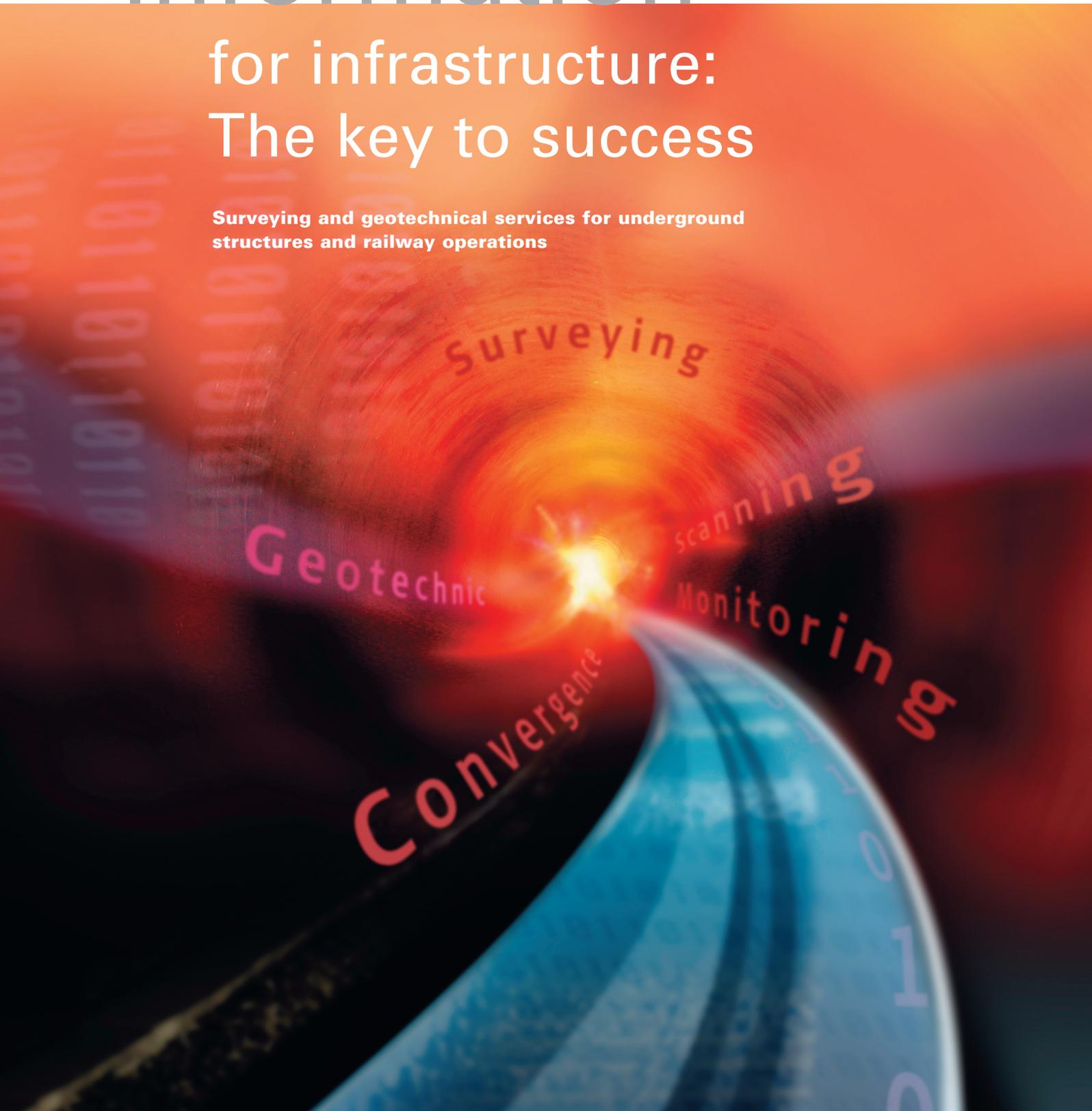


# Information

for infrastructure:  
The key to success

Surveying and geotechnical services for underground  
structures and railway operations



# Information for infrastructure: The key to success



**The requirements on public construction are continuously increasing. At the same time, these projects are subject to heavy cost pressure. Optimal solutions can only be obtained when complete information about infrastructure is available.**

Whether quality, safety, environment or cost-effectiveness: in recent years the requirements placed upon public construction have grown significantly. Politics and society are setting high standards on infrastructure projects.

