Trimble GEDO Systems
Track Measurement Solutions

Trimble

Railway Measurement Solutions

Railways are essential components of the global economy and infrastructure. Throughout their life cycle, rail operators demand an efficient approach to planning, construction, operations, maintenance and expansion. These applications call for innovative solutions for measurement and information management.

Based on decades of experience in the rail industry, Trimble® GEDO systems combine positioning and measurement sensors with communications and software. Trimble systems provide fast, accurate and reliable solutions for railway spatial information needs.

KEY BENEFITS:

▶ Speed and precision in measurement operations

▶ Accurate reliable information on track and facilities

▶ Increased efficiency in planning, design, and construction

▶ Reduced downtime for measurement and maintenance

Planning

Trimble GEDO systems collect and manage detailed information needed by planners and designers.

Construction

Use Trimble GEDO systems for precise alignment of track and for post-construction inspections and approvals.

Maintenance

Trimble GEDO systems increase productivity in inspection and tamping operations.

Modernization and Expansion

High-resolution data from Trimble GEDO systems assist planners to update facilities and track for larger, faster rolling stock.

Signalling (ETCS and PTC)

Use Trimble GEDO systems to collect and manage information on location of track, control structures and other safety activities.
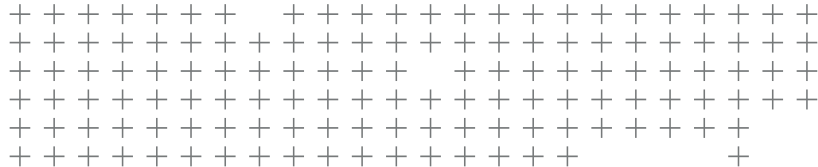
TRIMBLE GEDO SYSTEM

Speed and Precision

Safety

Flexibility

Coordinated with Railway Processes

Capture measurements in seconds using GNSS, optical systems and inertial measurement technology

Gather precise data on track and conditions

Small, lightweight field equipment can be operated by one person

Install and remove from track quickly and easily

Configure system to each application

Modular system can grow and adapt to changing needs

Optimize use of equipment and staff

Electronic data streamlines information exchange

Reduce downtime for inspection and maintenance

TRIMBLE GEDO SYSTEM

Trimble GEDO systems utilize Trimble GNSS, Trimble Total Stations, inertial measurement and related sensor technologies to capture precise positioning data on railway track and surrounding features. Based on decades of experience in the railway industry, Trimble GEDO systems provide efficient tools and workflows throughout the rail measurement process. By integrating rugged field hardware with customized software and point of work guidance, Trimble GEDO systems reduce rework and increase productivity across the entire enterprise workflow.

Flexible Trimble GEDO systems provide maximum return on your investment. You can quickly configure your system to support track location, inspection, construction and maintenance as well as planning for improvements, updates and expansion. As your client's needs change, Trimble GEDO systems can adapt to new requirements for measurement and data management.

®Trimble®

Solutions for Track Documentation

Efficient management demands accurate information. To provide complete information, rail operators need productive rail measuring systems to provide accurate surveys of existing track.

The Trimble GEDO system is a fast, efficient tool to measure, record and document detailed information about existing track. By simply walking the track, you can capture detailed information for asset management, realignment, GIS, design, and quality control.

To use the Trimble GEDO system, a single operator pushes a simple trolley along the track. Onboard the trolley, components for measurement, recording and user guidance are integrated into a rugged, weatherproof system. The critical data is collected and stored in a single operation.

TRIMBLE GEDO IN ACTION:
TRACK DATA FOR PTC

California-based Cinquini & Passarino, Inc. uses Trimble GEDO Rec system to capture data for more than 80 km of track for Positive Train Control (PTC). Limited to working at night in four-hour windows, the Cinquini & Passarino teams covered 8 km – 13 km each night. Using standard PTC Data Model Definitions, they collected more than 120,000 points maintaining accuracy of 2.5 cm or better.

Measurement of As-built Track Conditions

In addition to capturing the absolute position of the rails, the system measures and stores cant and gauge. Measurements can be captured as the operator moves continuously along the rails, or by stopping at specified intervals.

Determining Track Location

With the Trimble GEDO system, you can quickly survey existing lines without the need for alignment data. Using GNSS or optical surveying techniques, the system provides survey-quality location of the Trimble GEDO Trolley. Results can be tied to national or company-specific coordinate systems.
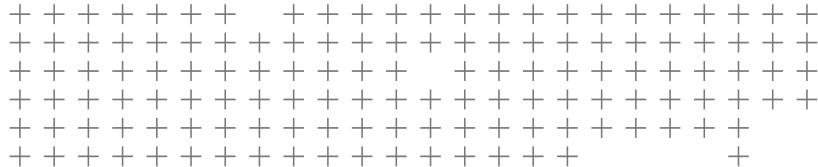
Fast, Precise Measurement

When configured with a Trimble S-Series Total Station, the Trimble GEDO Trolley can collect data with millimeter precision while covering up to 1,200 m of track in one hour. And, systems configured with Trimble GNSS can cover up to 3,000 m of track per hour with centimeter precision. The combination of inertial measurement technology with Trimble GNSS or laser distance measurement allows track survey with an inner accuracy of a few millimeter and a productivity of more than 2,500 m per hour. Pure relative survey can be done with up to 5,000 m per hour.

Measure Track in Any Location

Use the Trimble GEDO system to collect information on a wide variety of track. You can measure main lines, sidings, and spurs as well as urban trams and metro lines. The system can also measure track in industrial or commercial facilities. Because the Trimble GEDO system can use both GNSS and optical measurement, you are confident of accurate positioning in all locations.

TRIMBLE GEDO FOR TRACK DOCUMENTATION

Fast, Reliable Data Collection
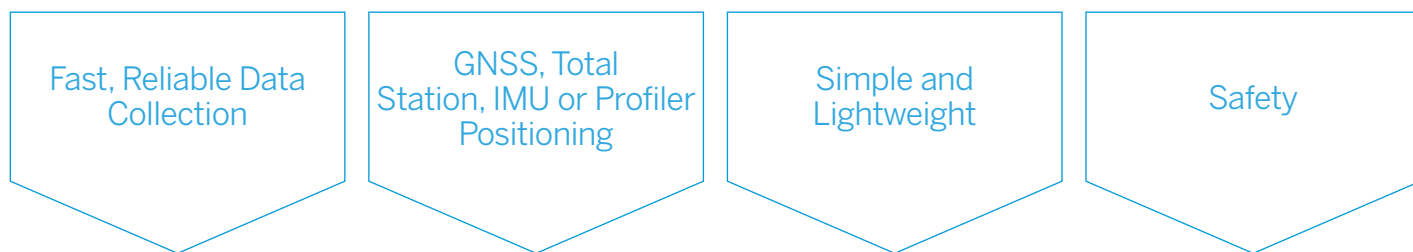
Capture data over long stretches of track

Collect information while in continuous motion

Gather precise measurements on track position, gauge, and cant

GNSS, Total Station, IMU or Profiler Positioning

Gather track position data with high precision

Operate in tunnels and urban areas

Integrate with other Trimble surveying systems

Simple and Lightweight

One person can install and operate the trolley

Single screw adjustment for different gauges

Reduce costs for surveying and inspection

Safety

Minimal disruption to normal rail traffic

Reduce the number of people near the track

Reduce downtime for inspection and maintenance

INTEGRATED TRIMBLE GEDO SYSTEMS FOR TRACK SURVEY AND CONTROL

The measurement of the track position can be done with different GEDO system configurations.

