 2000® offers various possibilities for horizontal separation, and for fastening by means of the concrete humps on the sleepers, or by patented steel bolt anchors.

INSTALLATION ON BRIDGES

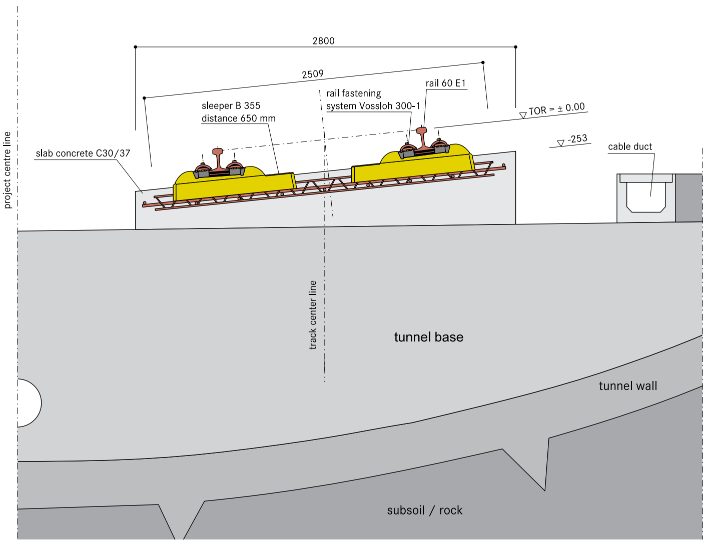


Connection of the track concrete layer with the bridge structure by means of negative cam plates

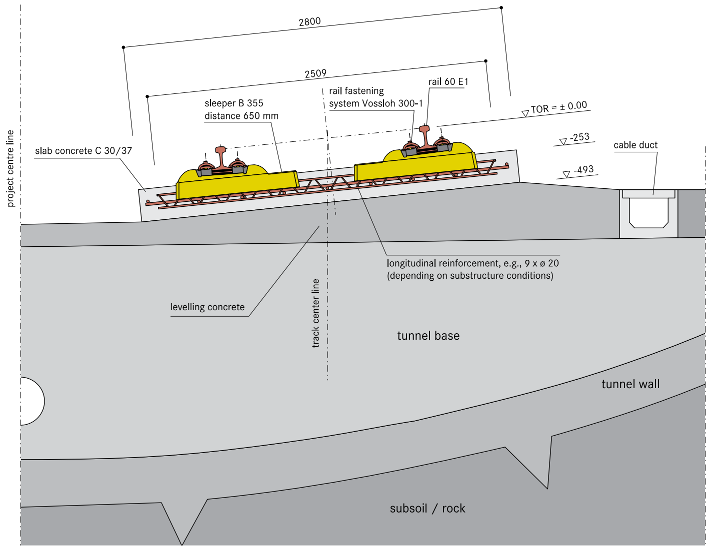


Connection of the track concrete layer with the bridge structure by means of positive cam plates in protection layer

INSTALLATION IN TUNNELS



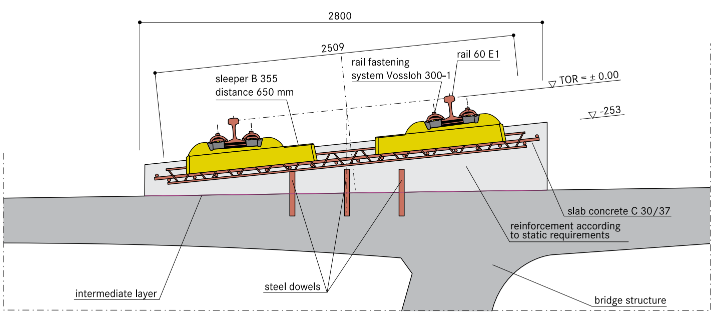
Track concrete layer, installed on tunnel-floor fill



Track concrete layer, installed on levelling concrete

THE DEFINITE ADVANTAGES OF RHEDA 2000® ARE AS FOLLOWS:

- A maximum of cost effectiveness and reliability by utilisation of concrete sleepers as superior-quality precast concrete building components in the critical area of the rail-seat zone
- Great precision of track-geometry parameters by application of precise concrete sleepers
- Great adaptability to all types of substructure and models executed, by means of application of cast-in-place concrete for the concrete track-supporting layer
- Great reliability as a result of technologically mature concrete engineering of the track-supporting layer for a great diversity of climatic conditions and concrete standards
- Flexible, high-performance installation procedures on the basis of simple installation steps that are reproducible for both manual as well as automated procedures
- Great added value by local production possibilities