For clients, designers and contractors, the right information at the right time is the key to success. Amberg Technologies is a proven partner for the acquisition, analysis and provision of valuable information in selected specialist fields related to infrastructure.



## The needs of the client

The requirements placed on infrastructure works are extensive: high quality, adherence to schedules and costs during construction, as well as the highest possible availability and safety during operation must be achieved under continuously increasing cost pressure.

The basis for decision making and compliance with these requirements is provided by comprehensive, correct and informative data and information during the entire life cycle of a structure.



## The needs of the contractor

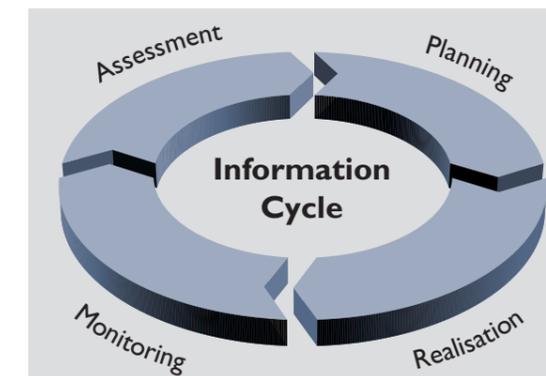
Whether new construction or refurbishment: the need for information is increasing. Requirements on the quality of data are becoming more complex and more time-critical.

Cooperation with external partners has many advantages:

- Fewer contacts
- Minimisation of own risk
- Purchase of professional Know-how
- Calculable price
- Best price-performance ratio

# Advantage through information

**The procurement of information is a key element of the construction process. The information obtained can be used during the entire service life of a structure.**



## Complete solutions

Amberg Technologies provides not only individual services, but also complete solutions. The tasks are undertaken in order to obtain optimal benefits for our clients.

## Profit-yielding synergies

Many years of experience, varied specialist skills and modern technologies are combined in the Amberg Group. Companies that choose Amberg as their partner benefit from profit-yielding synergies during the realisation of construction projects.

**With innovative measurement solutions, Amberg Technologies makes a decisive contribution during the planning, construction and maintenance of complex infrastructure. The range of services is comprehensive:**

- Tunnel surveying
- Geotechnical monitoring
- Railway surveying
- Engineering surveying
- Clearance profile analyses
- Laser scanning
- Shaft surveying
- Graphical data display
- Consulting
- Expert assessments



# Railway surveying: complete information

**Safe operation, accurate data and costs as low as possible: these are the objectives of railway surveying and demand exact information about the infrastructure. These aspects are crucial for operational safety and reliability as well as for maintenance, both for modifications and for new construction.**



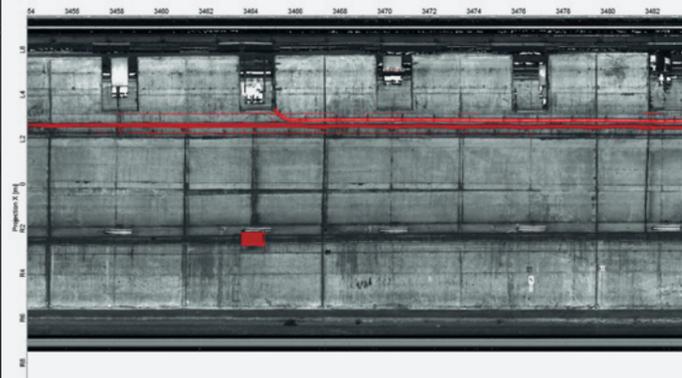
## Clearance analysis, Toronto subway

**Task:**  
Over the next few years, the subway in Toronto will change to a higher track cross-section. This work requires a complete study of the existing system as the basis for the planning and dimensioning of the new tracks. The flexibility of the system is important, as access is only possible during the short breaks in operation at night.

