



### Project

- Changchun-Baicheng railway expansion and renovation project  
长白铁路扩能改造
- Improve the track geometry with tamping machines
- Setup of a control point network, section K42+000-K65+000 with total length of 46 km
- Design speed: 200 km/h

### Duration

- September to October 2017

### Contractor

Shenyang Railway Bureau  
沈阳铁路局  
www.sytj.com

### Tasks

- Measure and evaluate the track geometry
- Transfer the correction data to tamping machines
- Setup of a control point network

### Challenges

- Time pressure on operating tracks
- Short window of 1.5 h/day
- Poor visibility due to thick fog

## Improved ride comfort on ballast track thanks to satellite-based positioning

Since its opening to traffic on August 8, 2017, the Changchun-Baicheng Railway has been very successful and transported on average 30,000 passengers daily. The new line has reduced travel time between Changchun and Baicheng to 2h25m.

The construction of Changchun-Baicheng railway expansion and renovation project started at the end of 2014. The length of the main railway is 328 km with a design speed of 200 km/h.

### Efficient track survey with satellites

Global satellite positioning system and inertial navigation technologies are combined in the IMS 1000 GNSS system to record 3D track position and its alignment. Furthermore, control points can be set and measured by a total station mounted on the trolley.

A GNSS base station was set on a known point to send reference data, which was received via radio by the GNSS rover on the trolley. With good satellite constellation, the absolute track position can be determined with about 20 mm accuracy. The relative geometry of the track can be measured by IMU with millimetre accuracy. Additional track parameters such as gauge, super elevation, horizontal and vertical alignment, twist, etc. were recorded by the GRP trolley.



«We knew that Amberg IMS 1000 systems have had a good reputation for years, but they were not suitable for our area of responsibility because we didn't have any

accurate track design information and control points. After Amberg introduced the new GNSS module in combination with the IMS in the summer of 2017, we decided to give it a try. The results were very good. The device is compact, easy to use, flexible and last but not least, very fast!»

Zhiqiang He 何志强  
Surveying Engineer, project leader  
Shenyang railway Bureau Changchun Section

### Amberg Technologies' products used

- Amberg IMS 1000 GNSS system
- Amberg Rail 3.0 software with IMS Survey GNSS module

### Customer benefits

- Survey without any given track design and control point data
- Compact, easy and flexible system
- Highest productivity of up to 5 km/h for fast results even in shortest maintenance slots
- Output of absolute coordinates, comparable to other planning tools

### Contact

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## No track design information, no control points – no problem!

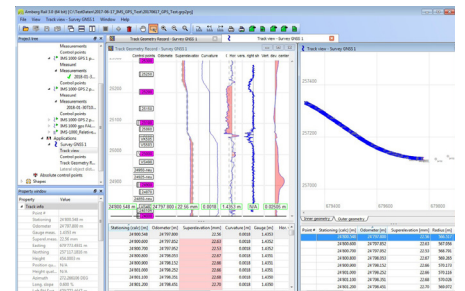
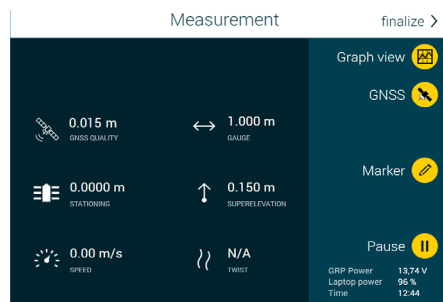
No track design information and control points are needed for executing the surveying job. A trained operator can easily perform the data recording at a normal walking speed of 5 km/h. The lightweight trolley can easily be carried away from the track by two persons to let a train pass.

Once the data acquisition has been done, the track geometry is analysed by the Survey Engineers using the Amberg Rail software. The calculated Track Quality Index (TQI) describes the smoothness or irregularity of the track. It has to be minimized to fulfil Chinese standards so that the track is safe for trains operating at speeds of 160-200 km/h.



A design tool was used to reconstruct the best-fit track parameters based on as-built track position. The deviations from the reconstructed track design can be used as correction values, which can then be transferred to the tamping machines.

The survey trolley can be used to both determine, where the track is, and how far it deviates from the designed alignment.



The software offers two ways of visualizing the information for outdoor and indoor applications. The measurement screen is optimized for outdoor survey under all light conditions and the big buttons were designed for the touchscreen. Real-time track parameters and the quality of GPS coordinates are monitored by the software all the time. The user is informed if the quality of the GPS signal gets lower. The post processing part is designed for office use. Sophisticated analysis and various reports are supported.

### Conclusion

With Amberg IMS 1000 GNSS we have managed to significantly reduce the Track Quality Index (TQI) with one single survey. We haven't only saved time, but also reduced the cost of setting up control points. After the tamping work was completed the passengers noticed substantial improvement of ride comfort.