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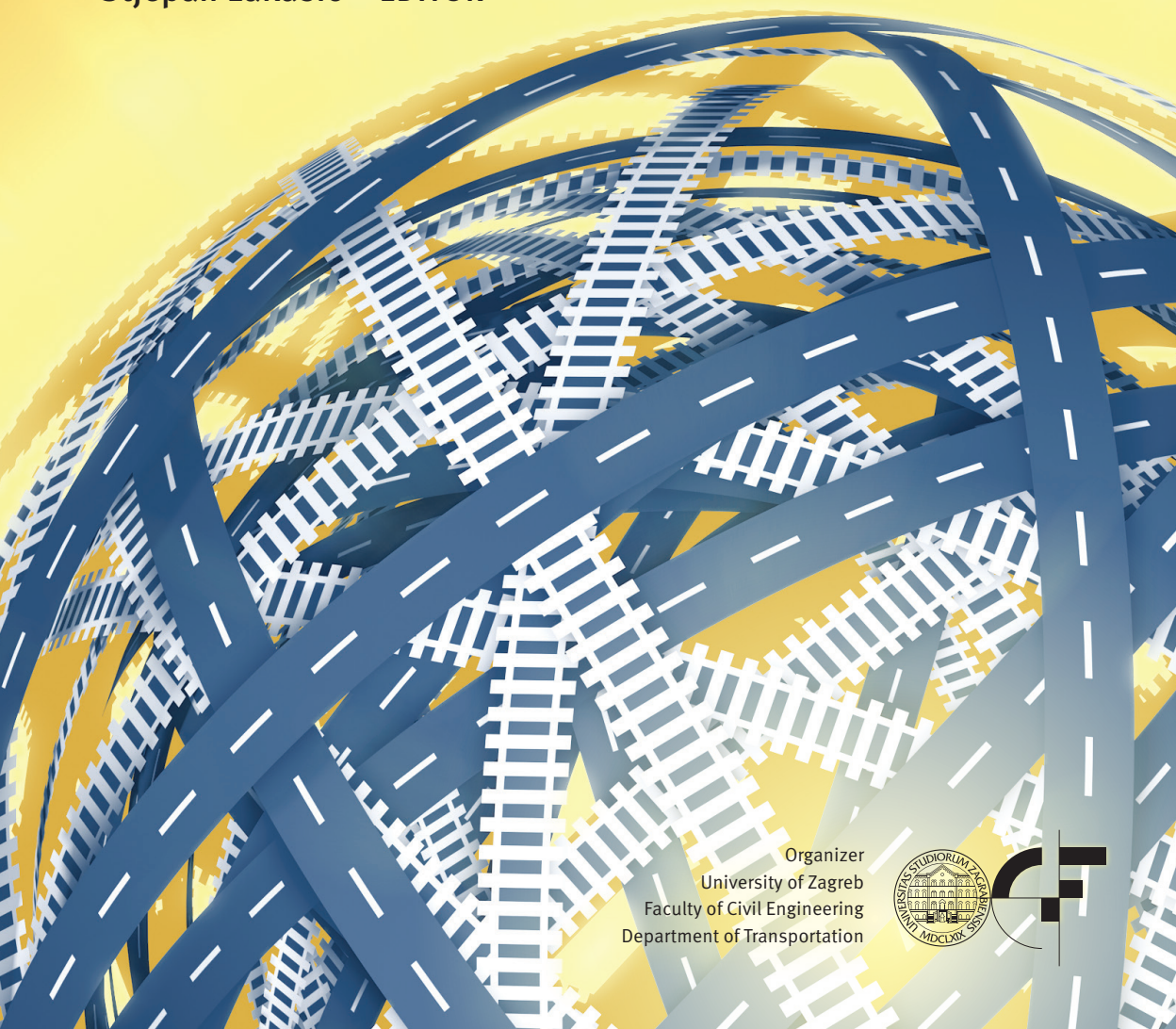
4th International Conference on Road and Rail Infrastructure
23-25 May 2016, Šibenik, Croatia

Road and Rail Infrastructure IV

Stjepan Lakušić – EDITOR



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RECONSTRUCTION AND MODERNIZATION OF RAILWAY SUBOTICA (FREIGHT) – HORGOS – SERBIAN-HUNGARIAN BORDER

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Abstract

The paper presents the necessary works included in the project for construction, reconstruction and modernization of the railway Subotica (Freight) – Horgos -Serbian-Hungarian border, with a total length of 27.9 km. Considering that the technical characteristics of the existing lines do not meet the requirements of modern transport systems, the implementation of these works will result in a high-quality interoperable railway link for both freight and commercial (passenger) traffic and a connection between regional centers in the border region (Szeged – Roszke – Horgos – Subotica – Csikeria – Bacsalmas – Baja). The project represents the first phase of work on the construction of the future railway (East-West) corridor between corridors IV, V, VII and X.