**Solution:**  
The measurements were made using the scanner system GRP5000. With a measuring performance of approx. 1.5km per hour, it was possible to achieve a point density of 20 mm. In two five-hour night shifts and three two-hour night shifts, a total of more than 21 km of subway track was measured.

**Results:**  
A clearance analysis was undertaken as a function of the track radius. All objects

protruding into the clearance profile were detected with co-ordinates and exported to a spreadsheet. In addition, the customer received the digital data and a viewer software so that the data can be utilized during the subsequent planning process.

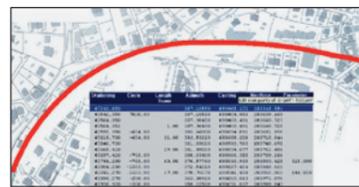


<b>Object:</b>	Toronto subway, Canada
<b>Task:</b>	Clearance analysis as basis for planning
<b>Solution:</b>	Measurement using GRP5000 system Clearance evaluation using dynamic, radius-dependent clearance profiles
<b>Special features:</b>	21 km of subway track measured completely in 16 hours
<b>Result:</b>	Informative basis for planning and decision making in the form of complete tunnel documentation



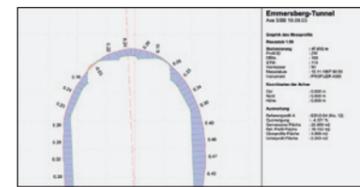
## Track surveying

Thanks to the latest surveying systems developed by Amberg Technologies, existing tracks are seamlessly recorded and documented, and quality checks are undertaken. Examples include integrating track fix points and a geodetic railway network, absolute track position, cant and track gauge.



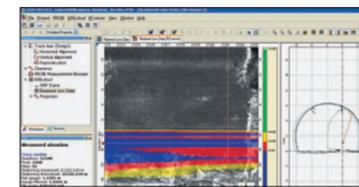
## Design studies and optimisations

Today there is an increasing need to modify existing tunnels in accordance with the ever stricter requirements placed upon railway operators. In collaboration with planners and operators, Amberg Technologies delivers design studies and optimisations using the latest software.



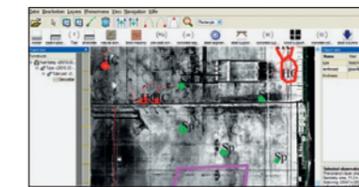
## Individual clearance checks

If the entire tunnel surface does not require clearance checks before approving a structure for operations, individual localized checks are the solution: specific encroachments are detected and surveyed using laser measurements.



## Complete clearance analysis

For planning and renovation work, complete clearance profile analyses are prepared with the aid of the latest scanner technology. This data and information provides the basis for planning parameters and supports the monitoring of construction activity.



## Inventory surveying and assessment

Full-surface scanner measurements can be used to record surface features through high quality grey-scale images as well as geometric data for damage registers and object mapping. The comparison of images enables information to be obtained about changes in condition of objects and structures.

« Modern scanner technology opens a new information dimension »

# Tunnel surveying and geotechnical measurements: the right information in the right place

In modern tunnel construction and specialised civil and underground engineering, surveying and geotechnical measurements often share the same basis. By combining these two areas, Amberg Technologies optimises processes and reduces costs.

## Tunnel guidance

The use of modern and straightforward guidance methods makes it possible: even with difficult geometrical project data, tunnelling can be guided precisely with few people. The tunnelling team is optimally integrated into the setting-out process.

## Excavation control

Whether traditional controls using total stations or 3D laser scanning: Amberg Technologies ensures maximum quality and cost-effectiveness of excavation controls with hardware and software solutions specially developed in-house for tunnel construction.

## Complete survey documentation

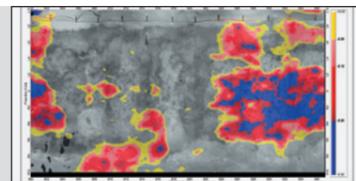
Maximum reliability during monitoring and documentation of infrastructure: provided by comprehensive measurements with 3D scanner technology combined with highly specialised software. Geometric information is obtained for quantitative and qualitative optimisation during all construction phases.