Connection of the track concrete layer with the bridge structure by means of anchor dowels

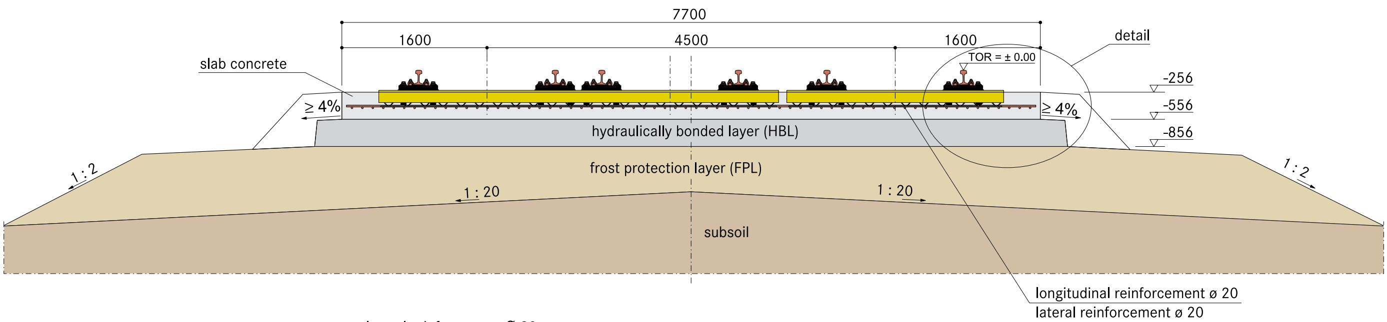
ADDITIONAL SYSTEM SOLUTIONS

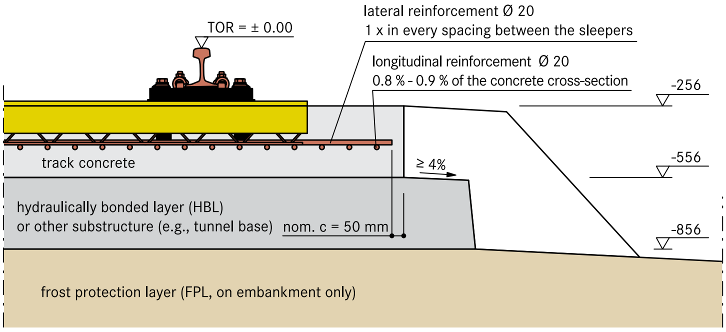
TURNOUTS WITH OPTIMIZED STRUCTURAL-DESIGN TECHNOLOGY

With the objective of end-to-end system engineering for tracks and turnouts for the RHEDA 2000® ballastless track system, extensive adaptation to reduced track structural height represented an essential step in sleeper design. The key aspect of this development was design and dimensioning of a concrete turnout sleeper based on the B 355 bi-block sleeper. The GWS 05 lattice-truss turnout sleeper currently represents the optimized state of system development. With its end-to-end system engineering, this sleeper assures effective provision of the recesses below the base of the rail that are necessary for the turnout drive, as well as the continuous reinforcement of the track concrete layer (approximately in the centre of the track cross-section). This solution achieves homogeneous height configuration in track and turnouts, and correspondingly reduces the weight involved. For project engineering and installation on the construction site, this means considerable time savings and cost reduction. The uniform systems engineering features allow integration of all track substructure variations and conditions into the design. In Taiwan, for example, RAIL.ONE implemented complete train-station systems with a great number of turnouts and platform connections, on viaducts by means of pile-supported constructions, or in tunnel areas.

RAIL EXPANSION JOINTS

The turnout sleeper for the RHEDA 2000® ballastless track system also offers a safe, reliable, robust, and at the same time flexible basis for various types of rail expansion joints. The GWS 05 sleeper is the heart of the system, and provides stable, requirement-satisfying, and exact mounting points - especially for the respective installation components of a rail expansion joint. The monolithic concrete track layer can be adapted to the special requirements encountered, especially in the immediate vicinity of the bridge joint. A number of major projects have already been planned and executed in the RHEDA 2000® system with special transition elements.