- GEDO Rec for geodetic track surveying with total station or GNSS
- GEDO Vorsys using an alignment methods
- GEDO IMS as a highly deductive system based on inertial measurement technology

The respective field software guides and informs the operator to ensure complete and accurate data acquisition. The Trimble GEDO CE 2.0 trolley can be quickly removed from the track in order to avoid interruption of operations. The GEDO Office software is used for data processing and analysis. Track position data can be transferred to GIS and planning systems.

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Solutions for Precise Slab Track Construction

Slab track construction calls for fast, precise measurements, and immediate feedback. The Trimble GEDO system let you measure for precise adjustments, inspections, and quality checks. In one operation, the Trimble GEDO system captures 3D coordinates of the track, together with gauge and cant. The information is compared to the design, and offsets and correction values are displayed in the field, where work crews make the necessary adjustments.

▶ Before bringing the design to the job site, use Trimble
▶ GEDO office software to check the data and upload to the
▶ field computer. You can import data from popular design software or manually enter the information from paper.

Tools for Slab Track Construction and Alignment

Trimble GEDO integrates measurements, field software and office systems to provide productivity and confidence in construction and quality control. Systems measure horizontal and vertical alignment, cant and gauge in a single operation. Working alongside track construction teams, the Trimble GEDO system provides immediate comparison of actual to design track positions. Construction teams can complete rough and precise adjustments as well as final checking quickly and with high confidence.

Track Construction for High-Speed Railways

The Trimble GEDO measurement systems provide millimeter accuracy for construction, adjustment and inspection. Working in real time, the system displays measurements and information to ensure that rails precisely conform to design. Trimble GEDO systems support high-speed rail construction worldwide
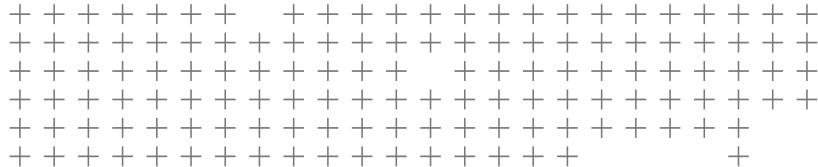
TRIMBLE GEDO IN ACTION:
SUPERVISION SLAB TRACK INSTALLATION AT TUNNEL ZIERENBERG

A.I.T. GmbH was responsible for construction supervision of the ballastless track in the newly built Zierenberg Tunnel of Deutsche Bahn AG. In the project, the connection to the ballasted track was build with the Rheda 2000 system. The rest was build with the IVES system from Rhomberg-Sersa.

The Trimble GEDO CE 2.0 system was used for acceptance measurements prior to concreting and control measurements after completion.

TRIMBLE GEDO IN ACTION:
CONTROL OF SETTLING IN SLAB TRACK HANNOVER - BERLIN

As a service provider for Deutsche Bahn AG the engineering company GI-CONSULT GmbH used the GEDO CE 2.0 system for controlling the settling of the installed slab track (System Rheda) on the high speed connection Hannover – Berlin. The measurements were only taken in nightshifts. The collected data was used to calculate new gradients for the track for nearly 1,000 m and to control around 400 m of reconstructed areas of the slab track. The track is approved for a speed limit of 300 km/h.

TRIMBLE GEDO FOR SLAB TRACK CONSTRUCTION

System for Precise Measurement
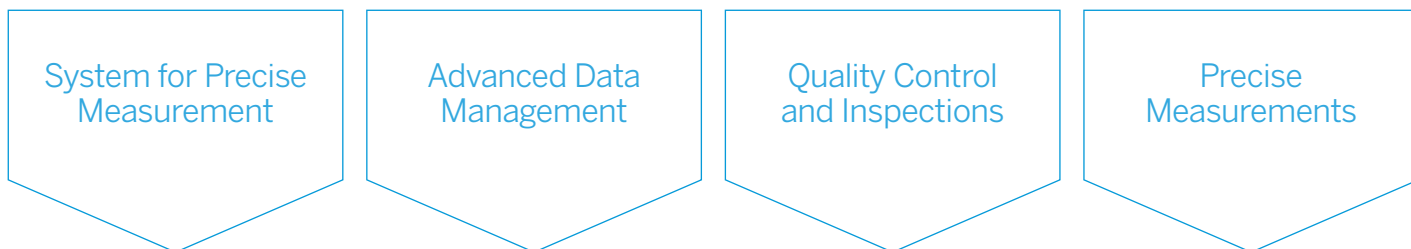
Measure for adjustment, documentation and acceptance

Real-time confirmation of construction results

Display correction values in the field

Reduce construction costs

Advanced Data Management

Import alignment data in industry standard formats

Alignment editor and checking

Support for FAKOP® system widening

Fast, error-free transfer to field systems

Quality Control and Inspections

Compare design to as-built track

Record final configurations

Fast measurement reduces construction delays

Reduce costs for surveying and inspection

Precise Measurements

Build and inspect high-speed rail lines

Millimeter accuracy conforms to project requirements

Reduce downtime for inspection and maintenance

TRIMBLE GEDO SYSTEMS FOR BALLASTLESS TRACK SYSTEMS ON HIGH-SPEED LINES AND METROS

In conjunction with the Trimble GEDO track measurement trolley, the Trimble GEDO Track software enables precise track adjustment during slab track construction and subsequent track position control. The flexible measurement configuration facilitates close cooperation with the construction team. If, due to the setup system used (e.g. portals), no track measuring carriage can be used, the electronic GEDO CE track measuring bar is used in combination with the Trimble GEDO Track software.

The system can also be equipped with rail inclination sensors for adjustment systems in which the inclination of the rail must also be set up or controlled.

The GEDO Office software is used for data analysis, the generation of the plate correction lists and the preparation of the final quality reports.

