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RAILWAY LINE "ZAGREB-RIJEKA"

ABSTRACT

The current condition of the Zagreb – Rijeka railway line, and the throughput capacity of the line on the Botovo – Rijeka section reflect the overall situation of the railway traffic on the section of the Corridor Vb. The existing condition needs to be reconstructed by investing in the infra- and supra-structure. Along with the modernisation the increasingly present environmental awareness should bring to the gradual shift of cargo from road to railways. Such principle would contribute to the increase in passenger traffic and eventually of the maritime traffic as well.

KEY WORDS

Zagreb-Rijeka railway line, traffic corridor Vb, modernisation, traction system

1. INTRODUCTION

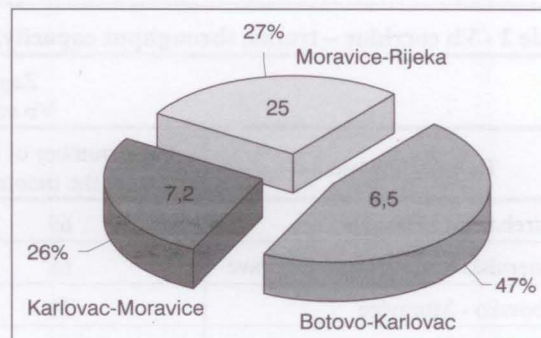
The Zagreb – Rijeka railway line passes along the European traffic corridor Vb. The route to Rijeka was constructed as early as 1873. It still exists today but featuring very poor characteristics. Following the development plans of the European railways, and also the necessity to be competitive with the road transport along the newly constructed motorway, it is necessary to modernise the existing line. By bringing the transportation of the previously carried volumes back to this route, it would be possible to justify the construction of the new railway line passing through the Drežničko Polje. Such a project should be also advocated by the government policy for several reasons. The significant ones include the energy preservation, reduction of road congestion by trucks, and reducing the number of severe traffic accidents most of which include trucks. By far the most significant reason is the implementation of sustainable development. Such a sequence of events is provided by the railway and its ecological advantages.

Another important item in respecting the sustainable development is also the development of combin-

ed transport. Today, this type of transport in Croatia is lagging far behind the West European countries (Austria, France and Germany). Croatia still has not got the conditions to redirect cargo from road to environmentally friendlier modes of transport, including both railway and inland waterways i. e. maritime traffic.

2. STATE OF THE ART ON THE ZAGREB – RIJEKA RAILWAY LINE

The Zagreb – Rijeka railway line operates in the European traffic corridor Vb. This is the railway line E71 Budapest – Gyekenyes – Botovo – Dugo Selo – Zagreb – Karlovac – Oštarije – Moravice – Rijeka. The line was completed to Rijeka in 1873, with a gradient of up to 25‰ and the curve radii of as much as 250 metres. This results in very poor level of service. The Zagreb – Karlovac section is a level line with a gentle gradient of up to 7‰ and ruling resistance of up to 7 daN/t. The Karlovac – Moravice section features a gradient of up to 8‰, and resistance of up to 10 daN/t. From Moravice to Rijeka the railway line features the characteristics of a mountain line with an ascent of 18‰, descent of 25‰ and resistance of up to 22 daN/t. Graph 1 presents the route in percentages per maximal gradient expressed in per mille.



Graph 1 - Route presented in percentages per max. gradient expressed in per mille

Apart from unfavourable level gradients, the existing line is also characterised by the great number of curves. The Karlovac – Rijeka section of the railway line features 70% of curves, and 40% of the length of this section of the railway line features curves with radii smaller than 300 metres. The traction system on the Zagreb – Rijeka railway line was modified in 1987 from Zagreb to Moravice from the system 3 kV D. C. to monophasic system 25 kV 50 Hz.