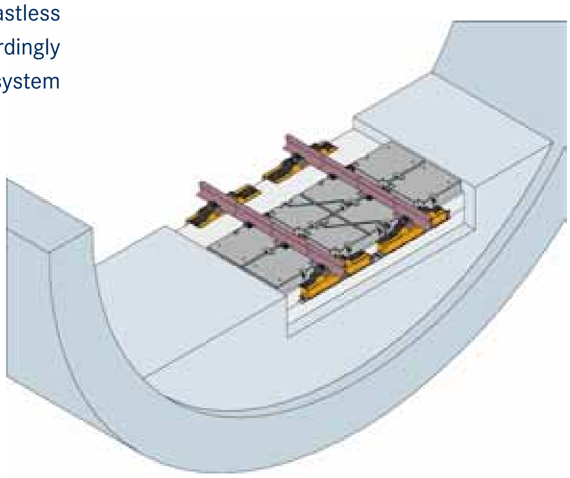
RAIL.ONE

TRANSITIONS

The installation of ballastless track systems demands special attention for the transitions between ballasted and ballastless track systems. With the RHEDA 2000® system, numerous system-optimized details enable stiffness adaptation in the rail fastenings and in the ballast, at such transitions from ballastless to ballasted track. As a rule, these solutions include the first step of multistage gluing of the ballast, in addition to an extension of the hydraulically bonded layer. This technique increases the stiffness of the ballasted track system. In addition, a special pre-stressed sleeper with highly elastic rail fastening is installed in the ballasted track. This arrangement enables an increase in stiffness, in several stages, between the ballastless track and the ballasted section. As an option, it is also possible to configure auxiliary rails: both for these special turnouts, as well as on the ballastless track. This likewise reduces the difficulties otherwise encountered at the interfaces between ballasted and ballastless sections. The RHEDA 2000® system accordingly offers an optimal solution, with uniform system engineering for all areas of application.

ROAD-VEHICLE ACCESS SYSTEM

New safety regulations in Europe stipulate that access for vehicles must now be ensured in railway tunnels for all types of road vehicles (passenger cars and lorries). As a result, a road-vehicle access system was developed for the RHEDA 2000® ballastless track system. As an adaptive measure, this access system can be installed directly onto the track. The emplacement of precast concrete slabs onto B 355 bi-block sleepers provides an operating surface for road vehicles at a defined level below the top of rail. This development allows passenger cars and lorries with up to 10-tonne axle loads to use the surface as a roadway without restriction. An additional advantage of the precast parts results from the fact that smaller connecting elements in the vicinity of the rails and the rail-fastening elements can be removed to allow easy performance of obligatory maintenance on these components.



ELECTROMAGNETIC COMPATIBILITY (EMC)

Ballastless tracks, with their reinforced concrete layers, have substantial electromagnetic properties. In their development, it is necessary to consider effective measures against lightning and catenary line breakage. These measures involve grounding elements (equipotential bonding). Modifications or extensions necessitate regular inspection of these elements.

In high-speed rail traffic, unrestricted compatibility is absolutely essential between train control systems and the ballastless track. Control systems operate with transmission systems and use electromagnetic signal transmitters and/or signal receivers. These control systems function directly in the reinforced-concrete track layers themselves (e.g., LZB and ETCS), or in the direct vicinity of these layers (e.g., UM 71 etc.). It is crucial to study the effects of longitudinal reinforcement, since it represents the primary attenuating element.

The RHEDA 2000® system has been tested for the most widely employed train control and management systems: i.e., for the LZB in Germany, the ETCS trans-European high-speed train network, and the UM 71 in France and Asia. The RHEDA 2000® system has been approved as observing the respective stipulated parameters. On the basis of its simple structure and construction methods, it is possible to quickly and economically conform to all the requirements of train control systems now in use.

