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3rd International Conference on Road and Rail Infrastructure
28–30 April 2014, Split, Croatia

Road and Rail Infrastructure III

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TRAFFIC-CONSTRUCTIONAL ASPECTS FOR BUILDING OF BYPASS AROUND NIS IN CORRIDOR X

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COWI d.o.o., Serbia

Abstract

City of Niš is the crossroads of the most important Balkan and European traffic routes. The territory of the City is intersected by important directions: Corridor X – road connect the Balkan with Central and Western Europe, Main lines E70 and E85, and regional and local traffic network of roads and railways. Niš urban and demographic development has not been matched by investment in road and railway infrastructure, consequently this network are overloaded. Unadjusted development of the city on already built of railway lines, led to the spatial and functional conflicts and many negative effects. Building of bypass line includes the implementation of Corridor X through node and unobstructed transit traffic on Corridor X. This creates the conditions for the separation of passenger and freight transport and relieving of freight traffic the central zone of the city of Nis. The construction of the railway bypass around the City of Niš will allow implementation of EU standards for interoperability, will contribute to the further development of the city and will also contribute achieving better conditions for transport of passengers and freights thus helping divert international road traffic to the railways with the consequent benefits in environmental terms. Aim of the author work is to show traffic and civil aspects of the construction of the bypass, its interdependence and the impact on traffic Niš junction. Optimal technical and spatial – urban solution can be realized in phases to meet the needs of transport and development plans of City of Niš.

Keywords: railway bypass, traffic, infrastructure

1 Introduction

Disharmony of city development, traffic and transportation infrastructure leads to spatial and functional conflict in the city area of Niš. Problem of railway traffic for the city can be at one side – a limiting factor, and at the other – a stimulating factor of the development. Functionality of railway transportation in the city should be subsumed under the needs and requests of the citizens, but in the functioning of the railway transportation system in the Serbia. Reduction of the collision points, city–railway should correspond to the previously planned and defined strategy of the city development. It includes:

- priority of phase construction and modernization of the railway in the Niš;
- dynamic plan of activities;
- control of activities.

The problem of level crossings in the center of Niš is especially expressed and endangering the safety of users and complicate realization of all transportation types. In the present state, passing freight trains through the central zone of the city produces increased levels of pollution and noise, with an increased risk of environmental protection because of the passage of

hazardous materials through the city. The general aims of railway bypass construction around the city of Niš are:

- harmonization of transportation infrastructure development with the development of the city;
- harmonization of transportation infrastructure development with the development of the airport of Niš;
- relocation of freight transportation from the city center;
- the development of railway systems without disrupting the transit transportation on Corridor X with local work.

Settings to define the technical and technological parameters of railway bypass construction are:

- official planning documentations;
- spatial limitations and places of collision with existing and planned installations;
- spatial limitations and places of collision with existing and planned transportation;
- necessary capacities and facilities at the stations on the railway bypass;
- connection of new railway bypass with existing infrastructure capacities of the node;
- connection of new railway bypass with existing railway line Niš – Dimitrovgrad;

2 The current state of the transportation system of the Niš.

2.1 General features – location and system elements

Niš as a regional, administrative, cultural, educational, industrial and transportation centre at the international network is a place of connection and separation of the two main international directions E-85: Budapest–Athens and E-70: Paris–Sofia. In the transportation system of Niš there are all forms of transportation, for the various types of passenger and freight transport, what Niš makes an important connection in the link of passengers and goods flows. From the aspect of the road traffic, Niš is the crossroad of international regional and local road traffic. Backbone of bypass roads around Niš are sections of the international road E-75 (M-1) and E-80 (M-1.12). In progress is construction of the highway E-80th. From Niš are separating 11 routes on which are organized bus transportation.

From the aspect of air traffic, city airport “Konstantin Veliki” is qualified for receiving medium aircraft. “Konstantin Veliki” is the second category airport, and it is airport for regular and charter flights for the passengers of Niš and the region, and serves as an alternative airport for Belgrade, Skopje and Sofia. Using of the runway is limited by the existing electrified railway.

2.2 Railway transportation diagrams

Niš railway junction is one of the most important and oldest junctions, created more than 100 years ago and has a very important role in the Serbian railway infrastructure, also has great influence at the development of the city Niš. Railway infrastructure capacities in the junction Niš were built and modernized in stages and gradually, and parts are:

- main lines: Beograd–Niš–Preševo–border, Niš–Dimitrovgrad–border;
- railway line of the first order (Niš)–Crveni krst– Zaječar–Prahovo Port;
- inside the junction connections are made over railway lines: Crveni Krst–Niš Marshalling Yard, (Crveni Krst)–(Čele Kula), Trupale–Niš Marshalling–Međurovo and Niš–Junction Bridge–(Niš Marshalling);
- railway facilities in the junction: triangle Crveni Krst–Čele Kula.