## Gotthard Base Tunnel

**Task:**  
The 57-km long Gotthard Base Tunnel is part of the new rail system through the Alps known by its German acronym NEAT. Amberg Technologies is responsible for surveying, geotechnics, surface measurements and geophysics in Section Faido, a subsection containing a large multifunction station.

**Solution:**  
Amberg Technologies is using the latest technology in a wide variety of areas:

- Heading survey with motorised laser
- Laser scanner for surface checks
- Varied geotechnical instrumentation
- Radio-controlled data download from geotechnical instruments

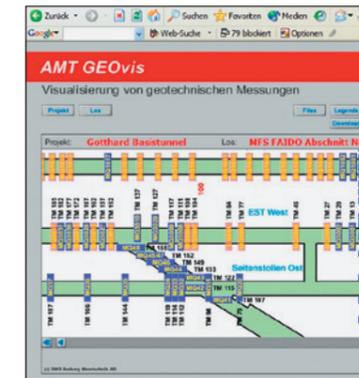


- In-house developed software, from tunnel guidance to construction documentation
- Seismic prediction and tomography in advance of excavation



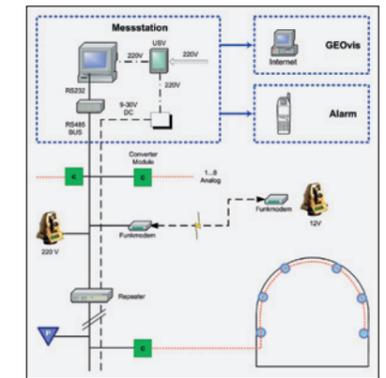
## Geotechnics from A to Z

From the supply of instruments to comprehensive solutions during the planning, construction or operation: Amberg Technologies optimally covers the entire spectrum of geotechnical measurements with skilled employees, modern measuring techniques and a quality assurance system in accordance with ISO9001:2000.



## Data flow from the site to the user

With personal password-protected access to the Internet platform GEOvis, engineers and decision makers have unlimited access to the results, which through simple graphics can also be easily identified and interpreted. Safety-related data or data of structural relevance can therefore be retrieved as necessary.



## Manual or automatic

From manual measurements and evaluations to powerful automatic monitoring systems with alarms: GEOvis increases safety on major construction sites and during projects with special risks.

**Results:**  
Tunnels excavated in this manner are geometrically correct. Information on the geotechnical behaviour of the various tunnel areas is provided in graphical form on the Internet using GEOvis. Documentation is prepared for surfaces and geometry, an informative basis provided for optimising logistics and billing the lining construction work.

« Optimal synergy by combining tunnel surveying and geotechnics »



<b>Object:</b>	Gotthard Base Tunnel, section Faido
<b>Task:</b>	Comprehensive geo-services from a single source
<b>Solution:</b>	Optimised deployment of personnel using the latest measuring technology
<b>Special feature:</b>	Use of laser scanning for undulation measurements and optimisation of the concrete of the inner lining
<b>Result:</b>	Quantitative optimisation of the concrete logistics, clear facts for the billing of work performed, complete construction documentation for quality management

# Engineering surveying: networked information

Amberg Technologies employs the latest innovative technology and measuring methods. The range of services covers the majority of surveying tasks and encompasses everything from simple tasks to complex specialist surveying.



## Basis information

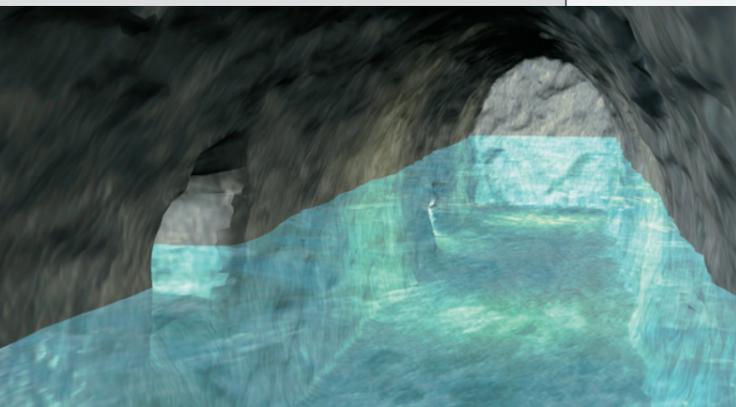
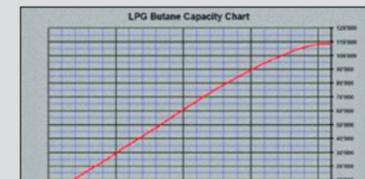
The quality of surveying to obtain basis information is often crucial for the success of activities such as design, calculations, setting-out and construction. Whether a fixed point network, digital terrain model, centre line calculations or measurements of existing objects: Amberg Technologies supplies optimal basis information over the entire infrastructure life cycle.