Keywords: reconstruction, modernization, railway track, transport systems, interoperability, corridor

1 Introduction

From 1908, the railway line for the relation Szeged – Roszke – Horgos – Subotica – Csikeria – Bacsalmas – Baja was part of the Great Hungarian Plain – Rijeka railway line, which made it possible for producers of agricultural products from the Pannonian Plain to have access to ports on the Adriatic Sea. After World War II, due to the construction of new border crossings between the Former Yugoslavia and Hungary, the railway lost its significance and in 1960 it was closed to rail traffic. Several sections of the track between Bacsalmas and Subotica have been dismantled and removed.
The Government of the Autonomous Province of Vojvodina, the Agency for Euro-regional development of the Danube – Cris – Mures – Tisa (DKMT), Hungarian Railways and Serbia Railways have initiated work on the reconstruction and modernization of this railway route in order to establish new connections between the Hungarian Southern Great Plains and Vojvodina in Serbia, and the Western region of Romania, thus connecting the major logistics centers in the region (Szeged, Subotica, Baja), including the intermodal port of Baja on the Danube River and the port of Szeged on the Tisa River. The completion of this project will create new, modern intercity public transport connections within the DKMT Euroregion which will provide greater comfort for the transport of passengers commuting between the major urban centers of the area.
Works on the project have been undertaken in order to develop a European network of roads and European corridors. Construction, reconstruction and modernization of the Szeged – Roszke – Horgos – Subotica – Csikeria – Bacsalmas – Baja railway lines represents the first phase of the future East – West railway corridor between the Pan European Corridors IV, V, VII and X (Figure 1).

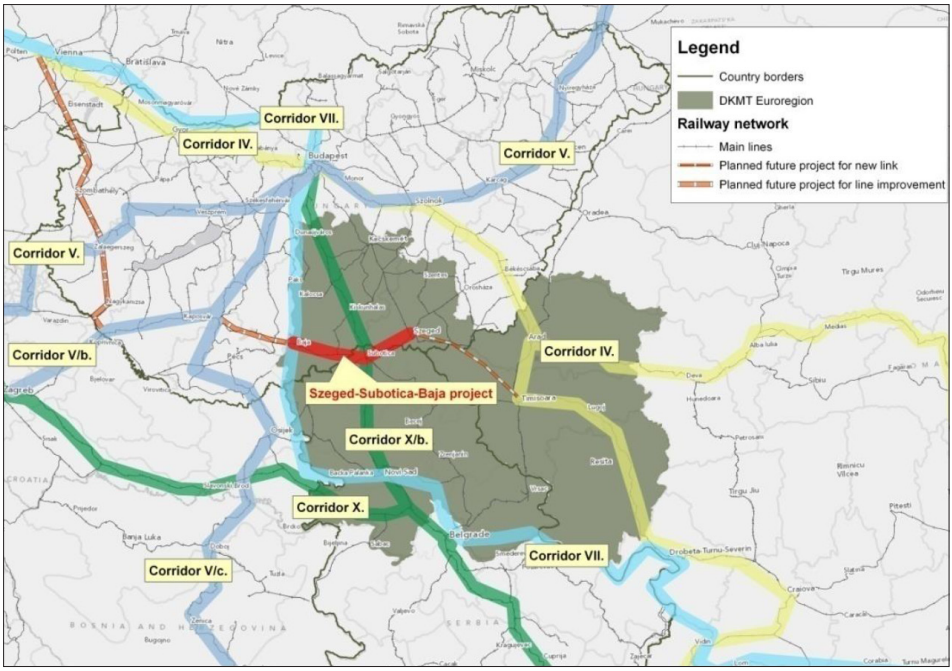

Figure 1 Position of the Szeged – Roszke – Horgos – Subotica – Csikeria – Bacsalmas – Baja railway line [1]