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Solutions for Railway Tamping Measurements

Tamping is essential for railway maintenance to ensure track quality and stable ballast. Trimble GEDO provides an integrated solution for measurement and quality control to support tamping machines and operations.

Using the Trimble GEDO Trolley, a surveyor collects information about existing track positions. Data is quickly analyzed and prepared for output to the tamping machines. Deliveries of ballast can be planned and tied to specific locations along the track. When the tamping operation is finished, Trimble GEDO trolley re-measures the track to confirm that the work has been carried out correctly.

For safety and convenience, the lightweight Trimble GEDO Trolley can be quickly removed and relocated onto the track. The trolley and operator can stay clear of normal traffic, tamping, and construction machines.

Reduce Surveying Costs for Tamping and Inspection

The Trimble GEDO system provides savings in time and labor costs for pre- and post-tamping surveys. In a single pass, the system collects information on track position, cant, and gauge. The Trimble GEDO Trolley can operate at speeds up to more than 2,500 metres per hour (6,500 feet per hour). The system records all data electronically, eliminating potential delays and errors in handwritten notes. The Trimble GEDO system compares measured data with design information to produce adjustment data needed by the tamping machine.
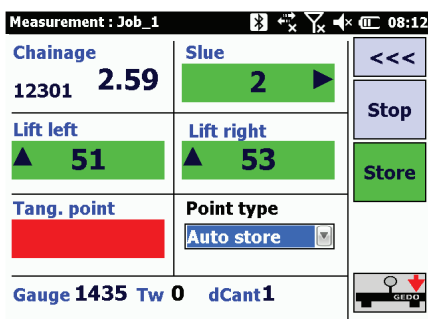
When compared to conventional surveying methods, labor costs are significantly reduced. Digital data management streamlines the capture and transfer of track information. Because the data is collected and checked in the field, the Trimble GEDO system reduces the possibility for costly revisits and rework.
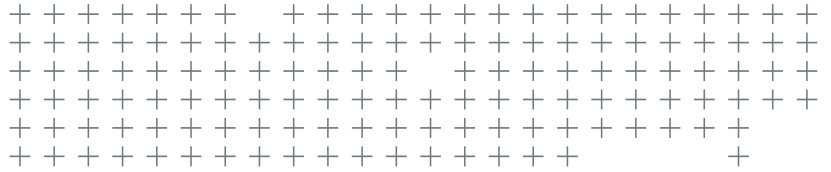
KEY BENEFITS:

▶ Reduce downtime for pre-tamping surveys

▶ Fast field operations reduce idle time for tamping machines

▶ Eliminate errors and delays in data transfers

TRIMBLE GEDO IN ACTION:
SPITZKE SE

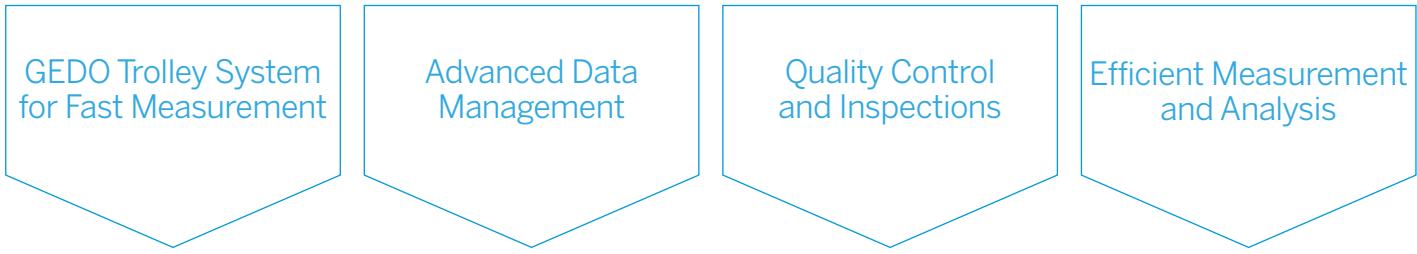Spitzke SE received a contract for rail maintenance from Deutsche Bahn AG. Using the Trimble GEDO system for pre-tamping measurements, Spitzke SE reduced labor costs by more than 80 percent and increased the productivity of the tamping machine by 30 percent. The accurate measurements allowed construction managers to make quick decisions on tamping parameters and the quantity of ballast required.

TRIMBLE GEDO FOR RAIL TAMPING

GEDO Trolley System for Fast Measurement	Advanced Data Management	Quality Control and Inspections	Efficient Measurement and Analysis

Reduce time and costs for pre-tamping surveys

Lightweight and easy to remove from track

Promote safety and schedule flexibility

Quickly process and analyze field data

Prepare data for tamping machines

Fast, error-free transfer to field systems

Fast measurement and results reduces delays

Compare design to existing track

Post-tamping inspections to confirm final configurations

Nominal to actual comparison at fix points

Support for platform edges

Reduce idle time for tamping machines

Reduce downtime for inspection and maintenance

Operate on standard and high-speed rail lines

TRIMBLE GEDO SYSTEMS FOR PRE-MEASUREMENT FOR TAMPING

The pre-measurement for tamping machines and related control measurements can be carried out with different GEDO system configurations:

- GEDO Track as a classical geodetic method with one or two total stations

- GEDO Vorsys as a universal and effective system using alignment methods

- GEDO IMS as a highly productive system based on inertial measurement technology for long distances

The respective field software guides the operator to ensure complete and exact data acquisition. During the measurement the tangent points are displayed and the user is already informed in the field about the deviation from the desired track position.

The GEDO Office software is used for data processing, analysis, data preparation for the tamping machine and the creation of quality reports.

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Solutions for upgrading lines and re-construction projects

Many infrastructure operators face major challenges when upgrading existing lines. Often tamping machines with insufficient precise absolute reference technology are used to measure the existing track. In contrast, a fully-fledged track layout can be created on the basis of a geodetic survey. This offers significantly enhanced driving dynamics and less wear.

However, the installation and measurement of fixed reference points along the track is complex and expensive. The Trimble GEDO IMS system in combination with the Trimble GNSS receiver and the Trimble GEDO Profiler can help.

