Reconstruction and electrification of railway line Plovdiv – Svilengrad

Construction section 2, railway route Harmanli – Svilengrad and Svilengrad to Greek border

Tanya Kostadinova

**Project data**

<table>
<thead>
<tr>
<th>Location</th>
<th>Railway route Sofia – Alexandroupolis – Istanbul, Harmanli – Svilengrad section (from km 266+000 to km 297+750) toward Greece and Turkey (South-Eastern Bulgaria)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client</td>
<td>Bulgarian State Railway Infrastructure Corporation</td>
</tr>
<tr>
<td>Contractor</td>
<td>Joint Venture Railway Infrastructure 2011 under the leadership of PORR Bau GmbH</td>
</tr>
<tr>
<td>Construction time</td>
<td>04 December 2012 – 15 March 2016</td>
</tr>
</tbody>
</table>

The project's client was the Bulgarian State Railway Infrastructure Corporation.

Bulgaria has been a member of the EU since 1 January 2007 and has thus access to European funds and programmes aimed at modernising railway infrastructure. The railway line Plovdiv – Svilengrad including the section from Harmanli to Svilengrad is the most important railway line in Bulgaria and part of the European corridors No. IV and IX as well as the subsidy programme Transport 2007 – 2013.

The railway line's modernisation guarantees the connection to Greece and Turkey.

**Project description**

The project's objective was to modernise the single-track, non-electrified railway line with its length of some 38km. Furthermore, new catenaries with a length of 60km were installed in the framework of the project. The line's new routing allows for a travelling speed of 160km/h for passenger trains and 200km/h for tilting trains.

The project was implemented by dividing the railway route Harmanli – Svilengrad into six sections which were constructed independently from one another.

**General information**

After the finished call for the tenders, the joint venture Railway Infrastructure 2011 under the leadership of PORR Bau GmbH was awarded the contract for the project "Reconstruction and Electrification of the Railway Route Harmanli-Svilengrad (from km 266+000 to km 297+750)" at the end of 2012. The contract also included the rehabilitation / new construction of the railway stations Harmanli and Svilengrad as well as all railway stations and stops in between. The project area encompassed a length of some 34km and also included the reconstruction and electrification of the railway line Svilengrad to Greek border at a length of some 4km.

In accordance with the conditions of the call for tenders and the contract, the consortium performed the following services:
- Geological, hydro-geological and hydrological surveys
- Creation of planning submission design including coordination with local authorities on the project’s submission to the Ministry for Transport, IT and Communication
- Project development and implementation of stabilisation measures
- Construction of bank and embankment reinforcements
- Overhaul and rehabilitation of existing structures along the railway route
- Construction of railway, road and pedestrian overpasses
- Removal of existing tracks
- Laying of new tracks according to European standards
- Electrification of the entire railway line with new catenaries
- Installation of signal and telecommunication systems in accordance with the project plan
- Creation of technical documentation for purposes of handover to client and commissioning by the Bulgarian authorities

**Construction works**

<table>
<thead>
<tr>
<th>Category</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation</td>
<td>1,145,012m³</td>
</tr>
<tr>
<td>Fill</td>
<td>1,318,000m³</td>
</tr>
<tr>
<td>Frost protection</td>
<td>137,600m³</td>
</tr>
<tr>
<td>Drainage channels and drainages</td>
<td>75,188m</td>
</tr>
<tr>
<td>Noise protection walls</td>
<td>2,441m</td>
</tr>
<tr>
<td>Number of relocated and rebuilt utility crossings</td>
<td>103</td>
</tr>
<tr>
<td>piping</td>
<td>36,560m</td>
</tr>
</tbody>
</table>

**Superstructure**

<table>
<thead>
<tr>
<th>Category</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removal of existing tracks</td>
<td>41,500m</td>
</tr>
<tr>
<td>Newly laid tracks</td>
<td>52,400m</td>
</tr>
<tr>
<td>Newly laid sleepers</td>
<td>91,700m</td>
</tr>
<tr>
<td>New track ballast</td>
<td>127,926m³</td>
</tr>
<tr>
<td>Newly installed catenaries</td>
<td>60,600m</td>
</tr>
</tbody>
</table>

Additionally, the following services were performed in the course of the project:

- Reconstruction of four buildings with a total floor space of 570m²
- Modernisation of three railway stations
- Rehabilitation of a steel bridge
- New construction of three buildings with a total floor space of 920m²
- Construction of two new halts
- Construction of ten new reinforced concrete bridges

All newly constructed buildings meet the requirements of the Eurocode and were designed to allow for a future extension of the line to a double-track line.

