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2nd International Conference on Road and Rail Infrastructure
7–9 May 2012, Dubrovnik, Croatia

Road and Rail Infrastructure II

Stjepan Lakušić – EDITOR



Organizer
University of Zagreb
Faculty of Civil Engineering
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OVERVIEW OF THE RAILWAY LINE ZAGREB–RIJEKA AS PART OF THE SPATIAL–TRAFFIC STUDY OF THE PRIMORJE–GORSKI KOTAR COUNTY AND THE CITY OF RIJEKA

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Abstract

The Primorje – Gorski Kotar County is situated between Dalmatia, Central Croatia and Slavonia. The Bay of Kvarner (Port of Rijeka) is well connected with the Pannonian valley with the traffic routes passing through the Kupa River valley. The Primorje – Gorski Kotar County is especially important when considering inland traffic connections between the Pannonian and the Adriatic territories, as well as for the traffic connection of the Mediterranean with the Central European territories. The nodes of the main road and railway traffic routes (Branch of the corridor Vb and the Adriatic – Ionian motorway), road, railway, sea and air traffic terminals are all concentrated in the Rijeka agglomeration. This fact, along with the relief characteristics of the coastal area and its abundant biodiversity characterize the complexity of the problem with regard to the solution of the overall traffic node.

The complexity and management of individual traffic infrastructure segments at different administrative levels along with the spatial development of the area require a certain level of coordination and solution to the conflicts within the overall traffic network of the area.

The already existing, planned elements of individual traffic networks are linked into an agglomerate of defined and composite traffic networks (road, railway, sea, air traffic etc.), and along with all adjoining elements (zones used for traffic etc.) form and integral traffic node – the Rijeka node, which includes public and individual traffic, i.e. passenger and cargo traffic. An integral network of passenger and cargo traffic in the Rijeka node had to be outlined, as an element of development according to the spatial planning principles as well as general goals of overall development of the Primorje–Gorski Kotar County.

The aim of the Study was a long-term and integrated definition of development of the Rijeka traffic node.

Keywords: traffic, traffic network, railway, railway traffic, motorway, spatial development plans, environmental protection, feasibility, bridge,

1 Introduction

'Integral Physical Planning and Traffic Study for the Primorje and Gorski Kotar County and the City of Rijeka' (the Study) deals with the integral traffic system of the Rijeka Junction with road, marine, railway and combined transport, air traffic and pipeline transport (gas pipelines, oil pipelines and product lines) on the territory of the Primorje and Gorski Kotar County and bordering areas with the neighbouring counties.

The traffic junction Rijeka is dealt with in more detail for the area of Rijeka agglomeration – the City of Rijeka with the surrounding system of towns and municipalities within the Rijeka ring: Opatija, Matulji, Jelenje, Čavle, Kastav, Viškovo, Kostrena, and functionally relevant surrou-

ding area consisting of the following towns and municipalities: Omišalj, Lovran, Kraljevica, Bakar, Klana, Crikvenica, Novi Vinodolski, Vinodolska Municipality and Fužine.

The Zagreb–Rijeka railway line, as a part of the Pan European Vb corridor branching road Budapest–state border Botovo–Zagreb–Rijeka, enters the county territory at Velika Kapela and extends to the east edge of the town (Krasica). In the context of the future Adriatic–Ionian route, the railway line extends further through the complicated urban network towards the west, towards Slovenia and Trieste.

Of all the traffic systems analysed in the Study, this paper will examine in more detail the railway transport system, i.e. the positioning of the new high performance railway line Zagreb–Rijeka–Slovenia (Trieste).

1.1 Study Goals

The goal of the Integral Physical Planning and Traffic Study for the Primorje and Gorski Kotar County and the City of Rijeka was to define the long-term and integral development of the traffic junction Rijeka.

The existing, proposed and newly-planned elements of certain traffic networks is connected into a group of specified and composite traffic networks (road, railway, marine, air and other) together with all corresponding elements (zones in the function of traffic etc) and constitutes the integral traffic junction Rijeka, which includes public and individual, i.e. passenger and freight transport. The development of the integral network of passenger and freight transport of the Rijeka junction was supposed to be clarified in terms of space and physical possibilities in keeping with the physical planning principles and general development objectives for the Primorje and Gorski Kotar County.

The main goal of the physical planning segment of the Study was to realise, by interactive superposition of traffic networks, assessment of options and assessment of possible impacts, a long-term solution for the traffic junction Rijeka, from the aspect of a steady physical development, coordinated with the economic and social requirements, requirements of environmental protection and cultural values, and in keeping with physical planning principles and general development objectives for the Primorje and Gorski Kotar County (1995–2015).