KEY BENEFITS:

▶ No time-consuming traverse measurement necessary for permanent marking

▶ Productive and precise determination of track position

▶ Consistent data flow from the intake via the leveling line to the tamping machine

Track Survey and reference points

The combination of inertial measurement technology with GNSS enables track recording in an absolute coordinate system with GNSS accuracy. The internal accuracy of the track position is ensured by the inertial measuring system integrated in the GEDO IMS. Parallel to the recording, new points can be determined at any time adjacent to the track with the profiler. The coordinates of the track fixed points are available as a reference for later measurements.
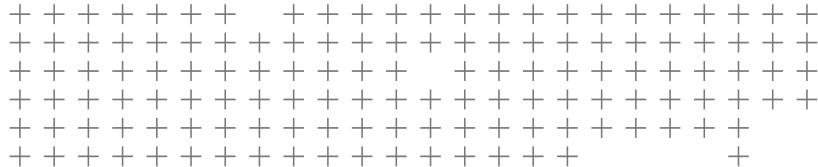
Alignment

The Trimble GEDO NovaTrack software allows the calculation of a new track position from the measured track export. By means of regression algorithms an approximate track alignment is calculated which can be optimized by means of a graphical-interactive editor. A smooth alignment for axis, gradient and superelevation is created.

Construction

All subsequent reconstruction work will be carried out on the basis of the measured track markings and the new alignment. The Trimble GEDO Vorsys and Trimble GEDO IMS systems are used for survey during construction and pre-measurement for tamping work.

The consistent data management during the exchange between field and office systems within the Trimble GEDO system components ensures that the rebuild projects can be carried out without delay and that the plant machinery can be used productively. Infrastructure operators benefit from the improved quality of the track position and shortened project duration.

TRIMBLE GEDO IMS SYSTEM

Integrated System	Efficient Measurement	Modern Data Management	Powerful Data Analysis

Flexible system configuration

Combination of different technologies depending on the field of application

Everything from a single source

Installation and calibration of temporary reference points

Integrated system with GNSS and IMU technology

Combination with laser scanning possible

Fast processing and evaluation of measurement data

Data storage on the basis of a central database

Consistent data storage for all work steps

Joint analysis of data from different sources

Semi-Automatic generation of the compensating alignment

Graphical user guidance for alignment optimization

Direct data output to the tamping machine

TRIMBLE GEDO SYSTEMS FOR LINE UPGRADING AND RE-CONSTRUCTION PROJECTS

The Trimble GEDO IMS system is used in combination with Trimble GNSS and Profiler for the initial measurement of the existing track. The result is a trajectory of the actual track position and coordinates for the temporarily marked and with the profiler measured reference points. Based on this data, the Trimble GEDO NovaTrack software calculates a smooth alignment and optimizes and adjusts it according to the project specifications. The differences between the nominal and actual track position can be used immediately for tamping work. In large conversion projects with several tamping runs, the temporary marking is used for track laying and the subsequent pre-measuring work for the tamping machines. The Trimble GEDO IMS System with Profiler or the Trimble GEDO Vorsys System are used as a pre-measurement system.

The Trimble GEDO Office and Trimble GEDO NovaTrack software packages are used for data processing, analysis, route calculation, data preparation for the tamping machine and the creation of quality reports.

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Solutions for asset data collection and clearance analysis

As demand for rail transport increases, railways are introducing rolling stock that is faster and larger than existing rail cars. To ensure that tracks and facilities can support the new cars, railways need to collect detailed information about existing tracks and surrounding structures.

The Trimble GEDO Scan System combines precise positioning with 3D laser scanning to capture high-density information in tunnels and underpasses, stations, rail yards and other areas where clearance tolerances are critical. Trimble GEDO Scan replaces slow, labor-intensive measurements with high-speed measurement and automated data collection.
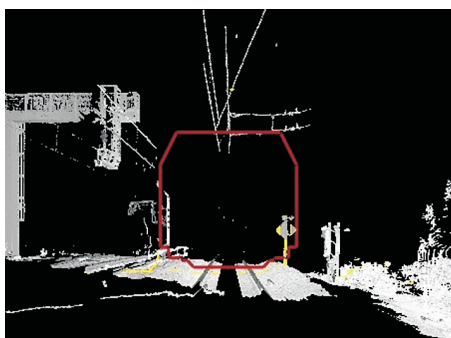
3D SCANNING FOR RAILWAY APPLICATIONS

Railway Design

▶ Develop accurate, detailed models of existing conditions. All features can be tied directly to the track alignment

▶ Detect and analyze clearance encroachments. Compare clearance envelopes against existing features and provide information for track clearance databases

▶ Test new designs using Trimble visualization and animation tools

Construction

▶ Final inspections

▶ As-built documentation / survey

▶ Quality control

▶ Clearance Analysis

Asset Management

▶ Collect information on railway facilities and structures

KEY BENEFITS:

▶ Fast, accurate data collection and processing

▶ Reduce time on site and downtime for surveys

▶ 3D point clouds for design and analysis

▶ Quickly identify clearance issues

▶ Plan new construction and rolling stock with confidence

TRIMBLE GEDO IN ACTION:

CLEARANCE DATA FOR THE *LIRA* DATABASE OF DEUTSCHE BAHN AG

As a service provider for Deutsche Bahn AG and contractor for the construction companies, Ingenieurbüro Herzbruch GmbH has been using the GEDO Scan System for clearance measuring for many years. The clearance profiles are measured at critical points along the tracks and the information obtained is processed for Deutsche Bahn AG's *LIRA* database.

TRIMBLE GEDO SCAN SYSTEM

GEDO Trolley System for Fast Measurement

Collects scanning data, location, gauge, and cant in one operation

Fast, lightweight and easy to remove from track

Safety and schedule flexibility

Collect Data for Planning and Design

Create 3D models of critical areas

Precise, detailed information on track and structures

Analyze clearance issues

Develop cross section drawings

Optimized Systems for Railway Scanning

Collect thousands of points each second

Capture complete profiles in tunnels and underpasses

Absolute or relative positioning

Collect complete scan data in a single pass

Integrated System

Streamlined data flow

Single system for measurement, processing and data analysis

Combine scanning with data from other Trimble GEDO applications

TRIMBLE GEDO SYSTEMS FOR ASSET DATA COLLECTION AND CLEARANCE ANALYSIS

A laser scanner is operated in helical mode on the Trimble GEDO CE 2.0 trolley to generate exact 3D data along railway tracks during movement. If the laser scanner is not required for measurements with the Trimble GEDO system, it can be used for static measurements in other projects.

The GEDO Scan System, consisting of the Trimble GEDO CE 2.0 trolley and laser scanner, is used for simple clearance checks. Trimble GEDO Scan System can be combined with other GEDO systems for asset data collection and advanced clearance analysis.

- GEDO Scan with GEDO Rec for classical geodetic recording
- GEDO Scan with GEDO Vorsys as a universal system using the alignment method
- GEDO Scan with GEDO IMS as a highly productive system based on inertial measurement technology optimized for long distances and subways

GEDO Scan Office software is used for data processing and analysis. The results are high-resolution 3D point clouds of the entire track system on the basis of which the object documentation and clearance analysis is carried out.

