Olympic High Speed

by Hansruedi Amrein

Due to great economic growth and social development, the People's Republic of China is rapidly expanding its railway network. The great speed of growth demands quick work: The long-term plan of the MOR (Ministry of Railways) is to expand the network from the current 75,000 to 100,000 km by the year 2020. To increase capacity, both passenger and freight lines are being developed, however, freight and passenger transports are separated. The plan is for around 50 % of the total network to be double-tracked and electrified and for the network to conform to modern standards in terms of quality and comfort. The construction plan also features high-speed lines – including the 114 km section between Beijing and Tianjin, linking a venue of the Olympic sailing competition with the Olympic metropolis Beijing, which went into operation on schedule for the Olympic Games 2008 after some three and a half years of construction.

The section is a Slab Track system and, for the most part, is supported on bridges due to the poor ground surface. This new high-speed line is the first in China to allow travel speeds of up to 350 km/h and train services with a frequency of three minutes. Travel time on the section comprised of three stops, is approx. 30 minutes. Building costs for the new section were US$ 1.73 billion (EUR 1.2 billion).

Leica Geosystems Technology in China

The surveying task involved high-precision positioning of 24 high-speed turnouts and complete geometric inspection surveys of the high-speed section between Beijing and Tianjin.

Three main challenges were faced by the surveying team during the construction phase:

- to quickly and effectively set up a high accuracy and high density Control Point III survey network (CPIII network),
- to adjust the Slab position with the highest accuracy and
- to achieve the highest level of track position, accurate to the millimeter for perfect driving dynamics and safe and comfortable operation, as well as to execute high-performance surveying with maximum accuracy for fast construction.

The tasks were complemented with comprehensive

documentation and compliance for checking relevant track geometry parameters.

Amberg GRP 1000 System Combined with Leica TCRP1201+

Eight GRP 1000 Slab Track measuring systems from Leica Geosystems partner Amberg Technologies, Switzerland, were used on the section between Beijing and Tanjin. Amberg Technolgies is a leading provider of specialized system solutions for civil infrastructure, particularly railways and tunnels. The GRP 1000 system consists of a track surveying trolley, prism column, special GRP Slab Track software module and an external, radio-controlled Leica TCRP1201+ precision total station. It allows precise track measurement during automated measuring processes. The system delivers 3D track co-ordinates in real time, performs gauge and cant measurements and displays the current track deviation relative to the design position. The GRP 1000 system accomplishes fast track positioning accurate to the millimeter before concreting work or track geometry acceptance measurement, with an output of up to 700 m an hour. The Amberg GRP 1000 also offers extensive options for final track documentation.

Millimeter Accuracy

The GRP 1000 in combination with a Leica TCRP1201+ allowed fast, efficient track surveying. Thanks to a well thought-out operating concept designed for the special requirements of the construction of the Beijing – Tianjin Olympic High Speed Line, tracks could be built with millimeter accuracy and comprehensively documented for quality assurance purposes. The real-time results contributed significantly to fast execution of construction work. Precise measuring provided a basis for the immediate start of subsequent processes (e.g. slab track concreting work). This helped prevent incorrect positioning of turnouts, as it is not possible to correct the position of turnouts once they have been concreted without expensive and time-consuming dismantling. Final track acceptance using the Amberg GRP software served as quality control and as the building contractor's documentation for the client. The results of the analysis with the special Slab Track software regarding deviation of position and relevant track geometry criteria were an important addition to acceptance of dynamic behavior using track surveying vehicles. ■

Three Key Systems

To successfully meet the survey challenges, three key systems based on Leica Geosystems high-end instruments were used:

- 10 Leica TCA2003 total stations for CPIII network measurements (Third Railway Institute)
- 22 Leica TCA1800 and Leica TCA2003 total stations for Precast Slab (type Boegl) positioning (China South Survey)
- 8 Leica GPS1201+ systems in GRP 1000 Slab Track measuring systems from Amberg Technologies, Switzerland.