Circular connection has multiple role because of the connecting station Niš Marshalling Yard with the depot and industrial tracks in the station Crveni Krst, station Niš marshalling with station Niš and Mechanical industry and station Niš with depot in the station Crveni Krst.

All mentioned tracks are electrified, category D-4 and load 22.5 t/ax and 8.0 t/m', except track Niš–Dimitrovgrad–state border (D-3, 22.5t/ax and 7.2 t/m') and track (Niš)–Crveni Krst–Zaječar–Prahovo Port (B-2, 18.0 t/ax and 6.4 t/m').

All railway sections are equipped with APB, except sections Niš–Crveni Krst and Crveni Krst–Matejevac. For interstation distance Niš–Crveni Krst, railway is double track and it is equipped with APB devices for two-way traffic. According to schedule for 2012/13 maximum allowed speeds are between 30 km/h and 70 km/h.

Existing junction Niš (Figure 1) consist stations: Niš, Niš Marshaling Yard, Crveni Krst, Trupale, Međurovo, Matejevac, Čele Kula and Niška Banja. Other halts are: Palilulska Rampa, Vojna bolnica, El Niš, Pantelej and Rasputnica Most. The main passenger station is the station Niš, the main marshalling yard station is Niš Marshaling yard.

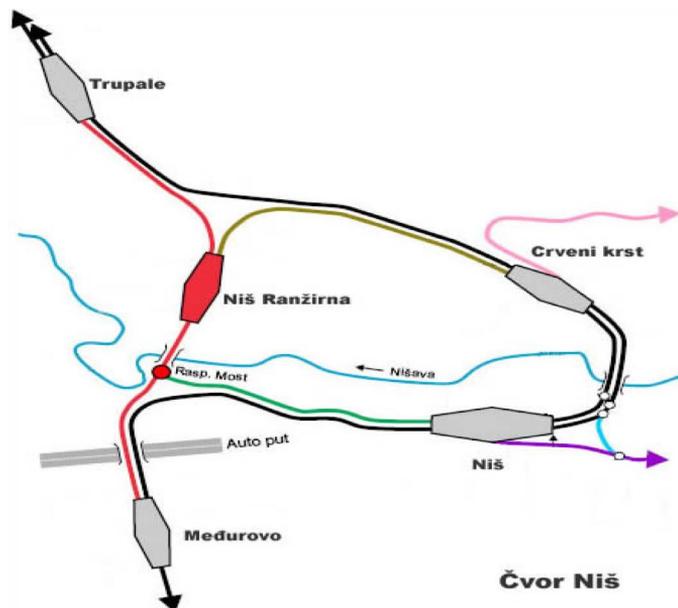


Figure 1 Niš junction

2.2.1 The organization of passenger transportation

All stations are opened for the reception and departure of passengers. At the station Niš all categories of trains for passenger transport have stopping. Besides the transit trains all trains for passengers are starting/ending ride in the station Niš. Transportation flows are presented according to the schedule for 2012/13th year. Marching of trains for passenger transport is shown in Figure 2. At the station Niš are performing necessary technological operations (changing of locomotives, adding or removing a wagons, combining of train set and etc.), and for relation Belgrade–Dimitrovgrad at the station Niš are changing the traction type and driving direction.

2.2.2 The organization of freight transportation

The current intensity of freight transportation is relatively small, partly because of the lack of adequate series of wagons and locomotives. All trains in the domestic traffic are starting or ending driving in the Niš Marshaling Yard station. Traffic flows are presented according to the schedule for 2012/13th year. Marching of freight trains is shown in Figure 3.

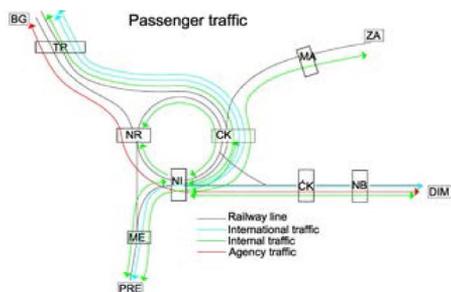


Figure 2 Passenger traffic

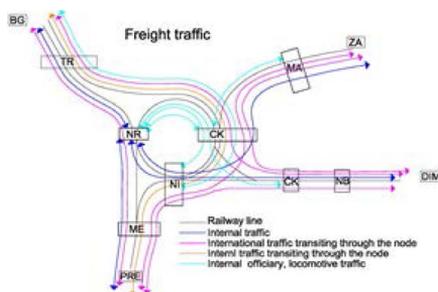


Figure 3 Freight traffic

At the station Crveni Krst are performing change of locomotives and other necessary technological operations for trains for/from the direction of Dimitrovgrad. Local work with vehicle goods is not concentrated in one place and its performing at the station and industrial tracks. Transport of part-load cargo and luggage is minimal.