2 The current state of the railway

The railway line Subotica (Freight) – Horgos – Serbian Hungarian border, according to Regulation 325 [2] is number 26 and it is 27.90 km long. The line is flat, single-track and non-electrified. It is intended for mixed traffic, but in its present condition its function is of importance for regional passenger traffic. The technical condition of the substructure and superstructure corresponds to category "A" (permissible weight per axle is 16 t and 5 t per meter), Figure 2. The speed at which trains run on the tracks is 80 km/h on the section from Subotica (Freight) to Bački Vinogradi station, while on the section from Bački Vinogradi to the border with Hungary trains travel at a speed of 20 km/h. The minimum radius of curvature on the route is 300 m which is found in the station area of Subotica Freight, while the maximum gradient of the finished track level is 6.67‰ for a length of 210 meters. Based on the results of a measured drive, for a length of 11 km the state of the track was rated as unsatisfactory [1].

The railway line has one underpass, four overpasses, seventeen small buildings of up to five meters in length and nineteen level crossings (14 on the open line and 5 in station areas). The existing buildings are in very poor condition, dilapidated, as some of them are over 100 years old [1].

Service buildings situated on the line are Subotica Public Warehouses, Palić, Hajdukovo, Bački Vinogradi and Horgos. All of these service buildings are open for work in passenger transport. The building structures are in good condition. The facades are dilapidated, and the sidewalks and steps are completely neglected. The basement rooms are ruined. The equipment in the buildings is worn out [1].

The space in which this railway line is situated belongs to the Danube Basin (Tisa sub-basin). For the majority of the route on this terrain there is a constantly high level of groundwater. The recipients of the channels that intersect the railway route are Palićko and Ludoško Lakes and the Tisa River, as well as local retentions and depressions.

Figure 2 Track on the existing railway line Subotica (Freight) – Horgos – Serbian Hungarian border [1]

The noise resulting from the traffic flow is intermittent, of variable intensity, with periodic pulses. Since there is a lot of housing in the immediate vicinity of this section of the track, it is essential to implement appropriate measures of protection against the adverse effects of traffic noise.

The only electrical installations on the line are those which include low voltage connection cables for the service buildings, outside lighting for these buildings and indoor electrical installations in the service buildings. The existing railway route is in collision with power lines with a voltage of 400 kV, 110 kV, 20 kV and 0,4 kV [1].

The transport of consecutive trains is based on the station schedule. Palić Station is secured with an electromechanical blocking device. There is a central blocking device in the signalman's office in the station building. Palić Station is protected by mechanical main entrance signals with separate distant signals. Bački Vinogradi Freight Forwarding is not protected by main signals. The switches are attached, secured with switch locks that are handled on site. Horgos Station is secured by mechanical – token blocking device. A central mechanical device is installed in the signalman's office. Horgoš Station is protected by mechanical unambiguous visual signals with distant signals. The switches are secured by switch locks (attached), they are placed on site and do not depend on the input signals [1].

For communication between the service buildings about the flow of rail traffic on the line, the following are used: from Subotica Station to the service building at Palić, as well as from the service building at Horgos to the one at Reske (Hungary) there is a TD 59U 4 x 1.2 cable, while between the service buildings at Palić and Horgos communication takes place by means of PTT connection. Service and signalling telephone cables can only be found on the section Subotica – Palić [1].

3 Reconstruction and modernization of the railway line Subotica (freight) – Horgos – Serbian Hungarian border

The term reconstruction of the railway implies the creation of a new quality in relation to the projected state. Reconstruction includes works on: the substructure and superstructure of the railway line, engineering constructions, architectural, hydro technical and other buildings, electric traction and electric power plants, signalling and security systems and devices, telecommunication systems and equipment, other facilities and equipment at railway service places concerned with the organization and regulation of rail transport, with the land that serves these buildings, the rail belt and air space above the railway line [3].

3.1 The substructure of the railway and service buildings

the project elements for the substructure of open tracks, stations and other service buildings are determined in accordance with the Project task: the railway line is designed as single-track, electrified, inside the existing rail belt; the railway is designed for category D4