1.2 The Scope of the Integral Physical Planning and Traffic Study

The study is conceptually conceived through three parts: physical and technical study, traffic study and pre-feasibility study. Physical and technical study analyses the existing condition, the existing study and planning documentation, previous and new solutions for certain modes of transport and economic basis in terms of the County territory.

The physical planning part provides an overview of strategic (planning) documents on the state level, and overview of relevant data from the Primorje and Gorski Kotar County Physical Plan and the basis for a detailed analysis on the local level (town and municipality plans).

The scope of separate studies (technical part) of certain modes of transport (road, railway, marine and air) and of public traffic has been determined in accordance with the scope and significance of a particular traffic junction within the external network.

The traffic study for the area specifies the coverage area and the goals of the study itself, specifies the methodological origins for study development, analyses the existing traffic streams and traffic operation, considers variations of developing traffic supply by systems, their upgrade or reconstruction, considers new variations and their combinations, and provides a proposal for the development of traffic demand for each mode of transport and an overall traffic demand.

The pre-feasibility study analyses the existing traffic streams and traffic operation, considers variations of developing traffic supply and dynamics by systems, their upgrade or reconstruction, considers new variations and their combinations, analyses investment costs,

analyses the feasibility of certain solutions by systems, plans and proposes the progress of work realisation.

Traffic junction Rijeka is formed at the end of the Pan European corridor Vb motorway (Budapest – Zagreb – Rijeka), the Adriatic – Ionic Motorway segment (Trieste – Rijeka – Split – Bar – Drač – Athens), which also functions as a bypass for Rijeka agglomeration, the railway corridor v (Budapest – Zagreb – Rijeka) and the Port of Rijeka. The main airport in the county is located on the island of Krk, as well as the existing and newly-planned port facilities.

The complexity and method of managing individual segments of traffic infrastructure at different administrative levels, as well as managing physical development, creates the need for coordination and for solving conflicts within the overall traffic network in the area.

2 Methodology

The approach to the study development is multidisciplinary, and includes consideration and elaboration of all economic and physical planning advantages, as well as environmental and other consequences of (not) upgrading traffic infrastructure on the Primorje and Gorski Kotar County territory.

Physical and technical study consists of a few stages and units with individual goals for each stage of Study development:

- a Analysis of the study and planning documentation, existing and planned condition, with subsequently included newly-planned interventions.
- b analytic set of maps,
- c analysis of the existing and planned condition,
- d formation of the basic traffic network,
- e basis for laying and evaluating route variations from study solutions from the aspect of physical planning,
- f an overview of basic data about the area from the planning documentation,
- g a proposal for categorising the overall traffic network
- h physical and functional organisation of the County territory in terms of an integral traffic network
- i physical organisation of the County, including quantification of the origin/destination of the existing and planned traffic demand
- j an overview of possible solutions and data from separate studies: railway and road traffic network, marine traffic, air traffic and public passenger transportation
- k description and significance of main traffic routes in terms of space and geography
- l detailed analyses – separate technical data for the proposal for amendments to the planning documentation
- m concluding remarks – an overview of the necessary amendments of the planning documentation in relation to the traffic network and other innovations proposed by the study

Input data for physical and traffic planning and network design are taken over from the Primorje and Gorski Kotar County Physical Plan (hereinafter: PGKC PP), PPPPO (physical plans for areas with special features) and documents formed on the basis of data from physical plans for municipalities and towns.

Traffic study set as its goal the interconnection of the entire traffic system which includes public and individual, road and railway, air and marine traffic as well as pipeline transport. The accelerated development strategy of the City of Rijeka and Primorje and Gorski Kotar County traffic systems should be analysed through some of the following aspects:

- Presenting available road/railway routes and port terminals, as well as feasible and proposed required short-term interventions in upgrading and reconstructing the existing traffic system