NOISE AND VIBRATION PROTECTION

NOISE PROTECTION

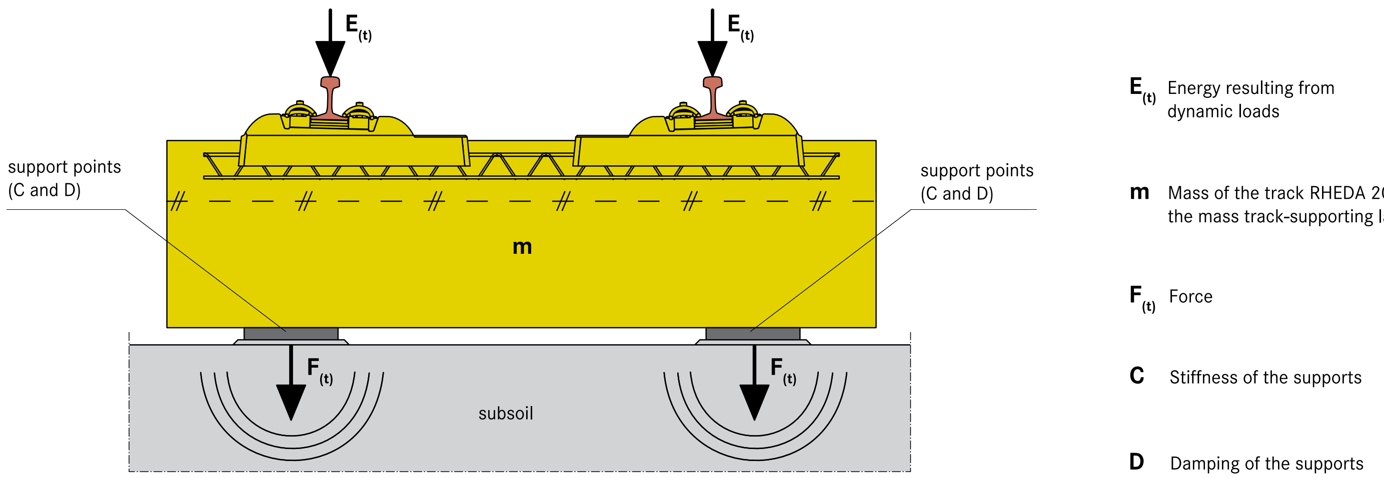
For significant reduction of airborne noise propagation, it is possible to install special noise-absorber systems for ballastless track systems. This solution achieves good noise-engineering parameters, even for half-surface installation in the outdoor areas of the rails.

VIBRATION PROTECTION

The increase in train speeds, axle loads, and traffic volumes on current train lines has also led to increases in the noise and vibration to which the surroundings are subjected. Irregularities between rail and wheels, as well as the dynamic deformation of tracks when rolling stock passes, introduce vibrations into the subgrade. These vibrations are propagated into adjoining building structures, which vibrate to lesser or greater degree. Secondary airborne noise can likewise produce disturbances. One of the most effective measures against the development of structural-borne noise and vibrations is mass-spring systems. These systems attenuate the transmission of vibrations into the surroundings. The characteristics of the amplification function of single-mass oscillators play a key role in the design of mass-spring systems. The use of mass-spring systems is advisable especially in densely developed areas sensitive to vibrations.

Mass-spring systems can be implemented in light, medium-heavy, or heavy models. Light mass-spring systems are mounted on either strip supports or entire-surface supports made of elastomer matting. For heavy mass-spring systems, individual supports in the form of elastomer blocks or steel springs are employed. The deeper the frequency of the vibration to be reduced, the higher the required mass of the mass track concrete layer. Here, the structure of the RHEDA 2000® ballastless track system offers benefits to the entire system: the appreciable mass of the track concrete layer, with its bi-block sleepers embedded in concrete, contributes significantly to attenuation of vibrations. In addition, the RHEDA 2000® system – as a result of its structural properties insensitive to water and erosion – is well suited for application both on open track sections, as well as in tunnels. As a result, many and various forms of the mass-spring system are feasible: light, medium-heavy, or heavy models, with the respectively required support types of individual, strip, and entire-surface elastomer support.

This great degree of design and adaptation flexibility makes the RHEDA 2000® ballastless track system on a mass-spring system an optimal solution for satisfying all requirements placed on vibration protection and operational functionality. The RHEDA 2000® ballastless track system on a mass-spring system has already been installed in numerous projects, in the form of various models: e.g., in the Cologne-Bonn Airport Link (as a heavy mass-spring system), in the Berlin North-South Link (with light to heavy mass-spring systems), and in the S-Bahn heavy-rail urban transit system in Unterfoehring, on the outskirts of Munich (light mass-spring system).