**Bridges, road overpasses and underpasses**

The road overpasses were mainly built from prefabricated girders supported on Neoprene bearings which were supplemented with a reinforced concrete track slab. This construction method allowed for quick and simple progress with the least possible impact on traffic.

To build the railway bridges, the courses of rivers had to be altered in places and bridge foundations had to be secured with gabion walls and recycled concrete sleepers.

One of the largest bridges along the line is the one at the River Biserska at km 284+720. 18 bored piles with a diameter of 1m were used for its foundation.

Another striking structure is the new reinforced concrete bridge at the River Harmanlijska at km 268+800. 25-m-long prefabricated girders weighing 85t which were manufactured on site were used for its construction. The bridge crosses the river at an angle of 45°. The river had to be temporarily redirected to install the piers. Sheet-piling boxes and more than 4,000m³ of concrete were used for the piers’ shallow foundations.

During the construction of an underpass within the city limits of Lyubimez, the construction pit and the tracks which had to remain open for traffic were secured by means of Larssen type sheet pile walls. Due to the high ground water table and the unfavourable geological conditions, these had to be installed to a depth of 20m. The underpass is furthermore equipped with a pumping station for purposes of storm water drainage.

Another thing worth mentioning is the 250-m-long pedestrian underpass which was installed in Harmanli, below the existing, likewise fully operational railway route.

**Svilengrad cargo station**

In the project’s framework, a new cargo station was constructed in Svilengrad. Due to difficult soil conditions, the entire station had to be built on an embankment constructed from geosynthetic materials, geotextiles and geogrids with an underlying layer of rough rock material. The embankment’s entire volume amounts to approx. 200,000m³. The station which serves as a border railway station between Bulgaria, Greece and Turkey, needed to meet EU standards and those of the Schengen Agreement. Respective barriers, video monitoring systems and the like were therefore installed.
Challenges
Without a doubt one of the biggest challenges was acquiring all permits required for the construction permit of the railway route. This could only be achieved through direct and close contact with the local authorities.

However, surprises awaited us throughout the entire execution of the project. Apart from numerous unknown underground utilities, which had to be protected in the end, archaeologically valuable sights were discovered which halted construction in the respective area for several months.

Several floods exceeding the HQ100 point flooded parts of the construction site and caused major damage during the execution phase.

The adjacent nature reserve Natura 2000 also had a significant impact on the execution of construction work.

All construction work had to be performed while ensuring the railway line’s full operability. This meant that the project could only be implemented in stages and individual sections were immediately opened for traffic.

State-of-the-art and innovative construction and stabilisation methods were used to overcome the mentioned difficulties:

- Use of innovative products made from geosynthetic systems and gabions to stabilise unstable soil
- Hydro-seeding – use of a special mix of grass seeds as a further means of slope stabilisation in the area of sandy and clay soil
- Use of concrete sleepers to stabilise slopes and secure railway embankments against erosion, especially in the event of floods; concrete sleepers were also used in the erosion-free execution of river redirections and channels.

Embankments and box-cuts up to a height of 10m each were constructed in the course of the construction scheme.

Conclusion
Regardless of the operational limitations to maintain the railway line’s operability and the enormous extent of the construction work involved, all services could be performed within the contractually agreed time and to the client’s full satisfaction.

A number of unforeseen events such as archaeological discoveries, the complete re-design of a railway station due to newly defined design parameters, floods exceeding HQ100 levels and more have caused a delay of 19 months.

All required exceedances of the original construction period were agreed upon in advance with the engineer and the client. Fully in line with cooperative project handling, this fact reflects the excellent cooperation between and professional execution of the project by the Bulgarian railway team, the engineer and PORR.

Our employees’ individual dedication resulting from their identifying with the project made it possible to successfully overcome all difficulties on site.

Together with numerous prominent guests, the route was finally opened on 15 May 2016 by Prime Minister Boyko Borissow.