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REVIEW OF THE PROJECT OF RECONSTRUCTION OF THE EXISTING AND RECONSTRUCTION OF THE SECOND TRACK ON THE SECTION HRVATSKI LESKOVAC - KARLOVAC

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Abstract

The Hrvatski Leskovac - Karlovac section is located on the M202 Zagreb GK - Rijeka railway line, which is part of the Mediterranean corridor of the EU core network. The section is currently a single-track line, and represents a bottleneck in terms of infrastructure capacity. The project envisages the reconstruction of the existing and construction of the second track with the reconstruction of the existing stations in order to meet the conditions of interoperability, the transformation of individual stations into stops, and the reconstruction of existing stops. Some of the existing railway-road crossings will be delevelled by constructing crossroads in two levels (underpasses and overpasses), some will be eliminated with the construction of connection roads and some will be reconstructed. The project is currently in the contracting phase of works and supervisions. In the period from 2017 until today, the Ministry of Environmental Protection and Energy (MZOE) Decision was published on the Environmental Impact Study, the Location Permit was obtained, and the Feasibility Study was completed and approved by the JASPERS Mission in the Republic of Croatia.

Keywords: Hrvatski Leskovac - Karlovac rail line, track reconstruction, track construction

1 Introduction

The Zagreb Gk - Karlovac section is part of the main corridor of importance for international traffic M202 Zagreb GK - Karlovac - Rijeka, the starting point or destination of the former Vb corridor Budapest - Rijeka, and now part of the Mediterranean TEN-T corridor, or RH2 corridor. According to the Decision on the classification of railway lines, this international railway line Botovo - Zagreb - Rijeka, on the territory of the Republic of Croatia has the designation RH2 and consists of lines:

- M201 state border (DG) - Botovo - Koprivnica - Dugo Selo
- M102 Zagreb Central Station - Dugo Selo
- M202 Zagreb Central Station - Karlovac - Rijeka
- M203 Rijeka - Šapjane DG (Ilirska Bistrica)

This railway line is important in connecting central Croatia, Gorski Kotar and the northern Primorje, but also in connecting European regional integrations such as the Alps - Adriatic, Mediterranean - Danube and the Central European Initiative.
The project in question deals with a part of the traffic route M202, on the section from Hrvatski Leskovac to Karlovac (stations included) in the length of 44.02 km. This project envisages the reconstruction and modernization of the existing railway in terms of the construction of

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a new track next to the existing one and the reconstruction of the existing railway track on the section Hrvatski Leskovac - Karlovac. Also included is the reconstruction of the Hrvatski Leskovac, Jastrebarsko and Karlovac stations, the conversion of the Horvati, Zdenčina and Draganić stations into stops, and the reconstruction of the existing Mavračići, Desinec, Domagović and Lazina stops.
Reconstruction and upgrading takes place in the narrower corridor of the existing railway, following the position of the route of the existing railway.
After the implementation of the project, which also includes the reconstruction of some LCPs and modernization of all other railway infrastructure subsystems (electricity and traffic management and signaling - safety), and in full compliance with applicable regulations governing rail transport, including interoperability, the line will allow passenger traffic at a design speed of up to 160 km / h, and freight traffic up to 120 km / h.