Application of the single-mass oscillator principle in the RHEDA 2000® track type on a mass-spring system

URBAN TRANSIT

RHEDA CITY

The RHEDA CITY track system has been designed especially for use with tram systems. This system is based on the same fundamental functional principles as all track models in the RHEDA family, especially the RHEDA 2000® system. The simple installation techniques produce good track positioning over the long term, without reworking. The system can be covered with asphalt, concrete, or paving stones, as desired. The latest development of RHEDA CITY is the vegetated (green) variation.

MEASURES TO REDUCE STRAY CURRENT

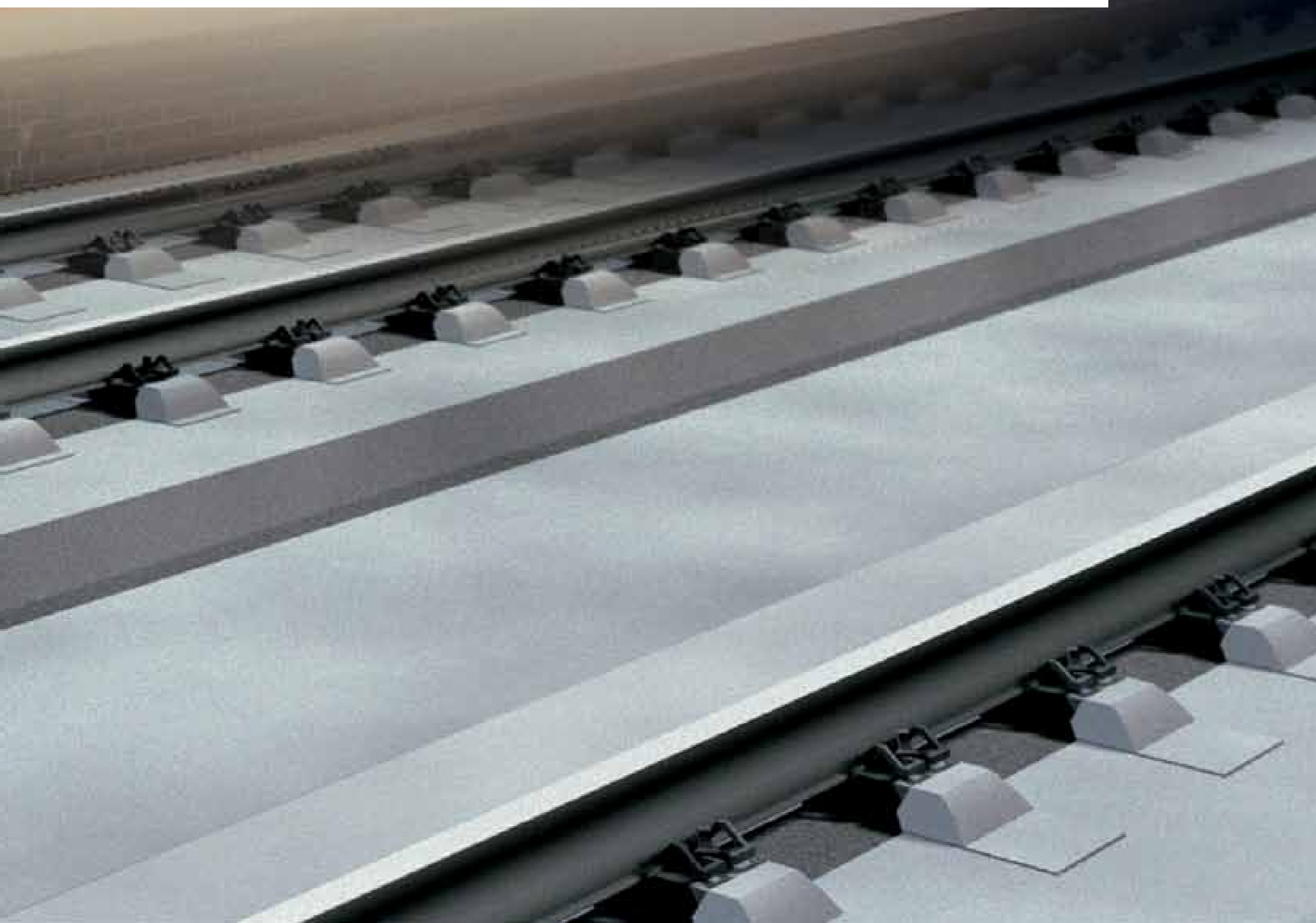
Within the context of railway engineering, stray currents are currents that do not flow through the running rails of the track, as intended, but along other paths back to the rectifier substations: e.g., through the earth. Stray current can cause considerable corrosive damage not only to the running rails, but also to nearby facilities that do not belong to the railway operations themselves: for example, the reinforcement of concrete elements, and piping made of metal.
In order to reduce stray current and the negative effects that it causes, RAIL.ONE has placed great emphasis on effective electrical insulation of the running rails with respect to the earth, in the development of its ballastless track system RHEDA CITY, for employment with tram systems in urban transit. The primary design principle implemented here was the effective combination of electrically insulating system components – such as rail-base coating, rail chamber elements, and rail joint filling compound.
RHEDA CITY has been installed in numerous cities. Laboratory studies and measurements on rail lines in operation have verified the effectiveness of the above-stated measures for reduction of stray current.

