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Road and Rail Infrastructure III

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RAILWAY M201, SECTION KRIŽEVCI – KOPRIVNICA – STATE BORDER: UPGRADE AND CONSTRUCTION OF SECOND TRACK

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Abstract

Currently, there is an emphasis on upgrade of railway network in Croatia. This is especially visible on railways that are a part of pan-european corridors (Vb: Rijeka-Zagreb-Budapest and X: Salzburg-Ljubljana-Zagreb-Beograd-Niš-Skopje-Veles-Thessaloniki). Design and construction of these railway corridors is in large part funded by the European Union through IPA programme, Priority axis 1 of IPA Component IIIa. Upgrade of railway M201 (State border – Botovo – Koprivnica – Dugo Selo) is divided into 2 phases. Phase 1 (Dugo Selo-Križevci) is currently in final stages of design, and construction should start in 2014. Phase 2 (Križevci-Koprivnica-state border), which is the subject of this paper is in the first stages of design, with obtaining of construction permit due in 2016, which will be followed by construction that is supposed to be finished by year 2020. Upgrade of M201 on this 43.2 km long section mostly consists of construction of second track parallel to the existing one, with modernisation of the control command and signalling subsystem, and reconstruction and upgrade of existing stations, stops, road crossings and structures. Smaller parts of the existing railway track will be reconstructed, or even abandoned to achieve design speed and station layout requirements, all in accordance with the proposed traffic technology. This paper presents the technical solutions of railway track alignment, road crossings and structures, that are a basis for all other design work on this project. Also, current state of spatial planning documentation regarding this project and influence of other big infrastructure projects, especially motorway projects that intersect with the rail corridor will be shown.

Keywords: railway design, upgrade, EU funding, construction

1 Introduction

The project of the upgrade and construction of second track on railway line section Križevci – Koprivnica – National Border is defined in the Transport Operational Programme 2007-2013, which forms the strategic basis for the absorption of funds from component III of IPA's programme in the transport sector. The project encompasses the reconstruction of the existing track on the Križevci – Koprivnica – National Border section for nominal speed of 160 km/h and the construction of the second track alongside the reconstructed track of the railway line M201 (State Border – Botovo – Dugo Selo). The Design Contract was signed on Dec 10th 2012 by HŽ Infrastruktura d.o.o. as the Contracting Authority and URS Polska Sp. z o.o., in consortium with URS Infrastructure and Environment UK Limited and IDOM Ingenieria y Consultoria S.A., as the Consultant. The total value of the design contract is EUR 5.3 million, of which 85% is provided by the European Union and 15% by the Croatian Government. The deadline for the completion of the design is 42 months from the contract signature date.