2 Route geometry and track structures

On the existing line on this section, the maximum permissible train mass is D4 (22.5 t/o and 8 t/m). The maximum current speed per area is: Hrvatski Leskovac - Zdenčina 110 km/h (conventional trains) or 130 km/h (trains with tilting technique), Zdenčina - Jastrebarsko 140 km/h, Jastrebarsko - Draganić 80 km/h with a limit in the curve behind Jastrebarsko at 75 km/h, Draganić - Karlovac 100 km/h. The railway is electrified with the AC 25kV / 50Hz system.
The type of insurance is APB, while relay devices are installed in the stations. The traffic takes place in a block distance.
The line is envisaged as conventional, for mixed passenger and freight traffic.
New line retains the existing geometry on most of the route. The distance between the rails will remain 1.435 mm, the distance between the new track and the existing track on the open track will be 4,75 m. Applied minimum radius of the horizontal curve is 700 m and the maximum 25.000 m, while stopping way is 1.500 m.
For vertical geometry, the maximum longitudinal slope is 12 mm/m. Vertical curves have minimum radius of 10.000 m, and maximum of 40.000 m. Level of the railway after reconstruction basically follows the existing level, with deviations in some sections in the range from +2,00 m to -0,41 m, so it can be generally stated that the level of the railway after reconstruction and upgrade is slightly highrt than the existing condition. Distance between tracks at stations and at AV junctions the rail is 4,75 m, and railway will be constructed for GC profile and electrification is AC 25kV / 50Hz.
The superstructure of the track consists of: rails type UIC 60E1, prestressed reinforced concrete sleeper 260 cm long and elastic fastening accessories.
The minimum thickness of the gravel curtain is 30 cm below the concrete sleeper at the side of the lower rail, and on bridges 40 cm below the lower rail.
The substructure of the railway consists of a bed 40 cm thick, geotextile for open drainage, and geomembrane for closed drainage, embankment core, soil stabilization where necessary and protective coverings of the slope with humus 30 cm thick.
As part of the reconstruction of the railway, there is also a drainage system, canals, drainage ditches, noise protection walls, service roads.
According to the state of design solutions, the characteristic cross-sections of the designed line have a total planum width of 13.35 m and the track spacing is 4.75 m. Depending on the situation and available space, the circumferential ditch and service road are added on one or both sides.
A 0.4 m thick protective layer and a geotextile layer are located between the ballast and the embankment bed. The protective layer has a bed-like slope, of 3 % towards the ends of the planum to ensure the removal of water from the body of the track. On the parts of the route

where closed internal drainage is planned, the geotextile is replaced by a geomembrane and elements for collecting rainwater and draining to treatment plants are added.
The upgrade of the second track will take place by step excavation of the existing embankment and connection with the existing embankment in phases.
The first step envisages the cascading design of the existing embankment on the side where the construction of the new track will be performed. After that, a new embankment and all layers in the hull of the railway, including the upper structure of the new track, are built. After the traffic is moved to the new track, part of the embankment and the upper structure of the existing track will be renovated, in accordance with the design solutions and depending on the condition of the existing embankment.
The implementation of the project is in principle planned without interruption of traffic, ie at the same time as the traffic. Exceptions to this are situations of switching between the northern and southern tracks and the construction of switch areas, when complete closures of traffic for a certain period of time are possible.