RHEDA MRT

The RHEDA MRT ballastless track system was especially developed for use with underground and surface mass rapid transit networks. The basic principle corresponds to the RHEDA 2000® high-speed system, with modification of the individual components to meet the requirements of urban mass rapid transit: adaptation that has significantly reduced the structural height and weight of the system. The system is therefore optimally suited for use in tunnels, with simultaneous enhancement of quality, safety, and permanence. The MRT models can also be implemented as mass-spring systems.

DESIGN & ENGINEERING

Ballastless track systems are special structures that are historically still very recent in comparison to conventional civil-engineering works such as normal buildings, bridges, and tunnels. In many cases they cannot be designed and tested according to the generally accepted rules of good engineering practice. Particularly in the area of high-speed rail traffic, they are subject to extremely high safety standards. With respect to the budgetary and time-scheduling constraints applied in major international projects, alternatives are available to long-term test series: i.e., other methods that have for many years now been successfully practiced in other fields of railway work such as train control and management systems. For implementation of these methods - for example, as set forth in CENELC standards, particularly in EN 50126 - track design must follow a process that verifiably assures the safety and the reliability of the entire system and its sub-systems, in addition to conformity with purely engineering requirements. This process must above all satisfy two aspects: reliable break-down of the system into components, as well as step-by-step development, detailing, and checking.



QUALITY MANAGEMENT

Top quality goes without saying for RAIL.ONE, and has been a core element of corporate policy from the beginning. Convincing evidence here is certification in accordance with DIN EN ISO 9001: all work processes are subject to continuous monitoring – beginning with planning and engineering, including production, and extending to logistics and delivery. Documentation is by RAIL.ONE's own concrete laboratories, all of which are monitored by official testing bureaus. The prime objective of the RAIL.ONE quality management system is the assurance of conformity of all delivered products, and ongoing enhancement of the satisfaction of its customers. Deutsche Bahn AG has likewise recognized the competence and reliability of RAIL.ONE: classification as Q1 provider is the highest quality level, achieved for years by RAIL.ONE. Ongoing RAMS tests for systems and system components further highlight the reliability and availability of RAIL.ONE products.

Production in foreign countries requires in all cases harmonisation of the standards and technical terms of delivery applicable in Germany and in the respective foreign countries. The requirements resulting from this harmonisation decide the choice of local raw materials, concrete qualities, and production processes. Proof of conformity of raw materials, the concrete quality achieved, and the sleeper quality with the requirements used as basis – as well as certification of production as per DIN EN ISO 9001: all of this leads to official national approval.

The low structural height, the high track-geometry quality for assurance of functionality and long life cycles, as well as the permanent bonding of track concrete layer and sleeper reinforcement – these are the quality characteristics of the RHEDA 2000® ballastless track system. Satisfaction of these strict demands requires perfect interaction of good system design with flawless execution of construction. Integrated quality assurance guarantees RAIL.ONE objectives: close supervision of the entire process beginning with engineering, including in-house production monitoring, up to execution on the construction site.