## Volume calibration in Shantou

**Task:** Butane and propane gas storage caverns in China. 55 to 135 metres below sea level. Calculation of the total volume of each cavern system. Calculation of the calibration curve for indicating the fill level.

**Solution:** Measurement of the entire surface using a 0.3 metre grid in a local coordinate system of each cavern. 3D modelling based on measured data.

**Results:** Calibration figures in the form of Excel tables and graphics of the contents at height intervals of one centimetre. Virtual 3D model.



<b>Object:</b>	Gas storage caverns, Shantou, China
<b>Task:</b>	Volume calibration of the storage caverns
<b>Solution:</b>	Complete measurement using reflectorless measuring systems
<b>Special feature:</b>	Extreme measuring conditions due to high temperatures and atmospheric humidity in the sealed cavern systems
<b>Result:</b>	Highly accurate information on the current gas quantity using the fill level calibration curve

## Pressure pipe, Cleuson-Dixence

**Task:** 4.32 kilometre long pressure pipe with a height difference of 1883 metres. Check on adherence to the profile and deformation as well as surveying of the absolute position of the pressure pipe.

**Solution:** The fixed point network was based on GPS measurements at the portals. As no welding work was allowed in the pres-

sure shaft, Amberg Technologies developed special mounting brackets that were fastened to bonded supports. The profiles were measured using the profiler system P100 on special stands. The measuring software developed specifically for the project informed the operator about deformations while the measurement was made. The P100 was calibrated from the shaft carriage using an RF link to the total station. Amberg Technologies undertook this project in partnership with Swissphoto AG.

**Results:** Profile plots with deformation values, absolute shaft error from the design centre line, absolute position of the shaft.



<b>Object:</b>	Pressure pipe, Cleuson-Dixence
<b>Task:</b>	Position, deformation and profile surveying
<b>Solution:</b>	Combination of GPS, geodetic and profile measurements
<b>Special feature:</b>	Difficult measuring environment with gradients of up to 70%. Special fixtures and special software for measuring devices in the pressure shaft
<b>Result:</b>	Optimal planning basis for the renovation of the pressure shaft in the form of deformation analyses and errors in the shaft's nominal position



## Monitoring

Detect movements early on to ensure suitable action can be taken in time: whether excavations, slopes at risk from landslides, bridges or buildings – monitoring will provide you with a high level of safety and cost-effectiveness. Whether 3D co-ordinates or simple movements and pressures, all sensors can be controlled automatically to provide the best solution for monitoring your structures.



## Shaft surveying

Measurements in shafts of power stations are among the specialisations of Amberg Technologies AG. Whether horizontal, inclined or vertical: customised measuring techniques are used with the appropriate instruments for all these measuring tasks.

## Customised surveying

Special tasks require solutions developed for the specific project. With specialist skills, an innovative attitude and hardware and software optimally matched to the required results, we solve unusual project requirements.

« Tailor-made solutions  
for your surveying tasks »

# Goal orientated information – Geoengineering from Amberg Technologies

**From simple measurements to complex comprehensive solutions: clients, consulting engineers and construction companies make use of our services. The close collaboration with our clients in combination with our experience and the use of the latest measurement and information technology forms the basis for mutual success**



## Underground structures are our core business

The Amberg Group combines know-how and experience in underground construction in a unique manner and is a leader in its sector. The range of services encompasses interdisciplinary planning processes, consulting, construction monitoring, project management, research and development as well as the manufacture and marketing of highly specialised measuring systems.