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The Versatile Solution for Rail Measurements

The Trimble GEDO Trolley provides the ultimate in productivity and flexibility. Developed based on years of experience, Trimble GEDO Trolley is a key component of Trimble GEDO field measurement systems. Easily adjusted to fit different track gauges, the lightweight trolley is designed for operation by one person. Powered by removable Trimble S-Series batteries, the system can operate for up to sixteen hours before replacing the battery.
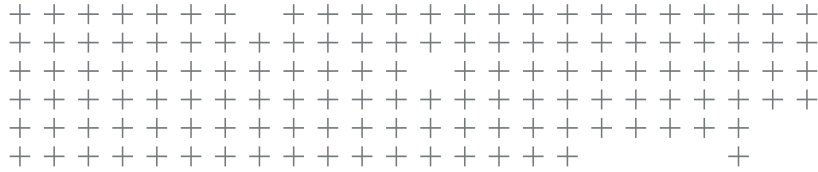
TRIMBLE GEDO CERTIFICATION

The Trimble GEDO CE 2.0 is approved by Network Rail (United Kingdom), SNCF (France) and other railway operators worldwide as track measurement equipment. Within the scope of the approvals, the compatibility with the network, the suitability of the test method, the functionality as well as the operational safety and ergonomics were verified. The Trimble GEDO CE 2.0 track measuring trolley meets the requirements of DIN EN 13977 „Safety requirements for portable machines and trolleys for construction and maintenance" and is therefore also approved for use at DB AG and on other European networks.

Benefits

▶ Lightweight, easy to use by one person (depending on configuration)

▶ Configurable to work with onboard Trimble GNSS, Scanner, or Total Stations

▶ Built-in sensors for rail gauge and cant

▶ Onboard cable-free Bluetooth® communications

▶ Removable rechargeable batteries for reliable power

▶ Single- and dual-trolley configurations to optimize speed and accuracy

▶ Non-profiled rollers for long life and low maintenance

▶ Specially raised trolley available for ballastless track projects with Iron Horse equipment systems

Product Specifications

▶ Description: Track-mounted trolley

▶ Gauge: 1000 mm, 1067 mm, 1100 mm, 1435 mm, 1520 mm, 1600 mm, 1668 mm, 1676 mm, other gauges on request

▶ Gauge Measurement Range: −20 mm to +60 mm

▶ Gauge Measurement Accuracy: ±0.3 mm

▶ Cant Measurement Range: ±9° or ±235 mm

▶ Cant Measurement Accuracy: ±0.5 mm (static)

▶ Weight: 16.0 kg

▶ Power: Self-contained, in-field replaceable

▶ Battery Type: Trimble S-Series Li-Ion, rechargeable

▶ Battery Life: 6–8 hours

▶ Certified by: Network Rail (United Kingdom), SNCF (France) and other rail companies around the world

TRIMBLE GEDO HARDWARE

1 Trimble S-Series Total Station

2 Laser Scanner

3 Precise prism

4 Active MultiTrack Target

5 Trimble GEDO Profiler

6 Trimble GEDO IMU

7 Trimble GNSS Receiver

8 Trimble Controll Units

A Brake

B Pushing rod

C Universal mount

D Roller

E Gauge adapter

F Inclination sensor

G Battery holder

H Electronic box with bluetooth

I Gauge sensor

J Spring loaded contact

Non-profiled rollers for long life and low maintenance; Bearings 14 mm below rails

Elevated trolley for slab track construction using iron horses

Adapter available for different track gauges

Battery holder with in-field replaceable S-Series Li-Ion batteries

LED strip for illumination

Integrated electronic box with Bluetooth communication

Integrated Software for Efficiency and Accuracy

Seamless Flow of Data and Information for Measurement and Analysis

The Trimble GEDO System ensures easy, secure data management throughout data collection and analysis. In the office, GEDO software provides data management and analysis in a modern, cohesive software environment. Importing data from external sources - both digital and paper plans - is fast and efficient. You can quickly complete your work and provide deliverables to clients and colleagues.

KEY BENEFITS:

▶ Simple operation and clear user interface with focus on the essentials

▶ Integrated software eliminates data reformatting and transfers

▶ Consistent look and feel streamlines workflows and reduces training needs

Software für den Einsatz im Feld

Trimble GEDO Field software provides powerful functionality and excellent user interface addressing various applications.

GEDO Doc: Used for entry level track control in combination with the track measuring trolley GEDO CE 2.0 for collecting gauge, cant and twist parameters.

GEDO Rec: Used in combination with the track measuring trolley GEDO CE 2.0 and a Trimble total station or a Trimble GNSS receiver. Based on the measurements the left rail, center line and right rail together with the cant and gauge are calculated and visualized live in the field. The software supports also the use of the Trimble Profiler to measure side offsets and height differences.
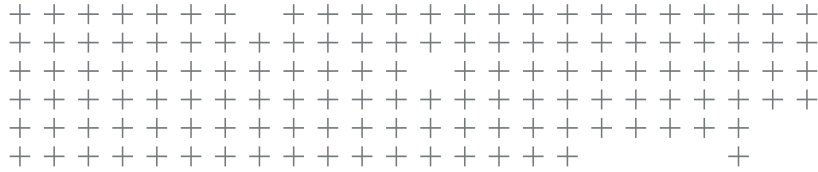
GEDO Track: For geodetic alignment based measurement. Based on the measurement, the differences between actual and target are displayed live in the field according to the track design together with the current station and the next tangent points. The calculation can be carried out either horizontally or in an elevated system.

Variant *GEDO Track Survey* is a software for several survey tasks at railway lines.

GEDO Track Trolley is used in combination with the track measuring trolley GEDO CE 2.0 and a Trimble total station or a Trimble GNSS receiver. Based on the measurements from the geodetic sensor and the cant and gauge values from the trolley the differences between design and as-built are calculated and visualized online in the field. These are calculated horizontal and in the elevated track system for the complete track (left and right rail).