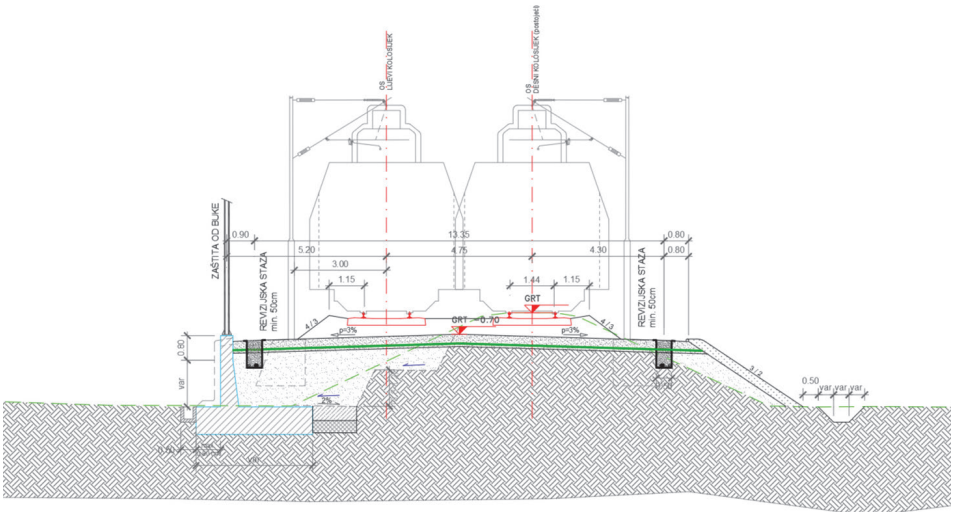

Figure 1 Cross-section of a double-track rail line

3 Stations and stops

The project envisages the reconstruction of 3 stations, the conversion of 3 stations into stops and the reconstruction of existing stops. The project envisages that existing stations Hrvatski Leskovac, Jastrebarsko and Karlovac will be reconstructed. Stations Horvati, Zdenčina and Draganić will be converted to stops, and existing stops Mavračići, Desinec, Domagović and Lazina will be reconstructed and upgraded. Stations that allow the retention of interoperable freight trains will be able to accept trains up to 750 m in length. Stations that allow the retention of interoperable passenger trains will have a platform length of 400 m, and other stations and stops with a platform length of 160 m.

3.1 Hrvatski Leskovac station

As part of this project, the reconstruction of the Hrvatski Leskovac station is planned in order to meet the conditions of interoperability. In relation to the current situation, the reconstruction of the entire station is envisaged, except for the part where the track for the necessary local industries is located. It is planned to build platforms for receiving passengers and underpasses. In order to achieve a useful track length of 750 m, the station will be extended in the direction of Zagreb, since in the direction of Karlovac it is not possible to perform an extension due to construction.
The existing building with a toilet is being reconstructed on the same site. A new station building is planned on the west side of the existing building. The new building will house the new ESSU, TK equipment, uninterruptible power supply and a new traffic office (since the station will be occupied after the reconstruction). The building will be single-storey.
The installation of a new traffic - management and signal - safety infrastructure subsystem, as well as the electricity infrastructure subsystem in accordance with the new track plan of the station is planned.

3.2 Jastrebarsko station

Reconstruction of Jastrebarsko station is also planned in order to meet the conditions of interoperability.
After the reconstruction, the number of tracks in the station will not change compared to the existing condition. In relation to the current plan, the reconstruction of the entire station is planned, except for the part where there are industrial tracks for the necessary local industries (Betongrad, Drvoproizvod), the construction of platforms for receiving passengers and underpasses is planned.
By upgrading the second track of the open track on the north side of the existing one, it is necessary to build a new 1st track, and the existing tracks 4 and 5 will be completely dismantled. The existing curve on the exit side towards Karlovac is maintained and the construction of a new deviation for 160 km/h is not planned. In order to achieve a useful track length of 750 m, the station will be extended in the direction of Zagreb
The existing station building is being reconstructed in order to accommodate the devices and arrange the waiting rooms and conversion of individual rooms. The part of the station building in which the rooms with the SS device and the traffic office are located will remain in function until the works on the new ESSU are completed, ie as long as the APB is in function. After putting the new device into operation, the premises can be rearranged for other purposes. The part of the building where the toilet is now located is being demolished to build a parking lot.
For the needs of passenger transport, the construction of two side platforms with a length of 160 m is planned. They are planned along the first and fourth track, respectively, and their connection is provided by an underpass with a staircase and elevators.
The installation of a new traffic - management and signaling - safety subsystem and electric power infrastructure subsystem is planned in the station in accordance with the new track picture of the station.

3.3 Karlovac station

The project plans a complete reconstruction of Karlovac station in order to meet the requirements of interoperability, except for the part related to the bridge over the river Kupa on the exit side towards Mrzlo Polje and the track for garaging DMV.

After the reconstruction, the function of the station will not change in relation to the existing one and the station will be functionally divided into two parts, the first part of the station (tracks 1-4) will be used for traffic on the Zagreb GK - Rijeka line, and tracks 5. - 7. for the railway Karlovac - Kamanje – State border. In relation to the existing situation, the number of tracks is reduced from 12 receiving-dispatching or shunting to 7 receiving-dispatching tracks. The existing track 9 will be completely dismantled, and the tracks 10 and 11 will be partially, ie the tracks 11 and 12 will become tracks 8 and 9, and will serve as connecting / pull-out tracks for the garage part of the station.