2.2.3 Organization of shunting works

Shunting work on the composition and decomposition of freight trains is performed at the station Niš Marshaling Yard and work on forming of passenger wagons at the station Niš. In the junction Niš is performing shunting work in order to service loading and unloading tracks, industrial tracks, serving of stations, etc. Shunting works performs more difficult because of the shunting locomotives lack.

2.3 The railway system infrastructure

Niš is the second largest city in Serbia, with all the functions of the regional center and its geographical position is located at the intersection of traditional transport corridors of Western and Central Europe to Greece and Asia. Direction that made basis of today's railroad junction are north–south (Belgrade–Skopje) and west–east (Niš–Sofia). The urban area of Niš is topographical located at river Nišava's valley and spatially has developed along the Niš valley and hence the first built big infrastructure objects: railway line Niš–Sofia and international road Niš–Sofia. Accelerated process of industrialization and urbanization, there, has been spatial expansion of settlements that has taken the functions of urban character, so that the railway infrastructure at this moment is located in the very urban area of Niš. Main stations are:

- Niš;
- Niš Ranžirna / Niš Marshaling Yard;
- Crveni Krst.

2.3.1 Station Niš

The station Niš is the main passenger station, with five platforms for reception–departure tracks and one bypass track. Platform next to the station building and two island platforms are connected with underpass and have awnings. The station Niš also performs technical tasks of passenger station. The station serves for the passage of freight trains on the direction Niš–Dimitrovgrad.

2.3.2 Station Niš Marshalling Yard

The station is marshalling yard and sorting on the network YR, in the parks with parallel tracks, turnout track and small marshalling yard hill.

Station tracks are classified into the group:

- Reception–departure group has 8 tracks;
- Marshalling yard–departure group has 18 tracks;
- Station track group has 8 tracks;
- Bypass tracks (3 tracks).

The total length of the station tracks is 25920 meters, with 90 single and 8 English switches. Within the station Niš Marshalling Yard is located depot and wagon workshop. From the station stands out industrial track “VP 3472.” It was designed for a former military airport in the Niš.

2.3.3 Station Crveni Krst

The station Crveni Krst is interstation on the railway Belgrade–Skopje and it is connecting station for railway Niš–Zaječar. Indirectly, through triangle, is connected with the railway Niš–Dimitrovgrad. Over circular railway, Crveni Krst is connected with the stations Niš Marshalling Yard and Niš.

On both sides of the station Crveni Krst is connected depot and from the depot is connection with the Factory of switches, which is located on the right side of the tracks. On the left side of the tracks from station stands out tracks for industrial zone of Niš. From the railway station Crveni Krst stands out 12 industrial tracks that serve for loading and unloading of goods, within of owners and users of industrial tracks.

For tasks that are performed by the station Crveni Krst there are 10 tracks. The total length of the station tracks is 6415m, with 29 single and 7 English switches. Depot group of tracks have about 6800m and 30 switches.

3 Spatial limitations for development of railway infrastructure in the Niš

3.1 Planning regulations

RS Spatial Plan 2010–2020 as a document of the highest importance envisages development of railway infrastructure in the Republic of Serbia, and special significance is given to the planning, construction, reconstruction and modernization of railway lines, as well as stations and other facilities, for performing passenger and freight transportation on Corridor X.

Spatial plans of the Republic determines the concept of development, organization, protection and usage of the area covered by the plan. It is implemented by developing of planning solutions and plans for special purpose of areas, spatial plans of local governments, urban planning and other plans. In all relevant plans for the city of Niš, as well as the general development plans it is recommended the relocation of railway freight transportation from the city center.

3.2 The functionality of transportation

Optimal technical–technological and spatial–urban planning solutions for railway bypass can be realized in phases according to the requirements of transportation and development plans of the Niš.

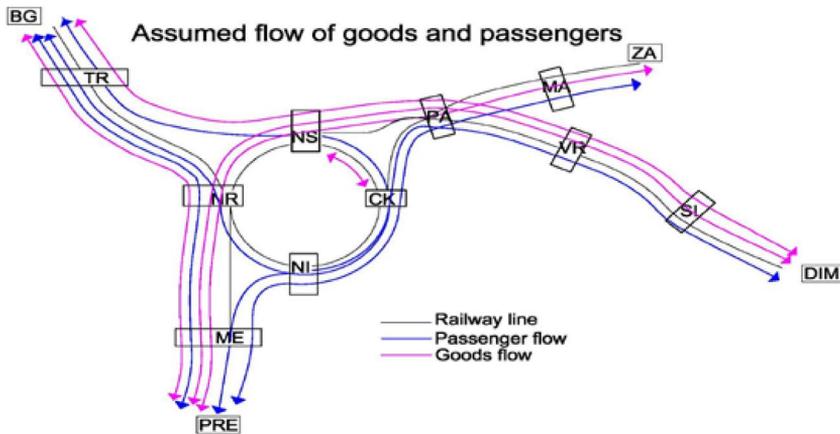


Figure 4 Assumed flow of goods and passengers

Construction of the bypass is the first step of undisturbed passage of double-track railway on Corridor X and undisturbed passage of transit traffic on Corridor X through the area of the Niš. This creates the conditions for the separation of passenger and freight transportation and relieving of the city central zone of freight transportation.

