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## CHARACTERISTIC OF RAILWAY CONNECTIONS BETWEEN THE AGGLOMERATIONS OF KATOWICE AND RYBNIK

In the study, technical equipment of the railway traffic control system was analysed in the track sections in the agglomeration of Rybnik and connections with the conurbation of Katowice. Presently operated ways of traffic control were characterized, as well as the number of railway tracks in a specific section. Also, differences in travel times obtained due to modernization of railway traffic control system were discussed.

## CHARAKTERYSTYKA POŁĄCZEŃ KOLEJOWYCH POMIĘDZY AGLOMERACJĄ KATOWICKĄ A AGLOMERACJĄ RYBNICKĄ

W pracy przeanalizowano wyposażenie techniczne w urządzenia sterowania ruchem kolejowym odcinków szlakowych na obszarze aglomeracji rybnickiej oraz połączeniach z aglomeracją katowicką. Scharakteryzowane zostały istniejące sposoby sterowania ruchem jak również liczba torów na danym odcinku. Analizie poddano również różnicę czasów podróży, którą uzyskuje się przez modernizację urządzeń sterowania ruchem kolejowym.

### 1. INTRODUCTION

Reciprocal relations between the two large agglomerations of people make transport inevitably essential. The best means of transport for such big crowds is the railway. The problem which presently occurs in connections between agglomerations of Katowice and Rybnik is low travel speed, which considerably affects decreasing competitiveness of this means of transport.

This report deals with the influence of infrastructure condition between the agglomerations and in the area of Rybnik and Katowice agglomerations on the travel speeds of the trains. Also, the possibility of starting a new connection between Gliwice and Rybnik was analysed, using the section of Zabrze Mikulczyce - Czerwionka.

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## 2. TRANSPORT QUALITY

The evaluation of existing infrastructure of the railway transport used in passenger traffic should be made from the point of view of the passenger as the purchaser of transport services. Definition of the quality of rendered services can be obtained by comparing synthetic coefficients with recommended data and carrying out a survey among the passengers expressing their subjective evaluation of individual criteria. Thus, service quality consists of subjective evaluation made by passengers and objective one expressed by values of coefficients within certain pre-arranged limits.

The significant coefficient is the travel speed which also translates into travel duration. Owing to this value, it is possible to estimate attractiveness of this offer in relation to other means of transport, such as public road transport or private transport.

The situation of both agglomerations towards each other is characterized by short distances between large urban areas – centres and sub-centres, which means that evaluation of the communication system can best be made using the criteria concerning the agglomeration or urban transport. An additional argument is the fact that distances between the cities – sub-centres of the Katowice agglomeration are similar to distances between the sub-centre of Gliwice city and the capital of the Rybnik agglomeration – the city of Rybnik. The above point has been presented in figure no. 1.

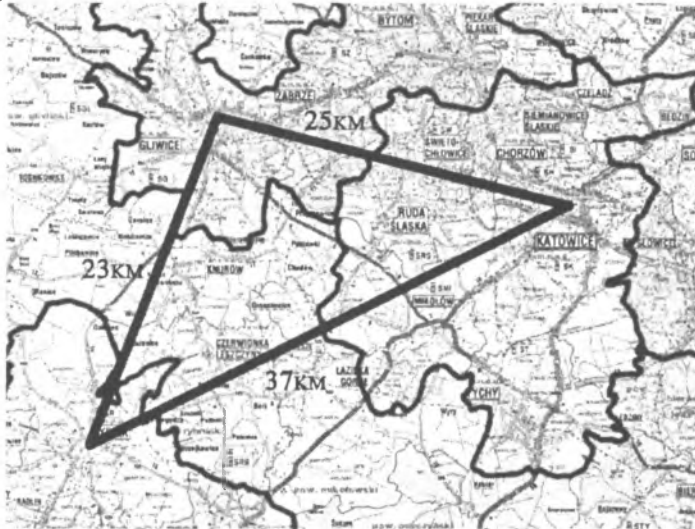


Fig. 1. Distances between agglomeration centres and the sub-centre of Gliwice city

Travel duration, the value directly dependent on the travel distance and infrastructure condition (including dependence on railway traffic control system), is in the last position – the fifth among criteria groups which estimate the quality of communication in the region. Its influence on selecting the means of transport today is essential because of differences in travel duration between individual transport, public road transport and railway, reaching even 500% for the railway connections on the route of Gliwice and Rybnik. The criteria and their values, have been shown in table 1.

Table 1

Evaluation criteria for public communication quality and their values

	Criteria	Criterion value
1	Reliability	24,5
2	Availability	24,2
3	Travel conditions	21,1
4	Travel ecology	16,8
5	Travel duration	13,4
	Total	100,0

Source: [3]

Availability criterion, being in the second place according to its value, is also closely related with applied railway traffic control systems. This criterion includes, among others, duration and continuity of operation and availability. Both of these values depend on permissible speeds and track or section capacity – the bottleneck in the railway network. In table 2 sample railway travel times were shown in relation to other means of transport.