Due to the extension of the track in the direction of Zagreb, and the construction of a new connection for the railway Karlovac - Kamanje – State border, dismantling of three tracks 12, 13 and 19 is planned. Due to the construction of the side platform next to the station building, track 15 is also dismantled. Under the current conditions, maintenance TMDs are installed on said track, and it will be placed on track 9 after reconstruction with respect to a sufficiently useful length.

The installation of a new traffic - management and signal - safety infrastructure subsystem and the electricity infrastructure subsystem is planned in the station in accordance with the new track picture of the station.

The construction of an island platform 400 m long is planned between 4 and 5 tracks, which will result in the dismantling of the existing 5 tracks. In addition to the island platform, between the station building, 1. and 1a. the construction of a side platform with a length of 400 m is planned. The connection of the platform is planned by an underpass with elevators. An underpass is provided under the entire station to allow the unimpeded arrival of passengers and to the right side of the station. The entrance to the underpass is planned next to the existing station building. Along with the planned exit from the underpass on the west side, the construction of a new parking lot is planned.

Since the station building and the canopy next to it are registered as a protected cultural asset, the solution of the new side platform has been adapted to this and the supporting pillars of the canopy. In the station area, only the removal of the building is planned for the construction of a new connection to the L104 line, a dilapidated building next to the Kupa bridge and several smaller dilapidated buildings for the construction of a noise protection wall. In the existing station building, interventions are planned in certain rooms for the installation of new SS devices and equipment, and a common entrance area, corridors and a toilet on the ground floor are being renovated.

The construction of a new pedestrian and bicycle underpass at Karlovac station is also planned, which will connect the newly planned parking lot and the existing underpass under DC1 (V. Holjevac Street).

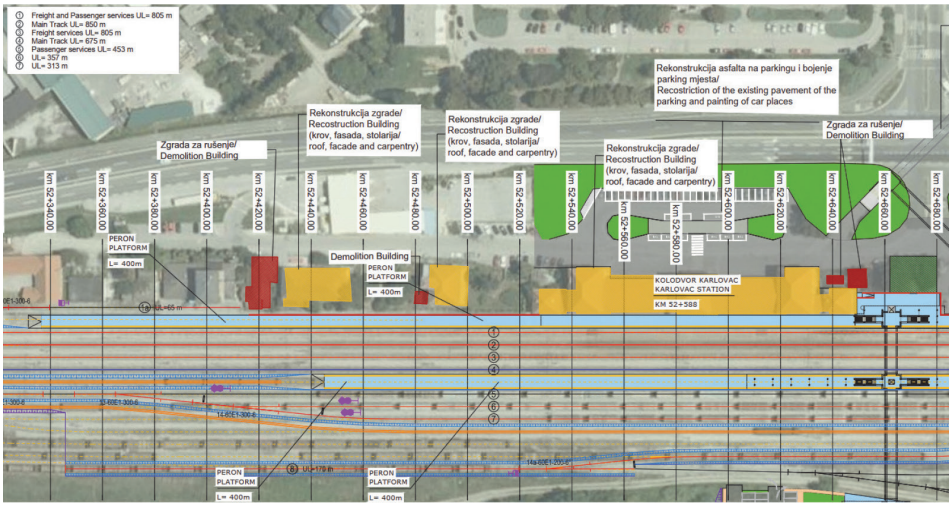

Figure 2 New track plan (red) with pedestrian and bicycle underpasses and arrangement of Karlovac station

3.4 Stops

The existing stations Horvati, Zdenčina and Draganić are being converted into stops. Existing tracks are removed completely, as well as all switches, devices and equipment.
The existing station building in Horvati is being removed, and in Zdenčina and Draganić (cultural property) they remain and are being renovated. Parking lots with accesses from the local road network are being built next to all stops.
At all stops, two side platforms 160 m long, 0.55 m high above the upper edge of the rails will be built, connected by an underpass with a staircase and elevators and equipped with canopies 100 m long.