If, due to the construction method or the low construction output, no track measuring carriage can be used, the *GEDO Track Bar* variant with the Trimble GEDO track measuring bar is used.
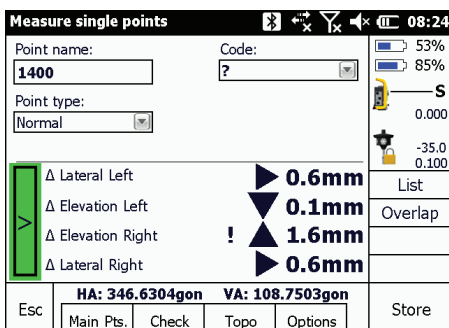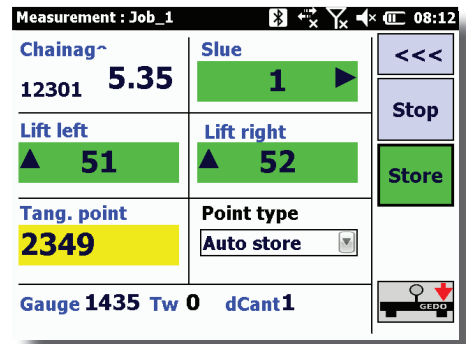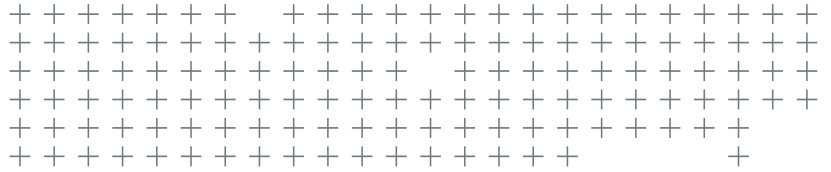
GEDO Scan: Supports the kinematic data collection of laser scan data in combination with a Trimble GEDO CE 2.0 trolley and a Trimble or Faro laser scanner. Data can be collected stand alone, in combination with GEDO Rec, GEDO Track or GEDO Vorsys as well as fully integrated with GEDO IMS.

GEDO IMS: Software for flexible and productive usage for several track survey applications. It's used in combination with the Trimble GEDO CE 2.0 trolley and the Trimble GEDO IMU. If used for track survey on lines with reference points along the track the Trimble GEDO Profiler is added to the setup. For re-construction projects without reference points additionally a Trimble GNSS receives is used. Combined with a laser scanner the software controls the full three dimensional data collection.

GEDO Vorsys: Software for high productive pre-measurement for tramping or track survey utilizing two trolleys in combination with a Trimble S-Series total station. The alignment based measurement method guarantees high inner accuracy and very high productivity. Measurements can be taken based on classic paper plans or based on digital alignment data. All differences between design and as-built are shown in field. An optimized user interface enables the usage by non survey staff.

Measurement : Job_1		08:12
Chainag^ 12301 **5.35**	**Slue** **1** ▶	**<<<**
Lift left ▲ **51**	**Lift right** ▲ **52**	**Stop**
Tang. point **2349**	**Point type** Auto store ▾	**Store**
Gauge 1435 Tw 0 dCant1		

GEDO Software

	GEDO Office Base					Data Preparation
GEDO Doc	GEDO Rec	GEDO Track	GEDO Vorsys	GEDO IMS	GEDO Scan	In-field measurment
	GEDO Office Modul Rec		GEDO Office Modul Vorsys	GEDO Office Modul IMS	GEDO Scan Office PreProcessing	Data Processing
	GEDO Office Modul Tamp				GEDO Scan Office Point Cloud	Data Analysis
	GEDO Office Modul Quality				GEDO Scan Analysis	
	GEDO Office Modul Monitoring					
	GEDO NovaTrack					Planning

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Software for Data Processing and Analysis in the Office

GEDO Office Base: Module for alignment data input and import of design data. Standard design data formats are supported (e.g. Verm.ESN, LandXML). Alignment data can be checked to verify the use of the data in the field.

GEDO Office Module Rec: Module for processing GEDO Rec field data. Station setups can be re-calculated. Different matching algorithms are used to connect the overlapping areas. Coordinate export for the left rail, center line and right rail together with the cant and gauge values. Based on alignment data the differences between design and as-built are calculated.

GEDO Office Module Vorsys: Module for processing GEDO Vorsys field data. Measured data can be re-processed based on another design or new reference point coordinates. Processing of measurements taken without alignment data for track survey purposes.

GEDO Office Module IMS: Module for processing GEDO IMS field data. Measured data segments can be analyzed and re-processed based on new reference point coordinates as well as merged to a line. The differences between design and as-built are calculated.

GEDO Office Module Tamp: Module for data preparation for tamping machines. Measured and processed data from GEDO Rec, GEDO Track, GEDO Vorsys and GEDO IMS measurements can be used. A graphical interface allows an easy ramp definition by ocusing on minimum lift values, maximum lift and shift values and other constraints. Data for all common tamping machines can be output.

KEY BENEFITS:

▶ Simple and clear user interface and operation

▶ Flexible data adjustment and recalculation taking into account any data or framework modifications

▶ Individual definition of parameters for calculation and output

▶ Concise quality reports

GEDO Office Module Quality: Generates reports on the quality of the track. In addition to flexible travel chord evaluations, special calculations can be carried out and special formats such as MKS (manual replacement measurement DB AG), Speed Raiser (Network Rail) or TUCRail (Belgium) can be created. For slab track projects, the necessary corrections are optimized and correction lists are created.

GEDO Office Module Monitoring: Module for comparison of measurements from different epochs for monitoring tasks and control of tamping work.

GEDO Scan Office: The *GEDO Scan Pre-Processing* Module pre-processes GEDO Scan measurements. Purely relative measurements are then available immediately. Absolute measurements as geo referenced 3D point cloud for analysis after synchronization with the track geometry.

The *GEDO Scan Office Point Cloud* module enables track-specific analysis of the point cloud. The distances of objects relative to the track position or between objects can be measured. The clearance can be checked with a static frame or on the basis of a wagon model. The position of the adjacent track can be detected from the scan. Overhead lines are detected and the distances to the track position are calculated. Points can be taken directly from the point cloud and line objects can be registered automatically. Cross profiles generated along the route are further processed and vectorized with *Trimble GEDO Scan Analysis*. After automatic dimensioning, the DXF export takes place.

In addition to the data kinematically recorded with the Trimble GEDO Scan System, static laser scan data and point clouds can also be processed by the Mobile Mapping System.

Additional modules (e.g. *WinLUE*, *Clearroute*, *Banedanmark*) allow the export of analysis results according to the requirements of the infrastructure operators for the respective clearance databases.