The highest speed train today operates the relation from Zagreb to Rijeka in the length of 228 km in 3.5 hours at an average travelling speed of 65 km/h for passenger trains, whereas the commercial speed of cargo trains amounts to about 30 km/h. The reduction of commercial speed is also the result of the changing of the engine in Moravice due to the change in the traction system

Such speed can hardly compete with road traffic in cargo transport and even less so in the carriage of passengers. The existing line needs to be modernised. Modernisation would make the railways competitive to road traffic. Although the soon completion of the Zagreb – Rijeka motorway will make this target a difficult one to achieve, according to the UIC (Union Internationale des Chemins de fer) plans, to a 50:50 ratio in road / railway traffic expressed at the 9th International Trade Fair for Logistic and Transport in Munich. It is primarily necessary to change the traction

system from Moravice to Rijeka and Šapjani and from Škrljevo to Bakar, and that is planned by the year 2006. An amount of about HRK 470.340 million has to be allocated for this purpose.

3. THROUGHPUT CAPACITY OF THE "ZAGREB-RIJEKA" RAILWAY LINE AND THE INFRASTRUCTURE DEVELOPMENT

Table 1 shows general characteristics of the Vb corridor section through Croatia.

Scheme 2 presents the throughput capacity of the Vb corridor Botovo-Zagreb-Rijeka railway line in 2003.

Daily number of trains, throughput capacity and occupancy of the Zagreb-Rijeka railway line are given in Table 2.

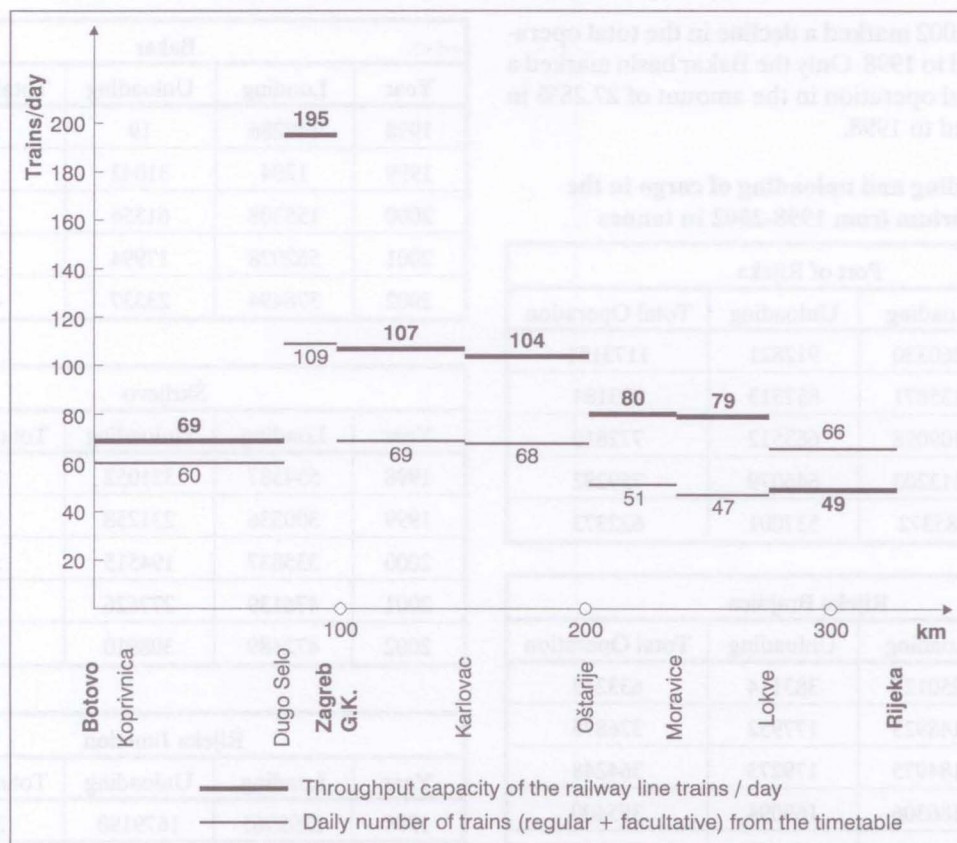
It is obvious from Table 2 that the occupancy of the Lokve – Rijeka railway line on the section Škrljevo – Sušak Pećine amounts to as much as 134.69%, which is according to the UIC method possible because of the time reserve t_r which represents the time planned for the reduction of risk of chain delays and the additional time t_d to guarantee the desired level of service quality and in case of the different number of spacing. Therefore, the conclusion is that the mentioned section does