- Analysing the structure of the road and railway network and terminals on the territory of the City of Rijeka and Primorje and Gorski Kotar County,
- Proposing strategic, long-term road and railway routes and facilities, as well as required short-term interventions in upgrading and reconstructing the existing road and railway network,
- Analysing the types of regular public passenger transport services (road, railway, marine, air, combined) and specifying elements for the realisation of an integral regular public passenger transport services on the territory of the City of Rijeka and Primorje and Gorski Kotar County,
- Analysing the structure of airports and sea ports open to public transport on the territory of Primorje and Gorski Kotar County,
- Analysing the network and structure of pipelines on the territory of the Primorje and Gorski Kotar County.
- Proposing stages, dynamics and functionality of the construction of the entire traffic system for the period of 5, 10 and 20 years,
- Proposing, based on the performed analyses, the necessary amendments to the physical planning documents.
- The traffic study, within an integrated solution, should have also analysed the following issues:
 - The traffic solution should have evaluated the proposal for an intermodal transport centre,
 - The study should have also proposed and justified in terms of traffic the new route of the motorway ring around Rijeka,
 - The study should have proposed an integrated railway infrastructure network on the territory of Primorje and Gorski Kotar County and the Rijeka railway junction,
 - A categorisation of road transportation facilities,
 - A solution proposal should have been provided for parking facilities at contact points of different transportation modes – the Park & Ride concept.
- Analysing the performance of traffic systems and availability of traffic systems.

3 Position of the new valley railway line within the county traffic network

The Primorje and Gorski Kotar County is positioned centrally in relation to Dalmatia, Central Croatia and Slavonia. The shortest connection of the Kvarner Bay (the Port of Rijeka) with the Pannonian plains is through the valley of the river Kupa. The Primorje and Gorski Kotar County is of special significance for internally connecting the Pannonian and Adriatic regions in Croatia and for connecting the Mediterranean by traffic with the central European regions. Main routes of road traffic (Corridor Vb and the Adriatic-Ionic motorway), terminals of road, railway, marine and air traffic all connect and are concentrated in the Rijeka agglomeration area.

The transport route along the corridor Vb branch road is of an especially large significance for the economy in Hungary, Slovakia, Ukraine, Poland. and is used to transport export/import freight for the requirements of the economy. Expectations are great for the increase in the number of containers being transported to/from Rijeka and to/from the territory of Hungary. These expectations will be even greater after the upgrade and construction of a new container terminal in Rijeka, because it is the most cost-effective route towards the ports in the Adriatic. This route is the fastest and most cost-effective route for the regular transport of passengers between Hungary, Russia and the Ukraine towards Italy and holiday destinations in the Adriatic. A growing interest in the regular passenger transport towards Italy and the Adriatic is to be expected, since travel time will be significantly reduced along the new railway line. The increased purchasing power of the citizens of Hungary, Slovakia and Poland is an issue, resulting even now in an ever-growing interest in spending vacation time on the Adriatic coast, along with the development of seasonal tourist transport, already yielding excellent results.

In railway traffic, the framework for the traffic junction Rijeka is comprised of railway lines of great significance to the international transport at the Pan European corridor Vb branch road, from the state border with Hungary, in the direction of Botovo–Koprivnica–Zagreb–Rijeka–Istria, Slovenia. This route is also the corridor for the future Trans European railway traffic network on the territory of the Republic of Croatia (railway transport corridor 2).



Figure 1 Position of the traffic corridor V in Europe

This railway route is important for connecting central Croatia, Gorski Kotar and north Primorje, but also for connecting European regional roads: the Alps–the Adriatic, the Mediterranean–the Danube basin–central Europe.

According to traffic and technological as well as geographic features, the said railway transport route consists of 4 typical sectors:

Sector I – DG–Botovo–Koprivnica–Dugo Selo

Sector II – Railway Junction Zagreb with entry slip roads onto corridor X

Sector III – Horvati–Karlovac–Drežnica–Krasica

Sector IV – Railway Junction Rijeka with entry slip roads for Istria and Slovenia.

All development plans related to the upgrade and construction of the said railway transport route are included into development plans for the Trans–European railway traffic network on the territory of the Republic of Croatia.

Based on performed detailed analyses and scenarios, and by taking into consideration assumptions, a traffic forecast had been made. Traffic forecast on the State Border–Botovo–Zagreb–Rijeka railway line has a distinctly developmental tendency and it is objectively speaking feasible in case a number of key facilities are constructed along the new railway line Rijeka–Zagreb, such as:

- Modernisation of the existing railway capacities within the Rijeka junction,
- Modernisation, extension and reconstruction of all existing terminals at the port of Rijeka,
- Modification of the traction system on the stretch from Moravice to Šapjane, including all railway lines within the Rijeka junction,
- Construction of a new multipurpose bridge from the land to the island of Krk, to be used for connecting the terminal in Omišalj via the railway line to the yard in Krasica,
- Construction of a new terminal for general cargo in the vicinity of Omišalj on the island of Krk,
- Construction of the Adriatic–Ionic railway line on the section of Rijeka–Koper–Trieste via the tunnel through Učka (Čičarija) provides,