GEDO Nova Track: For semi-automatic calculation of new alignments or new proposed track based on GEDO measurements. Trimble GEDO NovaTrack takes into consideration various specifications and limiting factors for smoothing design. Interactive graphical views with editing commands allow the end user to quickly generate a workable solution. There is a direct data exchange with GEDO Office to use GEDO measurements and return the alignment (axis, gradient, superelevation). This can be used immediately for as-build comparison and preparation of tamping data.
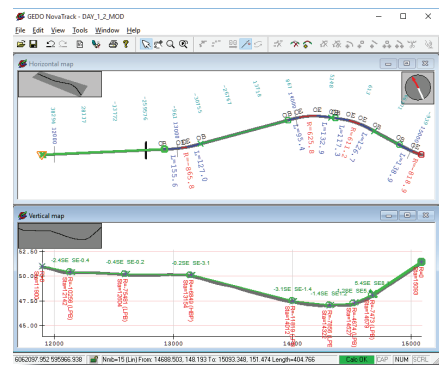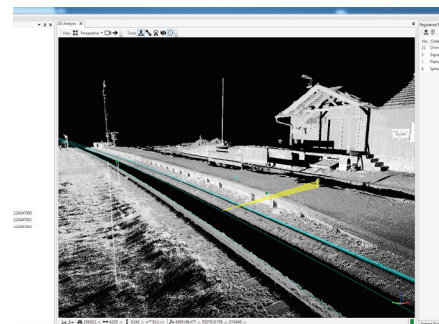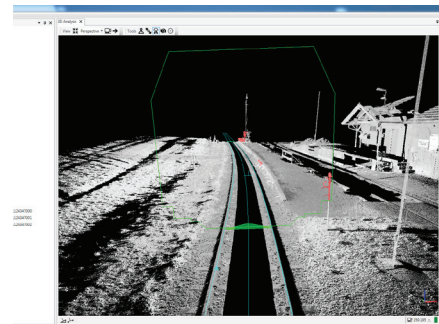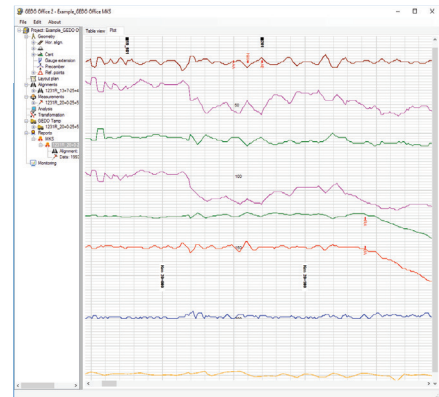
⊕ Trimble.

The Components of Accuracy

By integrating Trimble technologies for measurement and information management, Trimble GEDO systems are tailored to the environment and applications of the railway industry. Trimble instruments and systems are designed to meet exacting standards of performance under the most challenging conditions. The flexible, modular design lets you adapt Trimble GEDO system to meet changing and expanding needs.

▶ The Trimble GEDO measuring trolley can be equipped with GNSS as well as with optical instruments and inertial measuring technology for position determination.

▶
ADVANCED TECHNOLOGY FOR EFFICIENT MEASUREMENT

Trimble instruments provide world-class performance in precision and reliability. For track documentation in open areas, you can use Trimble GNSS with standard RTK or Trimble VRS™ corrections. To measure in tunnels, stations and congested or urban zones, If the application calls for the highest precision, use Trimble Total Stations for fast, reliable measurements.

ADVANCED TECHNOLOGY FOR EFFICIENT MEASUREMENT

Control Units

The powerful Trimble control units offer integrated communication modules and cameras in a robust and portable format. Thanks to the large display with touchscreen operation, all information can be viewed on site on the Trimble control units. A full Microsoft® Windows® 10 Professional 64-bit operating system means high data security and support for many other Trimble software products.
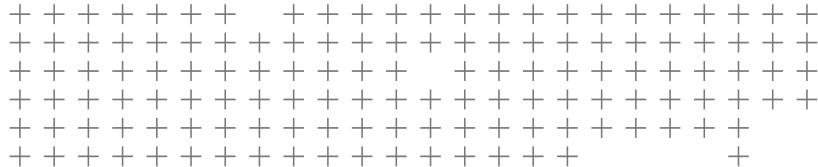
Trimble TSC7

The Trimble S7 and S9 Total Stations provide automated tracking and measurement with millimeter precision. Trimble Total Stations let you meet demanding tolerances for precise track positioning. Robotic measurement & free stationing gives the greatest flexibility & efficient operation.

Trimble T10

The robust Trimble T10 Tablet offers this functionality in a robust tablet format. The easily pluggable keyboard with track pad also allows it to be used as a full-fledged computer for evaluation,

KEY BENEFITS:

▶ All system components from a single source

▶ Universally applicable instruments

▶ Modular combination for flexible expansion and adoption to the respective measuring task

Trimble S-Series Total Station

The Trimble Total Stations provide automated tracking and measurement with millimeter precision. Trimble Total Stations let you meet demanding tolerances for precise track positioning. Robotic measurement & free stationing gives the greatest flexibility & efficient operation.

Trimble GNSS

Trimble GEDO Systems let you choose from a range of Trimble RTK GNSS receivers. Trimble's modern GNSS receiver combines advanced GNSS tracking and computation technology to ensure reliable results in challenging conditions.

Trimble GEDO IMU

Highly accurate and fully integrated sensor based on inertial measurement technology for track survey applications in combination with the Trimble GEDO CE 2.trolley. The measurements can be carried out precisely, quickly and almost independently of weather influences.

Trimble Scanner TX6/TX8

Trimble TX6/TX8 laser scanners are highly versatile scanning solutions for a broad variety of scanning applications. The compact and lightweight design, improved range, and simple, intuitive operation allow fast and accurate measurements of complex environments. In combination with GEDO Scan Systems they are used in helical mode. This achieves very high accuracy in the distance measurement between objects and the track.

Trimble GEDO Profiler

Used for fast and accurate measurement of objects close to the track. Enables the geo referencing of measurements carried out with the inertial GEDO IMS system.

Trimble GEDO Rail Inclination Sensor

These sensors are connected to the Trimble GEDO CE 2.0 track measuring trolley and are used to measure the inclination of the individual rails.

MAXIMUM RETURN ON INVESTMENT

The Trimble GEDO system helps you get the most from your Trimble positioning systems. When your Trimble instruments are not at work with the Trimble GEDO Trolley, you can use them on other projects. Your Trimble Total Stations, GNSS, Scanners and Field Controllers provide world-class performance in applications for surveying, construction, planning and industrial measurement.

Trimble.

Customized Solutions

Around the world, different construction methods require different approaches to track measurement. In many areas, new approaches to increase quality and reduce costs are being developed and tested. In addition to Trimble GEDO trolleys and software, Trimble can develop measurement solutions that are tailored to your construction needs. The Trimble GEDO staff of in-house development experts provide fast, flexible implementation for your needs.

BÖGL SPS IN ACTION:
MAX BÖGL NEW RAILWAY PROJECT EBENSFELD - ERFURT

The German based MAX BÖGL uses the custom specific SPS and SSPS systems to adjust more than 10,000 standard, special, compensation, and turn-out slabs. Some of the major challenges for the 32,3 km project that had to overcome were the difficult site access and time constraints.