Table 1 - Vb corridor – section Botovo-Zagreb-Rijeka

Vb Corridor Botovo-Zagreb-Rijeka								
Length: 328.7 km								
Capacity: 22.5 t/os, 8.0 t/m								
Electrified: 25 kV, 50 Hz (286.3 km), 3 kV (90 km)								
Section	Length	Max. speed	Number of tracks	Net-tonnes				
				average 1986-1990	1999	2000	2001	2002
Botovo-Zagreb	99.9	120	1	3.98	2.85	2.64	3.00	3.66
Zagreb-Karlovac	52.3	120	1	5.05	3.43	1.55	3.39	2.98
Karlovac-Oštarije	50.3	80	1	5.15	2.73	1.23	3.46	3.02
Oštarije-Rijeka	125.9	70	1	4.78	1.32	0.6	2.6	1.92

Table 2 - Vb corridor – trains, throughput capacity, occupancy of the railway line for 2003

Zagreb – Rijeka Vb corridor (2003)			
Railway line/section	Daily number of trains from the timetable	Throughput capacity train/day	Line occupancy according to timetable %
Jastrebarsko - Draganić	69	107	64.49
Generalski Stol - Gornje Dubrave	68	104	65.38
Vrbovsko - Moravice	51	80	63.75
Brod Moravice - Skrad	47	79	59.49
Škrljevo – Sušak Pećine	66	49	134.69



Scheme 2 - Throughput capacity of the railway line of corridor Vb and occupancy in 2003

not meet the service quality according to the UIC method.

4. IDEAS REGARDING FURTHER DEVELOPMENT OF THE "ZAGREB-RIJEKA" RAILWAY LINE

The Croatian Railways is planning the construction of the second track on the railway line section from Zagreb to Karlovac in the length of 52.6 km by the year 2008 with an investment of HRK 410 million. From Karlovac to Rijeka a level railway line has been planned from Drežničko Polje, first as a single-track line by 2020 at the latest, with the possibility of additional construction of the second track as necessary. Already in 1906 the MAV (Magyar Államvasutak) study considered the possibility of constructing a new line from Oštarije to Rijeka via Drežničko Polje, developed also in the 1999 Physical Planning Program of the Republic of Croatia. The route would fork off from the existing line in Karlovac by crossing the rivers Kupa and Mrežnica, passing east of Duga Resa, climbing along the plateaus between the rivers Mrežnica and Korana, and then crossing again the river Mrežnica near the town of Dobrenić, then the river Tounjčica, and the gate of Tounja-Skrad (Tounjsko-skradnička vrata), passing along a tunnel and entering the

Ogulin-Plašće valley. Passing Josipdol there is a 1850 m long tunnel to Ogulinsko Zagorje, then through the 9200 m long Kapela 1 tunnel to Drežnica. Exiting Drežnica there is the 13600 m long Kapela 2 tunnel, and two more tunnels, 380 m and 530 m respectively, reaching then Ledenica, Križišće and Krasica (Rijeka RK). The total length of the route from the shunting yard Rijeka to the station Karlovac amounts to 108.25 km. Out of this length, the route has tunnels - 28.87 km, bridges - 11.54 km, and the rest of 67.85 km runs along cutting or embankments. The railway line is characterised by gradients of up to 12.5%, curves are planned with the minimum radius of 2500 metres allowing a speed of 200 km/h.

The justification of constructing this railway line today is questionable, since the indicators regarding passenger and goods transport by railways show that it has drastically fallen over the recent five years.