## Complex tasks

With innovative measurement technology, we make a crucial contribution to the successful realisation of demanding construction projects. Thanks to an in-house research and development department, we are able to solve complex tasks, create new instruments and prepare new methods to suit specific requirements.

## Applying information technology

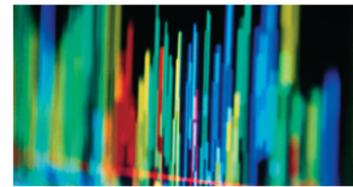
Anyone who endeavours to optimally solve surveying tasks is dependent on information. We ensure that surveying data are accessible everywhere at all times so that the correct basis for making decisions is always on hand.

## Complete solutions, utilising synergies

The skills that characterise our specialist organisation and its worldwide operations are based on the skilled utilisation of synergies. New data and knowledge are utilised to benefit various project stages. As a partner, we see our task as an integral element of the complete construction process.

## The in-house development department

With leading partners such as Leica Geosystems, we develop hardware and software in specialised areas of measurement technology. Our system solutions simultaneously provide a high level of cost-effectiveness and safety under difficult conditions.



## Access to high technology

Amberg undertakes research and participates in international knowledge transfers related to solutions in the infrastructure sector. Our know-how flows into the development of innovative products and services. The intense exchange of experience with customers and partners also ensures practical solutions suitable for construction sites.

## Custom solutions

There are challenges that cannot be tackled with standard solutions. Amberg Technologies develops customised hardware and software solutions for particularly large or difficult projects. The knowledge and skills from such development work flows continuously into subsequent projects.

## International means worldwide

Amberg is a Swiss company with an international orientation. The varied requirements and the high standard of surveying in our country form the basis of our experience. We successfully employ this experience on ambitious projects worldwide.

### New high speed line Nuernberg–Ingolstadt

**Task:**  
Imaging the tunnel arch in nine double track tunnels with a total length of 27,022 m. Preparation and management of a damage register in a database that forms the basis for further inspections and analyses.  
Provision of the database on a computer suitable for field use for subsequent inspections in the tunnel.

**Solution:**  
Using the scanner system GRP5000, complete images with a 5-mm grid were prepared. To be able to maintain a constant velocity of 0.6 km/h, an electronic drive was developed by Amberg Technologies. The in-house developed TunnelMap software was used for the mapping work.

**Special aspects:**  
A large number of specialists within the Amberg Group contributed to making this project a success. Both the measurement and the evaluation placed high requirements on the logistics. Only through extensive experience and optimal IT infrastructure was Amberg Technologies able to meet the high requirements on computing performance, data volume and short measurement and evaluation times.



<b>Object:</b>	German Railways, new section of track between Nuernberg and Ingolstadt
<b>Task:</b>	High resolution imaging and mapping of the existing damage
<b>Solution:</b>	Imaging using GRP5000 Mapping in TunnelMap based on the scanned images
<b>Special features:</b>	Motorisation of the GRP5000 system High requirements on the logistics for measurement and evaluation
<b>Result:</b>	DB-specific database in TunnelMap. Training of the personnel for the subsequent inspections using the field computer and for the maintenance of the database. Flexible, homogeneous measurement and evaluation system

# Information for infrastructure: The key to success

## **Tunnel surveying**

- Heading survey and machine guidance
- Motorised laser guidance
- Profile measurements
- Tunnel surface checks (undulation)

## **Geotechnical measurements**

- Monitoring concepts
- 3D deformation measurements
- Instrumentation for every task
- Monitoring networks
- Vibration monitoring

## **Railway surveying**

- Complete clearance analyses
- Track surveying
- Track alignment design

## **Engineering surveying**

- Geodetic measurements
- Precision levelling
- Customised surveying

## **Inventory surveying**

- Structural condition assessment
- Damage mapping
- Laser scanning
- As built documentation of structures

## **Shaft surveying**

- Vertical shafts
- Inclined shafts
- Horizontal shafts

## **Consulting**

- Consulting and expertise
- Comprehensive project-specific solutions

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