

# RECONSTRUCTION OF THE RAILWAY LINE VINKOVCI – OSIJEK

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Professional paper

After 17 years, railway line Vinkovci – Osijek has been finally restored and opened to traffic. Reconstruction of the railway line Vinkovci – Osijek is important for wider community of the two neighbouring counties. With this railway line, the Osijek – Baranja County and the Vukovar – Srijem County have got better connectivity and convenient alternative to road transport, offering the shortest and cost effective connection between the regional centres Osijek and Vinkovci. Complete replacement of the track on the line was made in a total length of 11,530 km, which includes extending from the trunk line, laying the buffer protection and geosynthetic layer. The track was made with used materials: concrete sleepers HŽ-70, rails type 49E1, rail fastening type K and new ballast bed. The line is capable of speeds of 80 km/h and traffic trains with weight of 225 kN per axle and 80 kN/m, in a total length of 33,339 m.

**Keywords:** ballast track, railway line Vinkovci – Osijek, railway track reconstruction, used track materials

## Obnova željezničke pruge Vinkovci – Osijek

Strukovni članak

Nakon 17 godina obnovljena je i puštena u promet pruga Vinkovci – Osijek. Obnova pruge Vinkovci – Osijek značajna je za širu društvenu zajednicu dviju susjednih županija. Ovom prugom, županije Osječko-baranjska i Vukovarsko-srijemska dobivaju bolju povezanost i povoljnu alternativu cestovnom prijevozu ostvarivanjem najkraće i ekonomski najpovoljnije veze između regionalnih središta Osijeka i Vinkovaca. Kompletna zamjena gornjeg ustroja na pruži izvršena je u ukupnoj duljini od 11,530 km, s proširenjem trupa pruge, polaganjem geotekstila i tamponskog sloja. Kolosiječna rešetka izvedena je s rabljenim gradivom: tračnicama tipa 49E1, betonskim pragovima HŽ-70, priborom tipa K, dok je zastorna prizma od novog kamena tučenca. Pruga je osposobljena za brzinu od 80 km/h i promet vlakova s težinom od 225 kN po osovini odnosno 80 kN/m, u ukupnoj duljini od 33,339 m.

**Ključne riječi:** kolosijek u zastoru od tučenca, obnova željezničke pruge, rabljeno kolosiječno gradivo, željeznička pruga Vinkovci – Osijek

## 1 Introduction

### Uvod

The recovery and putting into operation of the railway line Vinkovci – Osijek is important, not only as a renewal of the rail infrastructure, but also as an important support to the economic development of the two Croatian easternmost counties and the Croatian economy in general. The line connects the Osijek – Baranja County and the Vukovar – Srijem County, with regional centres Vinkovci and Osijek, and passes through the area of four other municipalities. By detailed looking at the location of the two counties, a very favourable geographic position can be observed (Fig. 1).

Northern border with Hungary, eastern with Serbia and southern with Bosnia and Herzegovina, which is also a state border, represent a convenient location that includes intersection of roads connecting the east and the west and enables Central Europe to have access to the Adriatic Sea too. Both regions are rich in natural resources that enable the development of productive potential, which requires daily communication of working population from smaller centres into the larger ones. It should also be noted that a significant number of students travel into the regional centres daily, and they require the best public transportation options.

## 2 Railway line Vinkovci – Osijek before the Homeland War

### Pruga Vinkovci – Osijek prije domovinskog rata

The railway line Vinkovci – Osijek was first built and opened to traffic in 1910. Ballast track was renewed in 1977 with the new track material, and rail-type 49E1, new concrete and wooden sleepers with fastening set type K. The line was capable of speeds of 100 km/h, and the track was welded into a continuously welded track (CWT). The allowable load on the line was D4 category, which means that the permitted load on the line was 225 kN per axle and 80 kN/m. This was lowland track length of 33,265 km in total and there were 21 arches of the radius  $R = 265$  m to  $R = 2000$  m, with the longitudinal grade of the line to max 6‰.