- Construction of the remaining sections of the Adriatic–Ionic railway line which pass through Croatia to Rijeka, via Drežnica to Split and Ploče,
- Reconstruction and modernisation of the railway junction Rijeka,
- Realisation of the transport project Danube Basin–Adriatic, which includes modernisation of the existing and construction of new capacities for the port of Rijeka, a new valley railway line Zagreb–Rijeka, upgrade of the river ports in Sisak and Slavonski Brod, ensuring the navigability of the river Sava through the entire year, from Sisak to Vukovar, including the construction of a multipurpose channel Vukovar–Šamac,
- Construction of the Zagreb railway junction, with new bypass lines, which would facilitate an unhindered flow of through traffic over corridor x and a branch of corridor Vb through a wider Zagreb and Zagreb County area,
- Construction of other capacities not mentioned here in the catchment area of the new railway line.

The forecast itself predicts global scenarios for the construction of large infrastructural facilities which are closely linked with the construction of the new valley line Zagreb–Rijeka, such as:

- necessary interventions at the existing capacities within the Rijeka junction and on the existing railway line in order to increase the efficiency of the railway operations,
- construction of new capacities (railway line, container terminals, intermodal centres etc).

As mentioned above, the corridor for the new line enters the County territory after the Drežnica railway station (Velika Kapela), where the corridor towards Dalmatia (Adriatic–Ionic) has been proposed.

A new double track railway Horvati–Karlovac–Drežnica–Krasica has been planned in sector III at the mentioned railway transport route. On the territory of Skradnik, a single track line connection would be constructed onto the existing railway line Zagreb Central Station–Rijeka and the existing railway route Oštarije–Split.



Figure 2 Proposed option for the construction of the new valley railway at sector III Zagreb – Rijeka (Option 1C)

The new Krasica railway station would be connected onto the existing railway line Zagreb Central Station–Rijeka via the connecting line Krasica–Tijani. After construction in sector III is complete, the new double track line Horvati–Karlovac–Drežnica–Krasica–Tijani would replace the existing railway line Zagreb Central Station–Rijeka on section Horvati–Tijani as a part of

the future railway transport corridor 2 of the Trans-European railway network on the territory of the Republic of Croatia. Section Horvati–Karlovac–Ogulin–Delnice–Škrležovo–Tijani on the existing railway line Zagreb Central Station–Rijeka would no longer hold the status of the main corridor railway line and would become a railway line of significance to regional transport. The properties of the new line will facilitate traffic of far heavier trains than the ones operating along the existing line. The abovementioned information indicates that the railway capacity expressed in gross tons of transported goods will be over 10 times larger than the capacity of the existing line, and that the line will facilitate transport of the predicted number of trains. Taking into consideration high classification and required technical elements, as well as the complexity of the terrain relief and the importance of the region, a series of tunnel structures appear on the railway route.

Subsection Drežnica–Ledenice (20.47 km) from the Drežnica station to the highest point of the railway line at 483.7 m above sea level, which is located inside the Kapela 2 Tunnel, 14,428 m long, at an upward grade of 5 mm/m, and after this point the line is at a downward grade of 7.6 mm/m. The line then passes through tunnels Burnjak (1,530 m), and Vranja (350 m) and reaches the new Ledenice station.