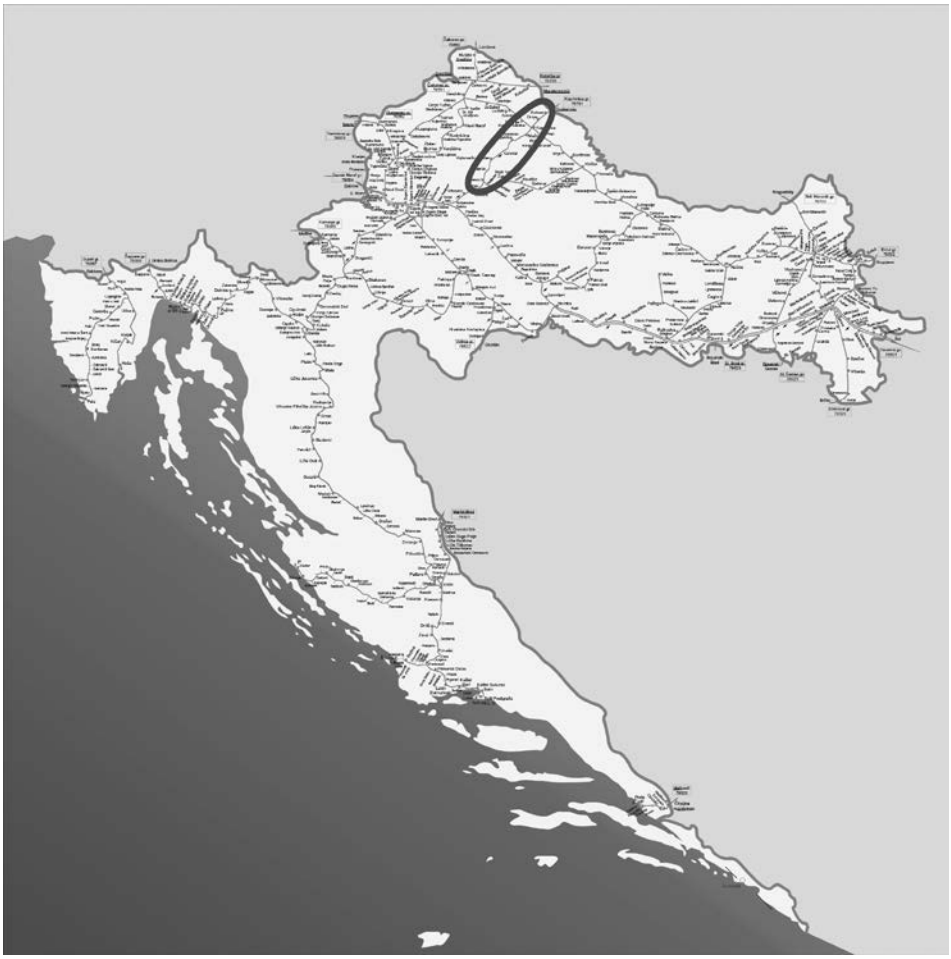

Figure 1 Position of Križevci-Koprivnica-SB section in Croatian rail network

The overall railway network corridor RH2 (State border Hungary/Croatia – Koprivnica – Dugo Selo – Zagreb Main Station – Karlovac – Rijeka – State border Croatia/Slovenia), as well as the railway transport corridor R**3 within the Republic of Croatia shall become a constituent part of the future Trans-European conventional railway transport network. Considering the geographical conditions, the characteristics of particular parts, the traffic-technological and organizational conditions and the planned technical conditions, the future railway transport corridor R**3 is divided into 4 sectors:

- Sector I ⇢ State border Hungary/Croatia – Koprivnica – Križevci – Dugo Selo
- Sector II ⇢ Zagreb railway node
- Sector III ⇢ Horvati – Karlovac – Skradnik – Drežnica – Krasica
- Sector IV ⇢ Rijeka railway node and Matulji – Borut – Pula/Raša/Slovenia

In all parts of the railway corridor RH2 it is necessary to conduct extensive works with an aim to increase the transport capacity, to reduce travel time and to align the condition and characteristics of railway infrastructure with the conditions of existing European railways regulation (Railway Safety Directive, Directive on the interoperability of the trans-European conventional rail system, Technical Specifications on Interoperability of trans-European rail system).

2 Existing state

The existing railway line M201 State border – Botovo – Dugo Selo on section Križevci – Koprivnica – State border partially passes through urbanized areas, and partially through uninhabited area. Although it partially passes through mountain area, according to its characteristics is a predominantly lowland railway section, at which the longitudinal gradient is less than 8 mm/m. At subsection Vojakovački Kloštar – Lepavina there are horizontal curves of 460 up to 715 m in radius which limit the designed speed at this subsection to 90 to 120 km/h, while on the remaining part of the line the design speed is 140 up to 160 km/h. The maximum allowed mass of trains on the entire railway section is 22,5 tons/axle and 8 tons/m' (corresponding to UIC line categorisation freight load model D4).

Figure 2 Existing railway near Mučna Reka

The usage condition is deteriorating year by year, even with recent renewal, thus the maximum allowed speed at subsection Križevci – Mučna Reka is reduced to 60 km/h, and at subsection Mučna Reka – Koprivnica – Botovo – State border at 80 km/h. The subsection Križevci – Koprivnica has been renewed in 2012, and subsection Koprivnica – Botovo – State border in 1978. The entire section has been electrified with AC 25kV/50Hz system, and is ensured with AB (automatic block), while relay devices are installed in stations. The traffic is operated in block intervals. The stations for planning traffic are Križevci and Koprivnica, and the maximum allowed train length, considering the usable main track length is 515/521 m. Limiting part of the railway line is the Križevci – Lepavina subsection, with average daily traffic of 46 trains in 2012. (31 passenger and 15 freight trains). Track capacity for Križevci – Lepavina subsection is 69 trains total, according to 2012./13. Croatian railways time table.