5. TRANSPORT OF GOODS IN THE RIJEKA AQUATORIUM

Table 3 shows that in the Rijeka port basin the total operation in 2002 was reduced by 53% compared to 1998. The total operation in the Rijeka Brajdica basin in 2002 was by 47% lower than in 1998. The Rijeka factory basin, the Škrljevo basin, and the Rijeka Junc-

tion basin in 2002 marked a decline in the total operation compared to 1998. Only the Bakar basin marked a rise in the total operation in the amount of 27.28% in 2002 compared to 1998.

Table 3 - Loading and unloading of cargo in the Rijeka aquatorium from 1998-2002 in tonnes

Port of Rijeka			
Year	Loading	Unloading	Total Operation
1998	260330	912821	1173151
1999	135871	857313	993184
2000	109098	663512	772610
2001	113203	646079	759282
2002	85372	537001	622373

Rijeka Brajdica			
Year	Loading	Unloading	Total Operation
1998	250129	383114	633243
1999	148923	177952	326875
2000	184975	179273	364248
2001	186306	169094	355400
2002	119196	179765	298961

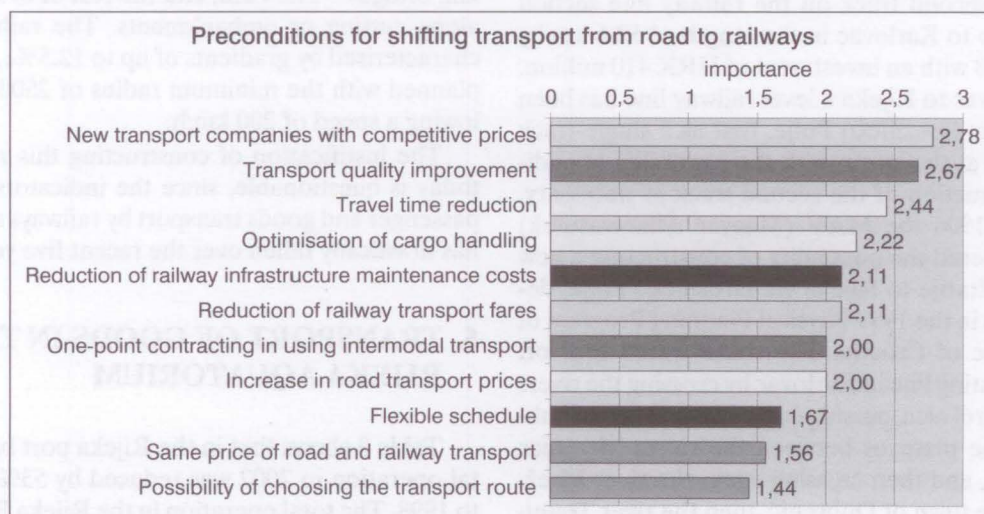
Rijeka Tvornica			
Year	Loading	Unloading	Total Operation
1998	81829	62184	144013
1999	36284	43916	80200
2000	21992	40265	62257
2001	32433	29716	62149
2002	25754	28436	54190

Bakar			
Year	Loading	Unloading	Total Operation
1998	147286	19	147305
1999	1294	31042	32336
2000	155308	61356	216664
2001	562028	17994	580022
2002	378494	23337	401831

Škrljevo			
Year	Loading	Unloading	Total Operation
1998	554387	321052	875439
1999	300336	231258	531594
2000	335837	194515	530352
2001	476139	277626	753765
2002	472489	308910	781399

Rijeka Junction			
Year	Loading	Unloading	Total Operation
1998	1293961	1679190	2973151
1999	622708	1341481	1964189
2000	807210	1138921	1946131
2001	1370109	1140509	2510618
2002	1081305	1077449	2158754

The transport of goods in the Rijeka aquatorium is rising every year, and the railway transport is declining from year to year. The road transport is increasing, which is unacceptable regarding the sustainable development. The following should be done (Graph 2).