TRIMBLE GEDO SPS SYSTEMS FOR PLATE ADJUSTMENT
GEDO SPS

Trimble GEDO SPS is a single-source system developed from years of on-site experience. During plate adjustment, the GEDO SPS measuring bar communicates with a Trimble TSC3 Controller running GEDO SPS software. Results are displayed immediately in the field and the workers can make adjustments according to the measured information.
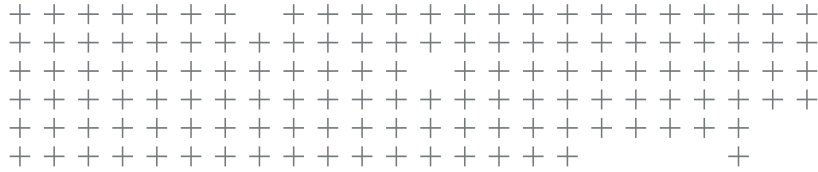
GEDO J-Slab

Developed to support Japanese slab track techniques, Trimble GEDO J-Slab is optimized to support larger ranges for side and height adjustment. You can use GEDO J-Slab for mounting Japanese slabs, and then use GEDO Track for fine adjustment of the rails.

GEDO Systems for Slab Track Bögl

Developed in cooperation with Max Bögl, the Bögl SPS and Bögl SSPS systems enable precise adjustment of the Bögl system of preassembled rail plates. The Trimble solution provides high inner coherence and fast construction. These specialized applications support construction of high-speed switch slabs.

Trimble GEDO Track Measuring Bar

The Trimble GEDO Track Measuring bar is an ideal solution for slab track measurements when the Trimble GEDO Trolley is not suitable or when you need to measure only a few locations on the track. It's easy to carry and place the bar where needed.

▶ Built-in gauge and cant sensors

▶ Bluetooth communications to Trimble field controllers

▶ Optical target for positioning with Total Station

▶ Fast and lightweight

Trimble Track Measuring Tools

Railway survey work requires specialized equipment and tools. Some work can only be done if you have the right tools tailored to the job at hand. For other jobs having specialized tools will increase the productivity and accuracy of your results. Trimble offers a wide range of solutions to meet country specific as well as worldwide needs for railway survey work.
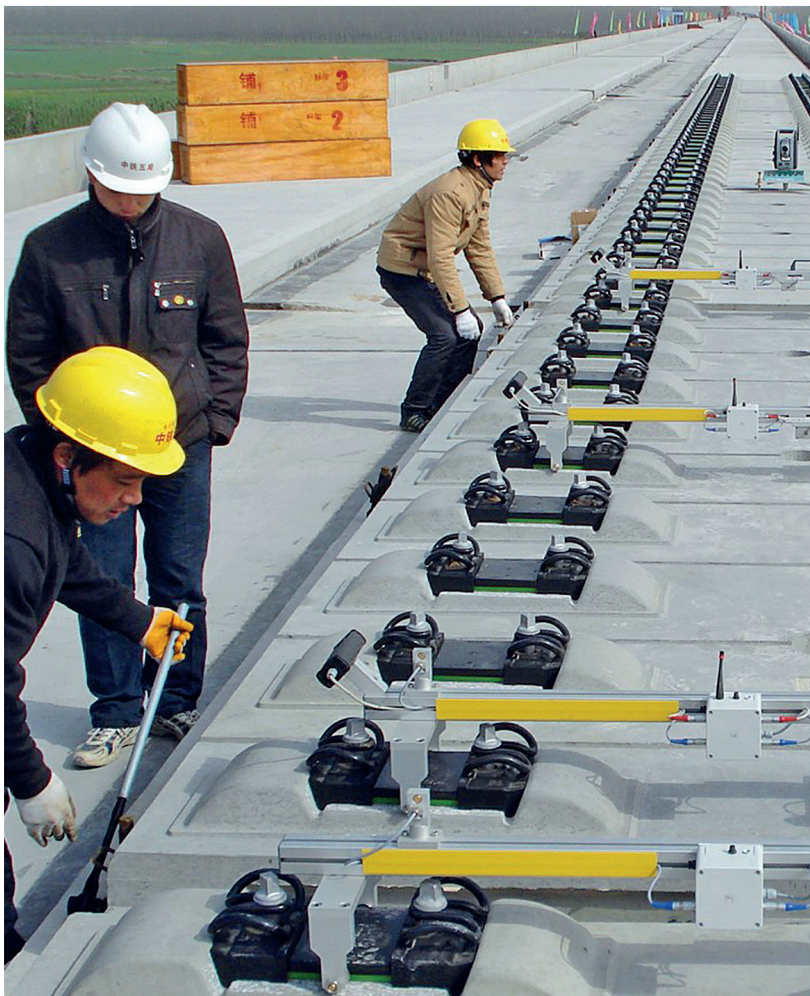
TRIMBLE GEDO SPS SYSTEM

The Trimble GEDO SPS system is a flexible measurement solution to adjust pre-fabricated slabs. The adjustment is done based on digital alignment data and precise reference points.
The system can be adapted to various slab types, workflows and construction methods where no rail is installed during adjustment.

All measurements are made by a Total Station in combination with additional sensors and special bars which are positioned on the slabs.

The Trimble GEDO SPS system provides precise correction values for height and side adjustment at all necessary locations on the slab. An easy user interface enables construction workers to operate the system.
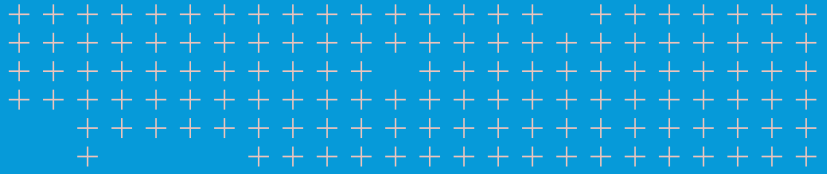
About Trimble

Founded in 1978, Trimble is a publicly traded company headquartered in Sunnyvale, California. Trimble serves its customers with employees and distribution partners in more than 100 countries. The company's more than 1,800 patents provide the basis for the broadest portfolio of positioning solutions in the industry. Trimble's integrated solutions allow customers to collect, manage and analyze complex information faster and easier, making them more productive, efficient and profitable.

Trimble Railway solutions combine measurement with data management, communications and customized software to deliver accurate information with speed and reliability. Trimble solutions enable advanced process and workflow integration for a more streamlined operation. From feasibility studies through construction and operation, Trimble Railway solutions help keep your operation running smoothly and safely.

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TRANSFORMING THE WAY THE WORLD WORKS

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