Table 1 Technical elements of the existing railway [1]

Minimum horizontal radius	452 m
Maximum longitudinal gradient (open track)	8.0 ‰
Maximum longitudinal gradient (stations and stops)	4.8 ‰
Minimum vertical radius	8000 m
Rails	49E1
Track formation width	6.5 m
Transversal gradient	5.0 ‰

The railway line is situated with its larger part on the embankment and with a smaller part in the cutting. Embankments are mostly low, 2-3 m high, except on the mountainous part of the track from Vojakovački Kloštar to Lepavina where the embankments are up to 15 m high. Railway line passes partly through agricultural area and settlements, and partly through forests. The embankments are sporadically narrow, low, and in some parts of inadequate width which causes dispersal of the ballast. At particular places, the bad condition of the substructure of

the track can be seen. In spring of 2013, heavy rain caused landslides that caused closure of the railway line for extended periods of time. There are 6 stations and 4 stops on the Križevci – Koprivnica – state border section. Out of the 8 existing bridges, only Steel bridge "Drava-Botovo" is significant, with length of 291 m. The rest of the bridges are single span structures with length up to 24 m. There are multiple crossings with the existing road network, with 13 level crossings and 5 de-levelled ones (4 underpasses and 1 overpass).

3 Planned state

Design and construction of the Križevci – Koprivnica – State border section is separated into 4 subsections:
· II.a – Križevci (excluded) – Carevdar (included)
· II.b – Carevdar (excluded) – Lepavina (included)
· II.c – Lepavina (excluded) – Koprivnica (included)
· II.d – Koprivnica (excluded) – State Border

3.1 Railway

Given the requirement that the future double track railway should be constructed for nominal speed of 160 km/h, changes to the existing horizontal track geometry were necessary. Major changes to track geometry were done on a 2.5 km long section directly after Križevci station exit, and on a 4.5 km long section between Carevdar and Lepavina. On the rest of the track, only existing horizontal curves R ‹ 1700 m needed to be reconstructed.

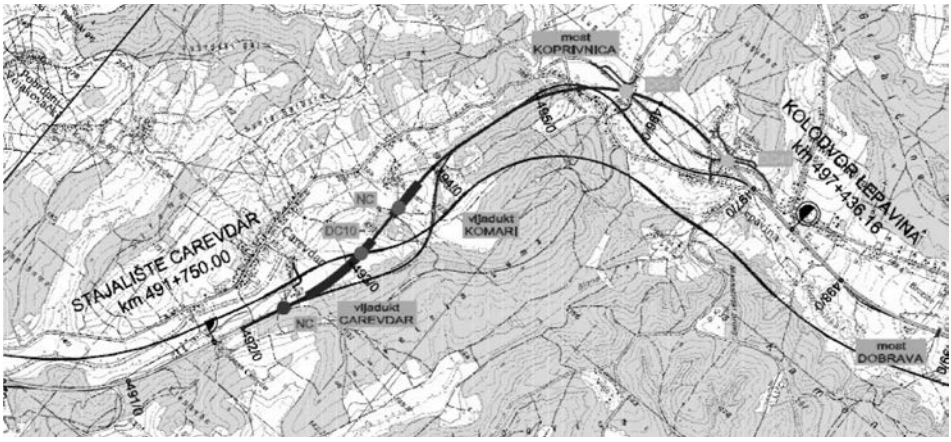

Figure 3 New track geometry between Carevdar and Lepavina

Maximum longitudinal gradient doesn't exceed 10 ‰ on open track sections and 2.2 ‰ in stations. On the whole length, the railway line is designed as a continuous welded track with 60E1 rails, with 4.5 m distance between tracks on open sections and 4.75 m in stations. The rails are installed on prestressed concrete sleepers, 60 cm apart, which are set on crushed stone ballast layer with minimum thickness of 40 cm. Rail and sleepers are connected using elastic type fastening.
Existing Lepavina and Koprivnica stations will be reconstructed, Mučna Reka station will be downgraded to stop, and Drnje station will be abandoned after the construction of a new station Novo Drnje which is planned app. 1 km in Botovo direction. In addition to existing stops, a completely new stop will be constructed near Peteranec. After the reconstruction, maximum allowed train length in stations will be 750 m for freight and 400 m for passenger trains.