4 Railway facilities

4.1 Railway crossings with roads

Depending on the importance and rank of the road, and the traffic load on it, the intersections of the road network with the railway are solved by denivelations or arrangement in level with the complete equipment of the LCP. Some pedestrian or crossings on uncategorized roads are abolished and reduced to adjacent locations.
The underpasses of Bedekova Street in Hrvatsko Leskovac, the underpass in Lazina and the Ribnjak underpass in Draganić are planned. Overpasses in Pavučnjak, Zdenčina, Cvetković and Domagović have been solved.
LCP Demerje, Stupnik, Desinec, Draganić and Zagrebačka (in Karlovac) remain level crossings, equipped with appropriate signalization in accordance with regulations.
LCP Orlovac is being abolished and the construction of a new road through the industrial zone in Karlovac is planned.
Underpasses are monolithic frame structures that translate the road below the track.
Overpasses are constructions combined from concrete and steel elements. The end spans are made of concrete T-beams with a monolithic slab, and the span across the track is a composite structure of steel girders coupled with a monolithic slab. The overpasses are 85-135 m long.
Pedestrian paths are run through individual underpasses and overpasses, and the corresponding part of the road on both sides of the building is arranged.

4.2 Structures in therailway substructure

It is planned to demolish the existing structures in the substructure of the railway because they do not meet the condition or geometry of the conditions for the construction of the second track and the construction of new ones. Of the larger facilities in the route are the bridge Ilovac 1 (15 m) and the viaducts Ilovac 2 (32 m) and Kupa-Kupa (100.5 m). At all three locations, the existing facility is being renovated and a new one for the second track is being added. In addition to these facilities, it is planned to install 50 smaller bridges or culverts over the existing watercourses in the hull of the railway. These constructions are prefabricated frame elements (box elements) of openings 6.0 * 4.0 m, 3.5 * 5.0 m, 2.5 * 3.0 m, 2.0 * 4.0 m which are in the profile of the watercourse. stack individually or two or three in a block, depending on the required hydraulic parameters of the watercourse.

4.3 Installations, security systems, equipment

It is planned to install ESSU in the stations Hrvatski Leskovac, Jastrebarsko and Karlovac and an electronic automatic track block (APB) on the sections Hrvatski Leskovac - Jastrebarsko and Jastrebarsko - Karlovac. The so-called "Multistation" solution will be used, in which one signal-safety station device (at Karlovac station) controls and manages several stations and their external elements.
The stations Hrvatski Leskovac and Jastrebarsko will have the possibility of local management from the local traffic office and the possibility of remote management from the station Karlovac.
Railway - road crossings are provided with a new electronic device for securing the LCP, which must have a technical dependence with electronic signal - safety devices.
The telecommunications system along the Hrvatski Leskovac - Karlovac railway will be completely renovated, and the existing SDH will remain during the construction works.
Appropriate optical cables for the transmission of all types of data are installed along the entire section. The section will be equipped with a telephone system, a radio system, ticket vending machines and all passenger information devices.
Reconstruction of two EVPs, Zdenčina and Mrzlo Polje, is planned for the supply of electricity to the section and the supply of the catenary.
The construction of two new sectioning plants, PSN Hrvatski Leskovac and PSN Draganić, is planned.
The catenary will be provided in accordance with the new solution and the new configuration of the station. The equipment for overhead lines will be designed for a maximum permitted train speed of 160 km/h.

5 Conclusion

The main projects have been prepared, the remaining building permits are being obtained, the land has been purchased and a tender for the execution of works is in the process. At the beginning of March 2019, the project was submitted to an independent EC quality control office and a positive decision was made to finance the project, with a total estimated cost of eligible costs of € 366 million. The grant contract was signed on 27.12.2019. the MZOE Decision was published on the Environmental Impact Study, the Location Permit was obtained, and the Feasibility Study was completed and approved by the JASPERS Mission in the Republic of Croatia. The main projects have been prepared, the remaining building permits are being obtained, the land has been purchased and a tender for the execution of works is

in the process. At the beginning of March 2019, the project was submitted to an independent EC quality control office and a positive decision was made to finance the project, with a total estimated cost of eligible costs of € 366 million.

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