KEY TASKS INVOLVED IN TRACK QUALITY ASSURANCE:

- Checking of detail design and construction drawings, and of the geodetic project
- Verification of the quality management of the manufacturers of sleepers and other components
- Certification of the concrete supplier(s) for the track
- Checking, documenting, and clearance of the track-positioning state before concreting
- Checking of delivery documents and conformity of the concrete supplied
- Checking of the concrete technology, processing, and curing in the track
- Supervision of rail handling: laying, welding, and grinding
- Re-checking of the track position
- Checking of the final documentation
- Preparation of the quality report
- Turnover with the line operator and other participants

INSTALLATION TECHNIQUES

Maximum precision during installation ensures exact and long-lasting track positioning

The great majority of the bi-block sleepers of the RHEDA 2000® system are produced locally in especially constructed production plants. This arrangement reduces transport costs to a minimum. As a result of the simple installation technology, which does not require special equipment, local track and civil-engineering companies can install the RHEDA 2000®. In addition, a surveying technique especially developed for the RHEDA 2000® system assures great exactness of track position and geometry. The alignment techniques used here – using spreader bars and spindle-base adjustment units – enable precise alignment and securing of the track panel, even under the most unfavourable of construction-site installation conditions.

The spreader-bar adjustment system involves a combined technique consisting of the following two elements: vertical adjustment by means of spindles attached at the ends of the sleepers, and horizontal adjustment by special spreader bars at the centre of the sleepers. The spindle adjustment supports the track panel directly at the rail base and enables both vertical as well as horizontal track-panel alignment.

With both techniques, the adjustment procedures are completed with approval granted by the survey engineer. The next step includes the casting of the sleepers into a track concrete layer. Here, two measured points on the rail may at intervals of 5 m have position or height differences of no

General overview of RHEDA 2000® production sequences, consisting of manual and mechanised steps of work

PREPARATION OF THE SUBSTRUCTURE

EMBANKMENT
- Placing of the frost protection layer using conventional construction machines
- Placing of the hydraulically bonded layer using conventional construction machines

CIVIL STRUCTURES
- Preparation of the civil structure surface and the possible track fixation elements according to the individual sub-/superstructure design

ASSEMBLY OF THE TRACK PANEL

ASSEMBLY ON SITE
- Placing reinforcement
- Placing of single sleepers and installation of track reinforcement
- Installation of rails (temporary or final)

PRE-ASSEMBLY
- Pre-assembly of the track panels on special sites
- Transport and placing of the complete track panels to the final installation location

ROUGH ALIGNMENT OF THE TRACK PANEL

MANUAL ROUGH ALIGNMENT
- Lifting and rough alignment of the track panel using manual devices (rail jacks, track alignment frames, etc.) and survey instruments

AUTOMATIC ROUGH ALIGNMENT
- Lifting and rough alignment of the track panel using automatic devices: e.g., rough alignment machines, remotely controlled by electronic surveying instruments

INSTALLATION OF THE TRACK FORMWORK

POSSIBLE KINDS OF FORMWORK
- Individually / manually (on site) manufactured formwork (e.g., timber formwork)
- Pre-fabricated formwork system elements (usually of steel)
- Pre-fabricated (steel) formwork system elements with integrated rails for construction vehicles

LOGISTIC ACTIVITIES

more than ± 2 mm with reference to each other – dimensions that demand a maximum of exactness in concrete construction. The top-down installation procedure inherent to this system can optimally satisfy these exacting requirements. Production of special sleepers by RAIL.ONE – with manufacture and installation of the RHEDA 2000® system by local construction companies – allows optimal economical cost/benefit relationship: both for RAIL.ONE as well as for the local industry.

FINAL ALIGNMENT OF THE TRACK PANEL

VERTICAL FINAL ALIGNMENT

- Vertical final alignment using the vertical adjustment spindles of the spindle brackets
- Alignment of the required superelevation, with adjustment of the proper angle of the base plates of the spindle brackets

HORIZONTAL FINAL ALIGNMENT

- Horizontal final alignment using the horizontal adjustment screws of the spindle brackets

PLACING OF THE TRACK CONCRETE

MANUAL CONCRETE PLACING

- Manual concrete placing using concrete bucket and crane
- Manual concrete placing using concrete pump

AUTOMATIC CONCRETE PLACING

- Concrete placing using an automatic concrete placing unit: e.g., concreting unit

SUPPLEMENTARY WORKING STEPS

CONCRETE CURING

- Wetting of the concrete surface
- Coating of the concrete surface with curing liquid
- Covering of the concrete surface with plastic or textile sheets