(permitted axle load of 22.5 t and weight allowed per meter of 8.0 t/m); free profile UIC GC was adopted for the electrified tracks, system 25kV/50Hz for a projected speed of up to 160 km/h; the border elements of the project plan and the profile of the substructure are for a projected speed of up to 160 km/h, except in the area of Subotica Junction (exit from the station Subotica Freight); the substructure on the open tracks is designed with a formation width of 7.00 m and with a one-sided transverse gradient of 4%; in the station area (between the entrance signals), and within the framework of the width of the formation, the plan proposes a prefabricated channel for holding the installations from either side of the final external tracks; construction of the substructure was designed based on the established engineering of the geological and geotechnical characteristics of the terrain and the characteristics of the material to be installed in the substructure, with a transitional and protective layer, and in accordance with guideline 338/ZJŽ [4]; the design of the reconstruction of the service buildings is in line with the technical requirements, the needs of the catchment area stations and local conditions in the area concerned; the track capacity of the stations, and the length of the track and platforms are designed according with technological requirements, and on the basis of the established engineering of the geological and geotechnical characteristics of the terrain and the available material [1].
On the open line and main through tracks in stations a free profile was secured in accordance with the Project task, and which is defined by the Rules on the design of the reconstruction and construction of certain elements of the railway infrastructure of individual main railway lines [5]. The distance between the tracks in the stations is 4.75 m, while the distance from the track axis to the edge of the formation for all service buildings is 3.5 m [1].

3.2 The superstructure

the projected elements of the superstructure of the new single-tracked section are adopted for a projected speed of up to 120 km/h. On the open line, the installation of type 60E1 tracks is envisaged, with a tensile strength of 880 N/mm² (quality 900A), welded together with an elastic track fastening system. The switches on the main passing track are type 60E1-300-6°, while on the remaining tracks in the service buildings the switches are type 49E1. On the open track, one-piece pre-stressed reinforced concrete sleepers are installed, with a length of 260 cm, with elastic fastening at an axial distance of 60 cm. The total thickness of the construction of the superstructure with this sleeper is 70 cm. The ballast prism is made of crushed stone, and the height of the ballast prism from the lower edge of the track to the formation of the track is a minimum of 30 cm (under the inner track), the width from the top of the sleeper to the upper edge of the ballast prism is 50 cm, and the slope of the ballast prism has a gradient of 1 : 1.5 [1].

3.3 Level crossings

Development of the level crossings is planned to take place in several phases. In the first phase the level crossings are maintained, the electrical equipment is secured and the stipulated traffic signs are put into place. In the next phase, on the basis of the estimated costs and insurance benefits / delevelling of the crossing, optimization of the number of level crossings is carried out with the active participation of local governments. The requirements of the urban and spatial environment for technical intervention at the crossing will have an important effect on the optimization process and the establishment of road transport links in the event of shutting down a certain level crossing [2].

3.4 Engineering constructions and buildings

The project foresees new buildings in place of the existing ones, a reinforced concrete retaining wall with a length of 123.38 m, a road underpass 21.50 m long (Figure 3), pedestrian

underpasses at Palić (L=54.75 m) and Horgos (L=26.6 m) stations and 10 trough shaped box culverts with winged walls of different holes [1].

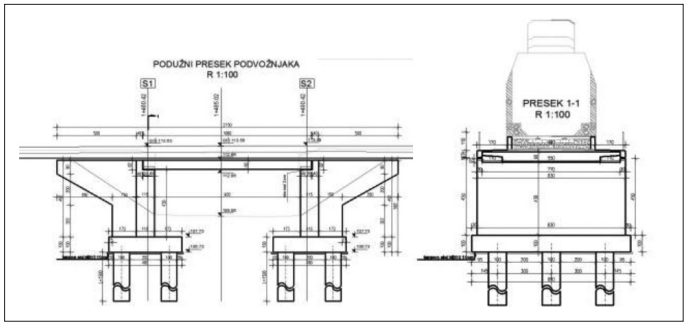

Figure 3 Underpass with length L=21.50m at km 1+485.02 [1]

3.5 Architectural buildings

As part of the reconstruction and modernization project, the adaption of station buildings is planned, Figure 4. In accordance with the necessary facilities and equipment for the staff and passengers, the plan envisages the construction of platforms and canopies, underpasses, new facilities for the accommodation of safety signalling and telecommunication devices (SS and TT), and installations for sectioning (PS).