Organizational and functional solution of railway transportation is conceived with position of the stations Niš and Niš Marshalling Yard within of Niš railway junction. Technological requirements on which are based variants of solving railway bypass around Niš are:

- using of the existing railway corridors and land to the most possible extent;
- keeping the railway capacities on existing locations with modernization and integration into a new solution, all in accordance with the spatial and urban plans;
- the separation of the freight and passenger transportation and the releasing of the city central zone of the freight transportation;
- direct trains traffic for passenger transportation on main lines through the station Niš without changing the direction of the ride and head of the train, as well as changes of the traction type;
- the high level of efficiency and safety of railway transportation;
- functional and rational solution for railway bypass and stations as well as the connection of a new bypass to the existing railway infrastructure facilities;
- providing the necessary capacities, passing capacity and transportation safety, fast passage of trains, passengers and goods through the junction, the maximum protection of the environment and to minimize investment and exploitation costs, and all in accordance of the city development and the economy;
- separate grade intersection of the railway with road traffic;
- retaining and improving railway connections with existing and planned industry;
- compatibility of railway, road and air transport in the city of Niš.

3.3 Construction feasibility

In accordance with technological requirements, spatial and planning restrictions is narrowed the choice of alternative solutions of the route of a new railway bypass. Corridor of the route with minimum variation is placed on the north of the city periphery. Beginning of the railway bypass is on the output switch at the station Niš Marshalling Yard over existing halt Pantelej and along the highway corridor, on the left side and connection to the existing alignment of the railway Niš–Dimitrovgrad, to the station Sićevo.

The basic elements of the route should be take into account the following:

- reconstruction and modernization of the railway double track bypass should follow the basic settings according to the European Agreement on Main International Railway Lines (AGC), European Agreement on main lines for combined transport (AGTC), and the composition of the Trans-European railway network in mixed traffic and high speeds;
- technical standards for interoperability ECTS;
- railway transportation will be developed to a high level of service for the passenger, freight and combined transport.

The goal is to define the long-term of optimal technological and spatial urban solutions that can be implemented in stages and phases, in accordance with the geostrategic importance of the national and European railway network and transportation requirements according to European standards, and in accordance with the requirements and development plans of the Niš as an important regional city by European standards.

4 Construction of the railway bypass around Niš and the effects of construction

Bypass railway starts from the output switch of the station Niš Marshalling Yard. Part of the railway track from station Niš Marshalling Yard to the station Crveni Krst will be relocated and it will be built separate grade intersection (above or below) with the existing railway Trupale–Crveni Krst. Bypass route continues on the corridor defined by the spatial plan, the northern periphery of the city, to the connection of the existing railway line Nis–Dimitrovgrad in the area of Prosek. Length of the new railway bypass is about 19 km. On railway bypass is planned to build new stations: Niš North, Pantelej and Vrežina.

Between stations Trupale and Crveni Krst, at bypass line, is planned to build the station Niš North. The capacity of this station will be designed to satisfy the requirements of transport and transportation, with the corresponding groups of tracks designed to receive and departure of trains. From this station it is possible to make connection with the industrial tracks that are in the station Crveni Krst. This location, because of the roads and airport proximity has advantages for the eventual construction planning of goods–transport center. Neighboring stations are Trupale, Niš Marshalling Yard, Crveni Krst and Pantelej.

The new station Pantelej, at bypass, in the transportation meaning, it will be junction railway station to Zaječar and it is designed for receive and departure of trains. The effect of its construction is reflected in the separation of passenger and freight transportation. Neighboring stations are Niš, Crveni Krst and Vrežina.

The new station Vrežina is designed for receiving and departing of trains in all categories. The effect of its construction is to increase passing capacity at new bypass line. Neighboring stations are Prosek and Sićevo.

5 Conclusion

According to the adopted goals of reconstruction and modernization of railway lines in the city area, taking into account of national and international importance of transportation infrastructure in the Niš, construction of the railway bypass around Niš is the first phase of modernization. The construction of railway bypass can be performed out in stages. Phasing of construction should not affect the continuity in the execution of the traffic flow. New stations on the route of the railway bypass which will be formed in the first phase with minimal infrastructure capacity in the next phases of development would allow railway transportation to competitive advantage over the different types of transportation in the terms of safety, shorter travel times, massive transportation, comfort, cost and cost-effectiveness.

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