Table 1 Freight traffic forecast on the new valley railway line by sections

Traffic forecast	2015.	2020.	2025.	2030.	2035.	2040.
Line: Krk–Krasica				8.344.800	12.557.400	16.770.000
Route: Krk–Krasica				4.172.400	6.278.700	8.385.000
Route: Krasica–Krk				4.172.400	6.278.700	8.385.000
Line: Rijeka–Krasica			9.664.745	9.285.120	10.068.684	11.461.846
Route: Rijeka–Krasica			5.798.847	5.700.355	6.165.646	7.142.515
Route: Krasica–Rijeka			3.865.898	3.584.765	3.903.038	4.319.331
Line: Krasica–Drežnica			9.664.745	17.629.920	22.626.084	28.231.846
Route: Drežnica–Krasica			3.865.898	7.757.165	10.181.738	12.704.331
Line: Drežnica–Goljak			11.739.187	20.800.080	26.655.794	35.385.326
Route: Drežnica–Goljak			7.043.512	12.896.050	15.993.477	21.231.196
Route: Goljak–Drežnica			4.695.675	7.904.031	10.662.318	14.154.130
Line: Goljak–Horvati		7.499.081	12.356.668	21.894.165	28.057.889	37.246.594
Route: Goljak–Horvati		4.274.604	7.043.512	12.896.050	15.993.477	21.231.196
Route: Horvati–Goljak		3.224.477	5.313.156	8.998.115	12.064.412	16.015.399
Line: D. Selo–Gradec	4.866.209	5.356.486	7.268.629	10.947.082	13.360.900	16.636.284
Route: Dugo Selo–Gradec	2.919.725	3.213.892	4.361.177	6.787.191	8.016.540	9.981.771
Route: Gradec–Dugo Selo	1.946.483	2.142.595	2.907.451	4.159.891	5.344.360	6.654.514
Line: Gradec–Križevci	4.686.209	5.166.486	7.068.629	10.667.082	13.060.900	16.331.284
Route: Gradec–Križevci	2.829.725	3.118.892	4.261.177	6.647.191	7.866.540	9.829.271
Route: Križevci–Gradec	1.856.483	2.047.595	2.807.451	4.019.891	5.194.360	6.502.014
Line: Križevci–Koprivnica	4.746.209	5.236.486	7.148.629	10.767.082	13.170.900	16.446.284
Route: Križevci–Koprivnica	2.859.725	3.153.892	4.301.177	6.697.191	7.921.540	9.886.771
Route: Koprivnica–Križevci	1.886.483	2.082.595	2.847.451	4.069.891	5.249.360	6.559.514
Line: Koprivnica–Botovo (SB)	4.396.209	4.736.486	6.548.629	9.867.082	12.170.900	15.346.284
Route: Koprivnica–Botovo	2.572.112	2.836.693	3.868.592	6.023.630	7.124.842	8.892.422
Route: Botovo–Koprivnica	1.824.096	1.899.793	2.680.036	3.843.452	5.046.058	6.453.862

Table 2 Freight traffic forecast on the new valley railway line by sections in mil. passengers/year

Section	2015.	2020.	2025.	2030.	2035.	2040.
Line: Krasica–Drežnica	2,90	3,50	4,20	4,32	4,90	5,06
Route: Krasica–Drežnica	1,45	1,75	2,10	2,16	2,45	2,53
Route: Drežnica–Krasica	1,45	1,75	2,10	2,16	2,45	2,53
Line: Drežnica–Goljak	4,74	5,60	6,40	6,58	8,50	8,76
Route: Drežnica–Goljak	2,37	2,80	3,20	3,29	4,25	4,38
Route: Goljak–Drežnica	2,37	2,80	3,20	3,29	4,25	4,38
Line: Goljak–Horvati	4,30	5,10	5,80	6,20	7,80	8,00
Route: Goljak–Horvati	2,15	2,55	2,90	3,10	3,90	4,00
Route: Horvati–Goljak	2,15	2,55	2,90	3,10	3,90	4,00
Line: D. Selo–Gradec	3,38	4,00	4,50	4,60	5,00	5,10
Route: Dugo Selo–Gradec	1,69	2,00	2,25	2,30	2,50	2,55
Route: Gradec–Dugo Selo	1,69	2,00	2,25	2,30	2,50	2,55
Line: Gradec–Križevci	2,48	3,07	3,54	3,63	3,90	3,95
Route: Gradec–Križevci	1,24	1,535	1,77	1,82	1,95	1,975
Route: Križevci–Gradec	1,24	1,535	1,77	1,82	1,95	1,975
Line: Križevci–Koprivnica	2,68	3,37	3,88	3,99	4,30	4,40
Route: Križevci–Koprivnica	1,34	1,685	1,94	1,995	2,15	2,200
Route: Koprivnica–Križevci	1,34	1,685	1,94	1,995	2,15	2,200
Line: Koprivnica–Botovo (DG)	0,50	0,60	1,20	1,30	1,80	1,86
Route: Koprivnica–Botovo	0,25	0,30	0,60	0,65	0,90	0,93
Route: Botovo–Koprivnica	0,25	0,30	0,60	0,65	0,90	0,93

Subsection Ledenice–Krasica (25.98 km). After the Ledenice technical station the route enters the Vinodol Tunnel (9,300) in order to avoid unfavourable geological zones as well as the impact of the line on protected areas of the Vinodol Valley. The route is at a downward grade along its entire length to the new Krasica station, with the rail axis slope of 8 mm/m in the tunnels and 12.4mm/m outside the tunnels. The following tunnels are located on this subsection: Vinodol (9,270 m), Kozja Draga (1,370 m), Veli Dol (4,730 m), Biljin (2,250 m), and viaducts: Antovo (1,000 m), Vinodol (1,440 m) and Praputnjak (920 m).