Graph 2 - Shift of transport from road to railways

Source: UIC Report, October 2000

6. PROSPECTIVE DEVELOPMENT OF RO-LA SYSTEM APPLICABLE ON THE RAILWAY LINE

Apart from the mentioned, the policy should favour the railways and see all the advantages provided by the railway traffic. Apart from water traffic, the railways is ecologically the most cost-effective transport mode. The mass cargo transport by railways consumes four times less energy than transporting the same quantity of cargo by trucks. Here, there is also the possibility of combined transport which is very poorly represented in Croatia, unlike the EU countries. The share of integral transport in the total railway traffic in Austria amounts to 22%, France 25%, and in Germany as much as 30%. Along with the application of incentive governmental measures, certain investments and organisation-regulation measures, Croatia plans over the mid-term period to increase the share of integral transport in the total railway transport from 7% to 12%, and by the year 2020 even up to 20%. In their wagon fleet the Croatian Railways own only wagons from the series Rgs and Kgs for transport of containers and exchangeable truck cases. As of 15 September 2003, out of 321 available Rgs wagons owned by the Croatian Railways, 193 were in proper order and out of the available 223 Kgs wagons, 194 operated properly. These wagons are not suitable for transport of exchangeable truck cases due to the great height of the loading surface of GRT (Kgs = 1240mm, Rgs = 1260mm) and due to the unfavourable ratio of the gross weight and tare, since these wagons have been constructed also for the transport of cargo of conventional traffic. Therefore, it is necessary to purchase wagons for combined transport of entire trucks. According to the plans of the Croatian Railways there will be 50 Saadkms-z wagons by the year 2006.

Eight-axle low-floor wagon (Figure 1) has been designed for loading trucks, trucks with trailers, tractors, and semi-trailers of up to 44.8t of mass. The loading is done at the end of the trains, turning the front heads, so that the trucks of up to 2.6m wide and 4 m high can be driven across the set access ramps. One should also consider the wagons that can be loaded sideways. Modalohr wagon is a low-floor wagon designed for loading of trucks, trucks with trailers, tractors, and semi-trailers of 44 t of mass, up to 13.7 m in length, up to 4 m in height, and of standard width. Figure 2 shows the sideways loading method of Modalohr wagons.

7. CONCLUSION

The current condition of the railway line on the traffic corridor Vb from Zagreb to Rijeka cannot compete on the market with road traffic. This is quite understandable regarding the absence of investments



Figure 1 - Wagons for loading of trucks, trucks with trailers and tractors with semi-trailers

into modernisation and construction of the railway infrastructure, as opposed to big investments made into road infrastructure. Traffic development should recognise the principles of intermodality and planning of an integrated traffic network. Traffic has to develop as a system considering the advantages and disadvantages of certain branches. Based on this, the alternatives should be considered, following sustainable development.

In compliance with the 1987 Bruntland's Commission definition for sustainable development which says that this means development which meets the present requirements and does not endanger the possibilities of the future generations to satisfy their needs, we have to wake up and make some steps towards increasing the volumes transported by trains, i. e. by shifting heavy cargo from road to railway.

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SAŽETAK

ŽELJEZNIČKA PRUGA "ZAGREB-RIJEKA"

Postojeće stanje željezničke pruge Zagreb-Rijeka, te propusna moć željezničke pruge na dionici Botovo-Rijeka oličanje su sadašnjeg stanja željezničkog prometa na dionici Vb koridora. Potrebno je izvršiti rekonstrukciju postojećeg stanja ulaganjem u infrastrukturu i suprastrukturu. Sve prisutnija ekološka svijest uz modernizaciju trebala bi dovesti do postupnog preseljenja tereta sa ceste na željeznicu. Ovakav princip pridonio bi i povećanju putničkog prometa, a na kraju i pomorskog prometa.