AVOIDING STRESS IN UNSET CONCRETE

- Loosening of the rail fastenings

LOGISTIC ACTIVITIES

RHEDA 2000® – A PROVEN SYSTEM WITH WORLDWIDE REFERENCE PROJECTS

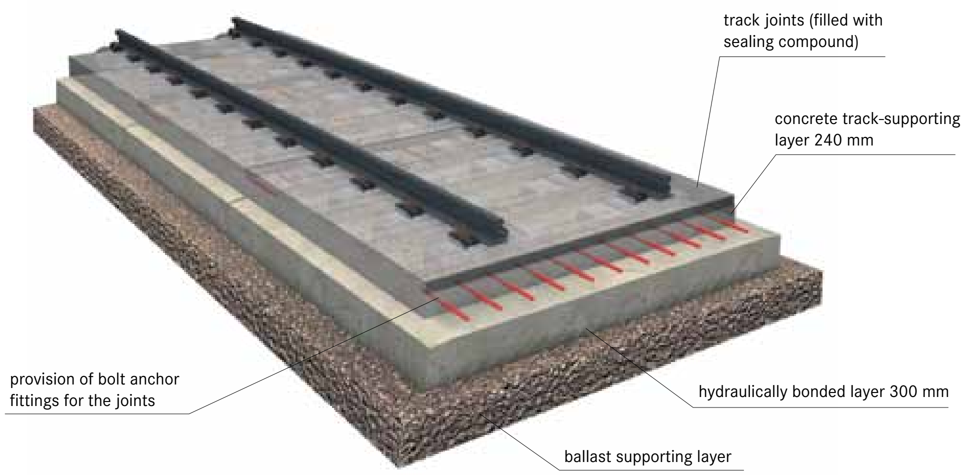
MAXIMUM RELIABILITY AND SAFETY IN PLANNING, CONSTRUCTION, AND OPERATION

Over the past 40 years, ballastless railway track has developed from a niche product to internationally proven standard technology in the new construction of railway lines with special requirements. One of the most influential systems for application of ballastless track with main-track sleepers is the RHEDA family of ballastless tracks. RAIL.ONE holds the patents for the latest and highest development stage of the RHEDA 2000® model and of the RHEDA Berlin system.

The RHEDA 2000® system, as well as other models with RHEDA technology, have until now been installed in more than 10 countries, in more than 2,000 km of tracks, and for more than 150 turnouts and rail expansion joints. The required official approval has been obtained for each of the applications of RHEDA 2000®, including a Certificate of Conformity in accordance with European Union Directive 96/48 (Version 2001), for the line from Amsterdam to the Belgian border. The use of the RHEDA 2000® system for the most widespread high-speed train systems – the Shinkansen, TGV/Thalys und ICE – and for the LZB, ETCS, and UM 71 signal systems – verifies the compatibility of this ballastless system. On the basis of the extensive and widely varied experience gained with the RHEDA 2000® system, it offers a maximum of security for every user: starting with the planning and approval phase, including installation, and extending to operation.

THE NEXT TECHNOLOGICAL STEP: BALLASTLESS TRACK WITHOUT CONTINUOUS REINFORCEMENT

An additional system solution is the new ballastless track system without continuous reinforcement. In its structural design and functional principle, it matches the current state of the art in construction of transportation infrastructure – whereas, in contrast to the RHEDA 2000® system until now, it has eliminated continuous reinforcement. This elimination of reinforcement enables shortening of construction time and reduction in costs. This modification has also minimized unwanted effects of the reinforcement on railway signalling systems and on the electrical grounding facilities. Analogous to roadway construction, this new track system features provision of lateral dummy joints that enable controlled formation of cracks in the concrete track-supporting layer. These joints are sealed to prevent the intrusion of water. The transfer of lateral forces, previously enabled by aggregate interlock, is now provided by bolt anchors. Furthermore, the higher concrete grade C35/45 can be used, instead of the grade C30/37 employed until now. This achieves greater resistance to frost, which in turn leads to longer life cycles. Ballastless track without continuous reinforcement can be executed either with or without a hydraulically bonded layer.



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RAIL.ONE GmbH | Ingolstaedter Strasse 51 | D-92318 Neumarkt
Tel +49 9181 8952-250 | Fax +49 9181 8952-5050
info@railone.com | www.railone.com