Along the line between Vinkovci and Osijek there were four stations: Gaboš, Laslovo/Korođ, Tenjski Antunovac and Brijest, in which switches type 49E1-6 with radius  $R = 200$  and  $R = 300$  m were embedded. A total of 32 water culverts were built on the railway line, as well as four bridges, the three of which were steel constructions and one a reinforced concrete structure. The line was not electrified.

Thanks to this state and a very intense traffic, the



Figure 1 Geographic position of the railway line Vinkovci – Osijek  
Slika 1. Geoprometni položaj željezničke pruge Vinkovci – Osijek

railway was transporting about 7 million gross tons of goods per year. As for the passenger traffic, the line was the shortest and the fastest connection between Osijek and Vinkovci, while a large part of northern Bosnia and Herzegovina gravitated toward these centres. The average daily traffic was 12 passenger trains and 14 freight trains in both directions.

Traffic on the railway was suspended due to war operations in August 1991, except on the section Osijek – Brijest, which has never been part of the occupied territory and thus constantly open to traffic.

### 3 Preparatory work for the railway line reconstruction Pripremni radovi za obnovu pruge

During the war the railway line suffered significant devastation. The greatest damages were at the locations of the war demarcation line, where the ballast bed and wooden sleepers were used for establishing military positions (Fig. 2). After the reintegration the demining of the line started gradually, during 2001. Subsequently, further demining of the wider belt line route was needed, which was done in 2004. During the first demining, the tour was conducted and detailed insight into the state of the line was obtained by employees of HŽ-Infrastruktura, Sekcija ZOP Osijek.



*Figure 2 Part of track between Ernestinovo and Laslovo without estranged rails and rail fastening  
Slika 2. Dio pruge između Ernestinova i Laslova bez otuđenih tračnica i kolosiječnog pribora*

It was found that the number of locations along the route of the railway was completely or partly missing over 10 km of track (rails, sleepers, rail fastening, ballast bed), while the bridge over the Bobota canal in km 22+326 was completely destroyed. All station tracks with side objects were destroyed (except in the Gaboš station), while a large number of trunk lines to establish military positions were built on the former demarcation line (between stations Brijest – Tenjski Antunovac and Vinkovci – Gaboš). After demining conditions were created for the reconstruction of the railway, for which project documentation had to be ensured. During 2005 the design was completed for the renovation project of the railway Vinkovci – Osijek, which was amended in 2007 in part related to the reconstruction of the bridge over the Bobota canal. The restoration project was drawn up by the company Granova, Zagreb.

The new line route mileage was changed in a way that the beginning of the line (km 0+000) was taken at mid

station building in Vinkovci, one false profile was expelled, and the end of the line was at the switch number 79 in Osijek at the km 33+339,579. Average projected transversal displacements in the route of the track were up to 20 cm, and the highest pitch on the route was 6 ‰.

In 2006 and 2007 HŽ Infrastruktura Ltd. Zagreb launched activities to carry out the renewal of the line M301 Osijek – Beli Manastir – State Border (with Hungary) as part of the modernization of the railway corridor Vc in total length of 32 km. Since before the renewal this line was in relatively good condition ( $v_{max}=100$  km/h), a significant amount of preserved rails type 49E1, concrete sleepers (type HZ-70) and rail fastening were available. That fact provided significant assumptions for the potential renewal of the line Vinkovci – Osijek with used track materials. Based on these assumptions, in late 2006 the HŽ – Infrastruktura Ltd., Zagreb took a decision to start the reconstruction of the railway line Vinkovci – Osijek. The work on clearing vegetation along the line was undertaken by the Company RVR Zagreb, the renewal was done by the companies "Remont i održavanje pruga" Zagreb and "Vibrobeton" Vinkovci. Company "POSIT" Zagreb was hired to work on the signal-safety and telecommunication devices.

The first phase of the works included the complete cleaning of vegetation along the route line which was started in late 2006. Along the section from the station Vinkovci toward the station Brijest it was necessary to remove the grown trees, shrubs and low vegetation, in order to facilitate the track access for the construction machinery.