Table 2 Planned stations and stops after the reconstruction [2]

No.	Name	Status	Km position	Number of tracks
1	Majurec	stop	485+454.85	2
2	Vojakovački Kloštar	stop	480+961.07	2
3	Carevdar	stop	491+750.00	2
4	Lepavina	station	497+436.16	6
5	Sokolovac	stop	499+580.64	2
6	Mučna Reka	stop	504+123.63	2
7	Koprivnica	station	510+668.89	14
8	Peteranec	stop	515+948.27	2
9	Novo Drnje	station	520+197.89	6
10	Botovo	station	522+762.51	3

3.2 Structures

After inspection of existing railway structures on Križevci – Koprivnica – State border section, it was concluded that unfortunately most of them can't satisfy current norms and regulations. Because of this only existing road underpass in Koprivnica, and pedestrian underpasses in Koprivnica station will be renewed and maintained. All other structures will be either demolished or abandoned, in regard to changes in horizontal track alignment. On Carevdar – Lepavina section, construction of 2 new viaducts, 350 and 635 m long is planned. They will also be used as animal passages. Also, 2 structures are planned as animal crossings, one under and the other over the railway line.
Parallel to the existing one, a new double track bridge over Drava river will be constructed. The new steel bridge is designed with a main span of 145.5 m, and 2 smaller spans of 72.25 m, on on each side of the main span.

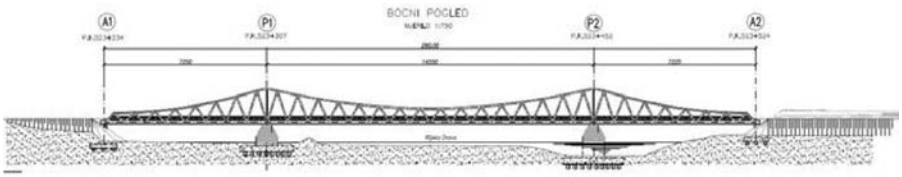

Figure 4 New Drava bridge

Given the demands of the new legislature that states all existing rail crossings with state or county roads must be de-levelled in case of rail reconstruction, 8 new road overpasses and one road underpass will be constructed.

3.3 Road crossings

Given the changes in horizontal track geometry at exit of Križevci station and between Carevdar and Lepavina, and planned construction of DC10 and Podravska motorways, there are 30 crossings with existing and planned roads (not calculating in field paths).

3.3.1 Existing roads

The reconstructed railway crosses a total of 26 existing roads. After construction, there will be 9 overpasses, 3 underpasses and 2 passages under bridges or viaducts. 6 of the existing level crossings with local or unclassified roads will be kept in level, with reconstruction of access roads and security systems (signals, half-barriers). 6 of the crossings at the sections

where the track is set in a new corridor will be reconnected to the nearest de-levelled crossing. In front of Lepavina station, new railway corridor crosses the existing DC41 state road at 2 positions, so two road overpasses (Lepavina 1 & 2) will be constructed. The fact that railway and state road corridor are parallel on long stretches of the section, made technical solutions of de-levelled crossings much more complex, especially for crossing of county road 2212 near Križevci and Pavelinska ulica in Koprivnica.

3.3.2 Planned roads

There is a total of four crossings with planned motorways, three of which are with future state road DC10, former highway A12. The crossing near Majurec is a part of Križevci-Kloštar Vojakovački section of the motorway. This section has a construction permit, and the crossing is solved with a road viaduct. Rail reconstruction on this part was designed to use the predicted free space in one of the spans. Two of the crossings with DC10 are on Kloštar Vojakovački-Mučna Reka section of the motorway. Since there are no permits issued for this section, railway design was done in coordination with Croatian Motorways and Croatian Roads to keep the necessary future changes of motorway design to minimum. Near Peteranec, planned Podravska freeway will cross the railway corridor on a road viaduct. Since that road is still in the conceptual design stage, and only construction of second track is planned on that part of the section, there were no major issues with this collision.

4 Spatial plans

Base for the design of this railway section was conceptual design made in 1998. Unfortunately, the rail corridor from that design was never implemented in the spatial plans. Because of this, changes made to the DC10 motorway corridor in 2011 collided with the M201 conceptual design. Also, new railway corridor proposed by in the conceptual design had big influence on the existing Orthodox monastery near Lepavina.

Because of these issues, a new railway corridor between Carevdar and Lepavina was designed, taking into account proposed corridors in Sokolovac municipality spatial plan. This corridor, as well as the new railway corridor at the beginning of the section which was a part of Križevci spatial plan, were never implemented in the county spatial plan.

This meant that before the approval of the Environmental Impact Assesment and subsequent request for issuing of Location permit, County spatial plan needed to be changed. This process was started in June of 2013, and should be ended by May of 2014.

In addition to this, reconstruction of existing road crossings demanded the targeted changes of lower level spatial plans in City of Križevci and municipality of Sokolovac. Procedure was started in December of 2013, and should be finished in time for Location permit extraction.

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