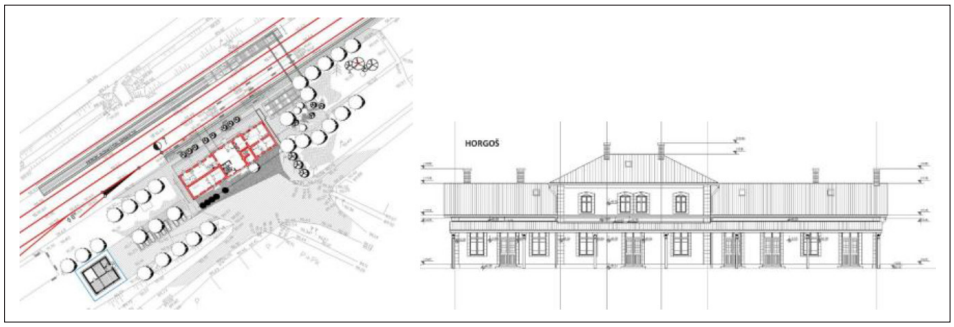

Figure 4 The station building at Horgos [1]

3.6 Hydro technical works

The project retains the dimensions of the existing culverts. In the immediate vicinity of buildings, to protection them from erosion, riverbed channels are coated with an appropriate coating. The flow through the buildings is largely calm. Draining the tracks in stations is envisaged with drainage pipes laid between the tracks [1].

3.7 Facilities for protection against noise

the project envisages the construction of protective structures – walls for protection against noise, which would eliminate its negative impact. The height and length of the walls was determined on the basis of calculations of noise levels, using the CadnaA software. The height of the walls was determined so as to provide a reduction in the level of traffic noise to below

the permitted level in settlements along the planned railway line (55 dB(A) during the day 45 and dB(A) during the night). A number of different solutions were considered, and a solution was proposed that should meet the following criteria: weather resistance, rational structure, visual effects, the possibility of pre-fabricated construction, the possibility of being upgraded, spatial compatibility and easy maintenance [1].

3.8 Electrical installations

according to the reconstruction and modernization project, the railway will be electrified with a single-phase system of 25kV, 50Hz adopted for the electrification of railways on the network. Electrification of the railway includes the construction of: stable electric traction facilities (contact network, installations for sectioning, remote management with stable electrical traction installations), upgrade (non-traction) of the electrical installations, as well as the relocation of power lines in places where they collide with the electrified tracks [1].

3.9 Signal – safety installations and equipment

in order to ensure the technical possibilities for interoperability and compatibility with different types of traction vehicles used in the Pan European corridors, bearing in mind the possibility of increasing the maximum speed on the line in the near future, this project anticipates that electronic signal-safety equipment (ESSE) must have the possibility of being upgraded to the European train control system (ETCS) thereby creating many advantages over other systems (interoperability, security, continuous access to information about trains, their position, speed and interval succession, and the management of trains with greater flexibility and efficiency) [1].

3.10 Telecommunication installations and equipment

the project for telecommunication installations and devices envisages the installation of a telecommunications system for the line which will consist of the following subsystems: cable installations (copper railway cable, local cables in stations and optical cable), a transmission subsystem based on SDH (Synchronous Digital Hierarchy) technology, track telephones and dispatch connections in modern technology with software programming and a local technological radio-network in Horgos Station (for maneuvers, maintenance and conversations in the office) [1].

3.11 Investment value

according to the prices given in the project (October 2015) the total investment value of the works for the reconstruction and modernization of the railway Subotica – Horgos – border of Serbia and Hungary amounts to € 46,084,194.53, or € 1,730,537.00 / km. On the basis of the Feasibility Study, the economic internal rate of return was obtained, which is very close to the discount rate (5.29 ‹ 5.5). The ratio of benefits and costs, for a discount rate of 5.5% is 0.97, while for a discount rate of 5% it is 1.04 [1].

4 Conclusions

Based on its current characteristics, the regional railway line Subotica (Freight), which is situated on the railway route Szeged – Roszke – Horgos – Subotica – Csikeria – Bacsalmas – Baja cannot meet the demands of a modern traffic system. The reconstruction and modernization of this railway line will achieve:

- improvement of the accessibility of the Euroregion Danube-Kris-Mures-Tisa by creating a high-quality interoperable rail connection for passenger and freight for the relation east-west, since a good and economically effective transport system is a prerequisite for maintaining high economic growth and advancing Euro-integration
- improving connectivity within the Serbian – Hungarian (- Romanian) border areas by developing an effective transport system, and potential improvement of conditions for accelerated regional development, as well as
- the transition from road to rail transport and the mitigation of impacts on the natural, historical and built environment in the study area, thus improving the sustainability of transport and resulting in beneficial effects on the environment.

All of the indicators analyzed in this study show that the project is on the limit of feasibility. From the socio-economic point of view, the project is highly justifiable. It is essential to co-finance through EU funds to the value of 66% of the total investment.

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