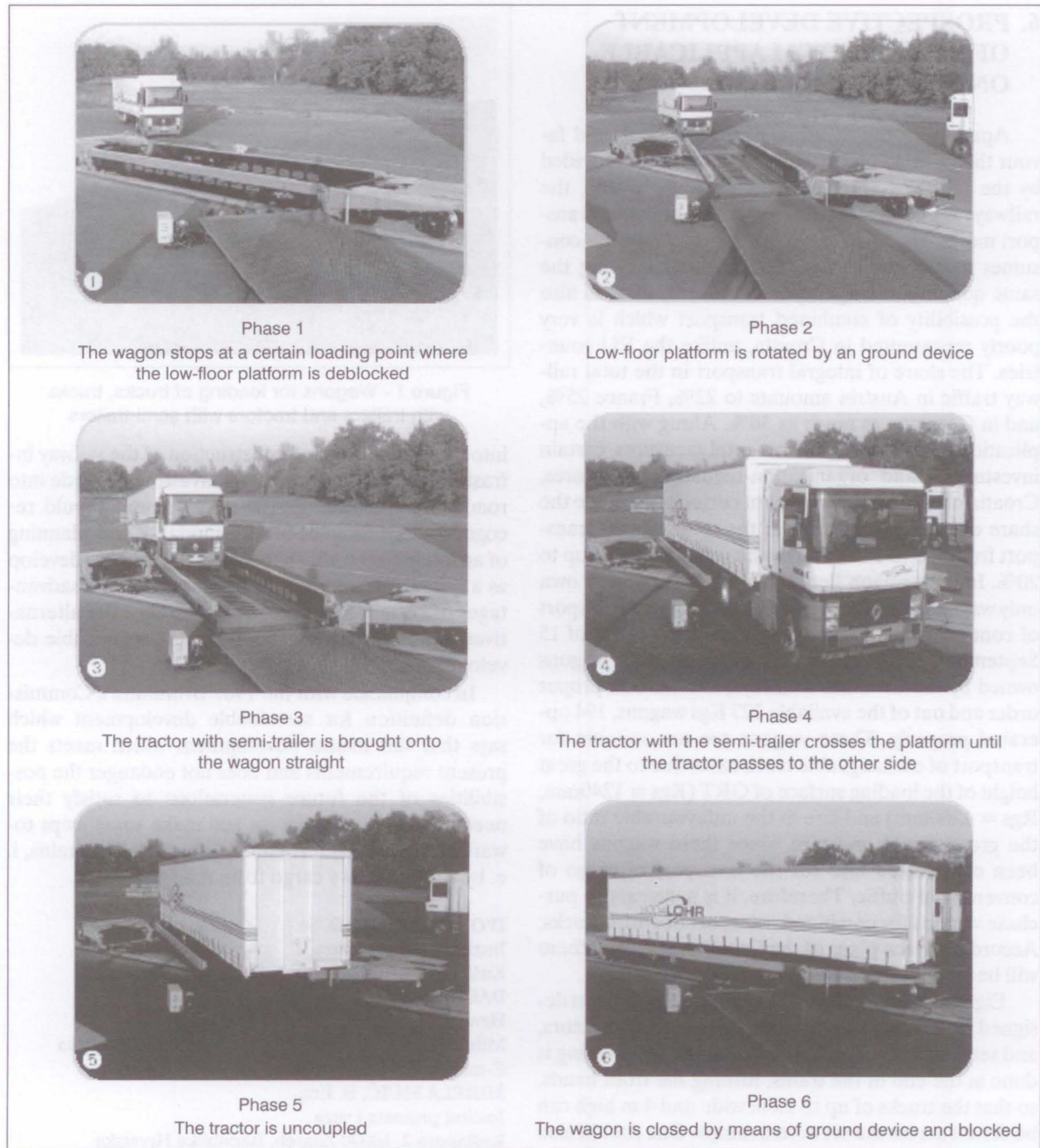


Figure 2 - Sideways loading method of Modalohr wagons.

KLJUČNE RIJEČI

željeznička pruga Zagreb-Rijeka, koridor Vb, modernizacija, vučni sustav

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