#### 3.1 Permanent way reconstruction Rekonstrukcija gornjeg ustroja kolosijeka

In May 2007, the work on the mechanical cleaning of the ballast bed on the parts of the route where track has not been destroyed began, first on the section from the station Osijek toward the station Antunovac, then the section from the station Vinkovci to the station Gaboš (Fig. 3). In parallel with the ballast cleaning, machine works were done on levelling lining tamping, supplementing ballast material for forming appropriate ballast prism and replacing individual damaged rails, sleepers, and rail fastenings.



*Figure 3 Ballast bed cleaning from station Vinkovci toward Osijek  
Slika 3. Strojno rešetanje kolosijeka od kolodvora Vinkovci prema Osijeku*

In parts of the track where the track was missing only partially, works on removing the existing ballast bed with

construction machinery were started. Later it was necessary to widen the subgrade to fit 7 m. As the old subgrade width was 6,0 m, it was necessary to make the extension of the three existing water culverts on the part of the route where subgrade was expanded to 7 m.

On the rolled and aligned track subgrade a layer of geotextile (with geogrids in some places) was first laid after which a protection layer of crushed stone material 30 cm thick was laid (Fig. 4). On the protection layer the used concrete sleepers with steel base plates (concrete sleeper type HZ-70) were laid at a distance of 60 cm, at which the used type 49E1 welded rails 180 m in length attached to the sleepers with type K fastening accessories were placed (Fig. 5).



**Figure 4** The buffer laid on the subgrade at train stop Antunovac  
*Slika 4. Položeni tampon na trupu pruge kod Antunovca*

After the installation of the track grid, the delivery and unloading of crushed stone material from work trains with wagons type Facc-z and the forming of ballast bed started. Machine regulation (level lining tamping) gradually made ballast bed with minimum thickness of 30 cm below the lower edge of the sleeper, and with a minimum of 50 cm of crushed stone material at the forehead of the sleeper. After the final machine-regulation of the track, works on releasing the rails from the internal stresses and their final welding to continuously welded track started with the help of hydraulic machinery or with natural temperature.

A total of 41 marked points were built along the line to ensure permanent monitoring of longitudinal and transversal displacements of continuously welded track. On the rails, according to the project, devices against the longitudinal rail travel were embedded. On the forehead of sleepers the devices against the lateral movement of tracks in the curves of small radius (radius lower than  $R = 500$  m for wooden sleepers and  $R = 400$  m for concrete sleepers) were embedded.

The line was partially restored in the total track length of 21,346 km. It included mechanically ballast cleaning, adding ballast material and forming ballast bed, leveling line tamping and individual replacement of damaged rails, sleepers and rail fastening on track.

Complete replacement of the track on the line was made with a total length of 11,530 km, which included extending of subgrade, laying the buffer protection and geosynthetic layer, used track materials (concrete sleepers HZ-70, rails type 49E1, rail fastening type K) and new ballast bed.

The project of renewal planned the installation of the two switches at the station Laslovo/Korođ and the two



**Figure 5** Laid track made of used track materials over water culvert near the train stop Laslovo/Korođ

*Slika 5. Položena kolosiječna rešetka od građiva preko propusta u blizini stajališta Laslovo/Korođ*

tracks to allow the crossing of trains, which would significantly increase the railway line capacity. But the investor has decided to temporarily drop the issue due to the lack of funds. Of course, in case of a need, there exist all necessary prerequisites for the construction of the additional tracks in the area of the train stop Laslovo/Korođ.

### 3.2

#### Permanent buildings

#### Pružne građevine

At the train stops Ostrovo, Gaboš, Markušica/Antin, Ernestinovo and Antunovac new side platforms were built, with the 100 m length, 0,55 m height and 3 m width with ramps for the disabled persons' access. At the train stop Laslovo/Korođ 2,6 m wide insular platform was built (Fig. 6). All the platforms have the possibility of extending the length to 160 m. In addition, electric public lighting was built-in at all platforms. At the station Brijest the area for passengers boarding was done in 100 m length.



**Figure 6** Insular platform in train stop Laslovo/Korođ  
*Slika 6. Otočni peron u stajalištu Laslovo/Korođ*

On the railway line there are four bridges, of which 2 are steel bridges and 2 reinforced concrete bridges. The reinforced concrete bridge at km 8 +061 has a span of 7,5 m and did not suffer any major damage, so significant works were not necessary.