The line route from the Skradnik station to the Krasica station is very demanding in terms of construction works and exploitation because there are structures along 76.56%, i.e. 51,292 m of the route. Route under option c meets all geotechnical requirements specified by the geotechnical report on the territory of the Vinodol Valley.

In sector IV a connection of the said railway traffic route is planned onto the existing and future railway and port capacities in the wider Rijeka area, as well as onto the existing and future capacities for the passenger transport in the Rijeka area; a connection is also planned onto the existing railway line towards Slovenia and a new connection onto the railway network in Istria. The most important interventions include the construction of the new connecting line Krasica–Ivani, further on with the connection onto the existing Škrlevo – Bakar railway line, of the new bypass and connecting Krasica–Tijani–Matulji–Istria railway line and connecting line from Krasica to the planned new port capacities on the island of Krk.

By constructing a tunnel and a railway line for connecting corridor Vb branch onto the Istrian railway network and by possibly continuing the construction of the line through Istria towards Trieste, the connection between the corridor Vb branch and corridor V might be achieved in Trieste as well.

4 Options for the railway traffic junction development

The new redefined solution of the Rijeka railway junction has to meet the functional requirements of the port and other economic agents, i.e. the City of Rijeka and its residents, with maximum protection and undisturbed development of other urban functions. This also means that the capacities for freight transport would be dislocated to the highest degree possible from the inner city circle to its peripheral areas (Krasica, Kukuljanovo, Bakar, Ivani, Bršica, Krk etc.), while the passenger transport facilities would be efficiently incorporated into the physical and traffic plan for the city of Rijeka. This applies particularly to the railway being included into the urban and suburban passenger transport, which might significantly improve transport services in the narrow and wide Kvarner region, from Opatija and Rijeka all the way to Crikvenica and Novi Vinodolski.

Modelling the Rijeka railway junction was a complex project, both technically and technologically. This complexity is caused by a number of limitations which hinder a logical and rational approach to finding an optimal traffic solution. One of the greatest limitations is certainly a lack of adequate surface area onto which to arrange railway facilities in a technologically most appropriate succession.

The second largest limitation is certainly the existing level of development of the railway and port infrastructure which should be utilised to the utmost degree and functionally incorporated into the new solution for the Rijeka junction.

And finally the third limitation is the obligation to adhere to the urban and physical development plans for the city of Rijeka, and accordingly the port and the railway should not hinder its development.

Along with the abovementioned limitations, there were also several other limitations in implementing the conceptual solution to the Rijeka railway junction, such as water and environmental protection, etc. All this played a part in redefining the role of the junction and in the arrangement of particular facilities in accordance with the proposed concept.

The mixed traffic line from the Krasica station to the port of Omišalj has been devised as electrified and double-track, and has been considered through a number of options with a new bridge to the island of Krk. All considered options from the land–Krk bridge to the location of Blatna end at the port terminal in Krk next to the future logistics and distribution centre.



Figure 3 New railway connection at Vitoševo (direct link between Ivani and Rijeka and Brajdica) – (stage III of the junction construction)

The railway route from Krasica to Matulji has been considered through two options 'at elevation 200' and 'at elevation 300' with several variations (in plan view, detailed grade line, shorter–longer tunnels). The problem in making a final decision lies in the inability to run the route through developed areas, and to run through traffic through town, at the same time making sure that the line functions as urban and suburban passenger transport route.

The dilemma between elevation 200 or 300 still remains and requires additional investigation. The 'elevation 300' was considered as an option in order to force penetrating Ćićarija

(14,370 m) and rising to the elevation of the Jurdani station (341 m above sea level). This route achieves a shorter link to Trieste and a direct link to the large business zone after Jurdani (Miklavija). By the option 'elevation 200' and the Učka Tunnel (12,030 m) the railway link to Istria is realised from the Opatija–Matulji station (at the elevation of 211 m). This avoids running the route down the slopes of Učka above Opatija, but transit through central urban zones, the large business zone after Jurdani towards Slovenia, are not directly linked via good railway connections.



Figure 4 Integrated scheme of the Rijeka railway junction

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