The steel bridge across the river Vuka at km 9+411,936 has a total span of 34,25 m (Fig. 7). It is composed of two structures: one structure is a beam girder with the span of 11,5 m, while the second structure is a truss girder with the span of 22,75 m. The restoration was completely done by painting the bridge and installing the new hiking surfaces and special wooden bearers.



**Figure 7** The renewed steel bridge at km 9+411,9 (near train stop Gaboš)  
*Slika 7.* Obnovljeni čelični most u km 9+411,9 (kod stajališta Gaboš)

The steel bridge at the km 13+007,681, across the river Vuka, has a span of 22 m. The restoration was done by painting the bridge and installing the new hiking surfaces and special wooden bearers.

The collapsed bridge at km 22+326 was a simple beam static system with steel beam structure. The span was 11,3 m, width 1,8 m and 10,6 m of the light opening. A brand new bridge was built with the reconstruction of the railway with the mileage changed to km 22+404,526. The new bridge is also a simple beam static system, a reinforced concrete plate structure with the span of 12,1 m.

Before the war there were 27 road level-crossings on the railway line Vinkovci – Osijek. After the renewal this number was reduced to a total of 24 level crossings, while the 3 crossings were abolished. Of the 24 crossings, 16 were paved with synthetic elements type STRAIL (Fig. 8), and 8 level-crossings were paved with wooden sleepers.



**Figure 8** Renewed level crossing at km 25+700  
near train stop Antunovac  
*Slika 8.* Obnovljeni cestovni prijelaz u km 25+700  
ispred stajališta Antunovac

Before the war there were 9 level crossings on the line insured with light-sound signalling and half-barriers. During the war 7 level crossings with light-sound signals and half-barriers were destroyed. These level crossings were rebuilt during the track reconstruction and put into operation.

At the end of 2008 all the works were brought to the end. A technical examination was conducted before opening to the traffic. The line was examined with the measuring vehicle EM120 in order to check the track geometry parameters (longitudinal profile, horizontal alignment, gauge, superelevation). With this measurement the performance index track (Track quality index - TQI) for category B was determined (the criteria for the existing line after the completion of major projects on the rehabilitation or repair with used materials), which amounts to 8,9 and fully meets the design.

With the new timetable, on December 14<sup>th</sup>, 2008, the line was opened to regular traffic. The total value of track reconstruction was about 90 million Kunas (approximately 13 million Euros).

The line is capable of speeds of 80 km/h and traffic trains with weight of 225 kN per axle and 80 kN/m, with a total length of 33,339 m.

Today, the line runs nine passenger trains in both directions, and, when necessary, freight trains. Speed on the track is 80 km/h, because of the limitations of the used materials used for the renewal. At those parts of the route where the original wooden sleepers are older than 30 years (5 km in total length) the speed is limited to 50 km/h. In the coming period their gradual replacement is anticipated as part of the maintenance works.

Unfortunately the restoration project of the railway line, did not provide the renovation of damaged railway buildings (ruined and dilapidated facilities at the former stations and train stops), which partially disrupts the overall impression. Hopefully, this will be resolved in the future through a demolition and removal project of dilapidated buildings (Fig. 9).



**Figure 9** Heavy damaged construction of the train stop in Laslovo/Korođ  
*Slika 9.* Teško oštećena zgrada stajališta Laslovo/Korođ

## 4

### Conclusion

#### Zaključak

After 17 years the railway line Vinkovci – Osijek is finally restored and opened to traffic. Reconstruction of the railway line Vinkovci – Osijek is important for the wider community of the two neighboring counties, Osijek – Baranja and Vukovar – Srijem, and their major destinations, Osijek and Vinkovci. It provides better connectivity and convenient alternative to road transport, offering the shortest and cost effective connection between regional centres.

The replacement of old wooden sleepers on the partially restored sections through maintenance works will provide the conditions for increasing the speed which will lead to further reduction of driving time on the track. At this point the exceptionally favourable track transport record results in the transport of passengers, and thus justifies the great efforts of all who have consistently advocated the final reconstruction and putting into operation of this line.

## 5

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