Table 2

Travel times between Katowice agglomeration cities and Rybnik by various means of transport

Katowice agglomeration city	Rybnik agglomeration city	Travel time				
		railway [min]	individual transport [min]	travel time in relation to railway	bus [min]	travel time in relation to railway
Katowice	Rybnik	78	42	54%	70	90%
Gliwice	Rybnik t.Katowice	120	22	18%	40	33%
Gliwice	Rybnik directly	80	22	28%	-	-
Tarnowskie Góry	Rybnik	180	40	22%	95	53%
Sosnowiec	Rybnik	88	50	57%	84	95%
Jaworzno	Rybnik	127	56	44%	100	79%

It should be noted that travel time from Gliwice to Rybnik is five times longer by railway in relation to individual transport and three times in comparison with public transport by road.

### 3. PRESENT THE RAILWAY TRAFFIC CONTROL SYSTEM DEVICES AND THE SPEED IN RAILWAY TRACK SECTIONS

Infrastructure condition and railway traffic control devices can considerably affect the track speeds and their local limits. Another factor dependent on operated railway traffic control devices is the section capacity, i.e. the number of trains which can pass a specific section in a specific time. This value will additionally depend on the number of tracks in a specific section and on the section length. Table 3 presents the number of tracks in a specific section along with permissible speeds.

The number of rail tracks and permissible speed in sections covered by passenger traffic

Table 3

Section	Number of tracks	Mode of train announcements*	Permissible speed [km/h]
Katowice Ligota - Pszczyna	2	SS	90-100
Pszczyna - Żory	1	T	70-90
Żory - Rybnik	2	T	50-60
Katowice Ligota - Leszczyny	1	T	50-60
Leszczyny - Rybnik	2	PP	50-60
Rybnik - Chałupki	1	PP/T	50-60
Gliwice - Kędzierzyn K.	2	PP	90-100
Kędzierzyn K. - Turze	2	T/PP	70-90
Turze - Rybnik	2	PP	50-60
Turze - Racibórz	2	T	70-90
Racibórz - Chałupki	2	T	50-60
Gliwice - Chorzów Batory - Katowice	2	SS	90-100
Katowice - Katowice Ligota	2	SS	70-90
Katowice - Katowice Zawodzie	2	SS	50-60
Katowice Zawodzie - Dąbrowa Górnicza	2	SS	90-100
Katowice Zawodzie - Mysłowice	2	SS	90-100
Chorzów Batory - Bytom	2	PP	30-50
Bytom - Tarnowskie Góry	2	T	50-60/90-100

\* SS – two-way automatic block system, PP – two-way semi-automatic block system, T – phone announcement

It can be concluded from the data above that the lowest permissible speeds occur for announcements by phone, and the highest speeds for automatic block system. Exceptions include particularly dangerous places and those with mining damage. Figure no. 2 shows information relating to railway traffic control systems in described area, whereas figure no. 3 presents permissible speeds.



Fig.2. Railway traffic control devices at present

Within the main junction of the Rybnik agglomeration – the station of Rybnik, at the neighbouring stations (Wodzisław Śląski Obszary – Kamień) and along the line of Rybnik – Sumina – Turze – Kędzierzyn Koźle there is a semi-automatic block system installed. In remaining sections where passenger trains run, traffic is controlled on the basis of phone announcement.

In the area of the Katowice agglomeration the situation is definitely better. There, an automatic block system predominates (sections of Gliwice – Katowice – Dąbrowa Górnicza-Zawiercie and Katowice – Mysłowice – Jaworzno Szczakowa). In sections of Gliwice – Kędzierzyn Koźle, Chorzów Batory – Bytom and Mysłowice – Chęlm Śląski semi-automatic block systems are installed. Only in the section of Bytom – Tarnowskie Góry the phone announcement is still used.

Connections between the agglomerations involve five sections:

- single-track Katowice Ligota – Orzesze – Leszczyny – Rybnik section; up to Leszczyny phone announcements are used, between Leszczyny and Rybnik a semi-automatic two-way block system operates,
- double-track Katowice Ligota – Pszczyna; single-track Pszczyna – Żory – Rybnik, up to Pszczyna an automatic block system operates, between Pszczyna and Rybnik trains are announced by phone,

- double-track Gliwice – Kędzierzyn Koźle; double-track Kędzierzyn Koźle – Turze – Sumina – Rybnik / Sumina – Rydułtowy – Rybnik, from Gliwice to Kędzierzyn Koźle and from Bierawa through Turze and Sumina to Rybnik a semi-automatic block system is installed, between Kędzierzyn and Bierawa train announcements are used.

Suggested direct connection from Gliwice to Rybnik will use the route of Gliwice Sośnica – Leszczyny, where traffic is conducted on the basis of phone announcements, and maximum speed in most of the section is 40 kph. This connection, as compared with the present one – through Katowice, is definitely slower at this moment, however, taking into account the difference in distance and the time needed for changing trains, travel time is shortened by 1/3 – from 120 to 80 minutes. Application of light track-buses in transport would result in the increase in permissible speeds, just as it was in other operated connections in Poland.

Modern devices have improved safety standards and mean higher permissible track speeds. The map in figure 3 presents permissible speeds on railway lines within the borders of both agglomerations and alternative connections to direct ones.

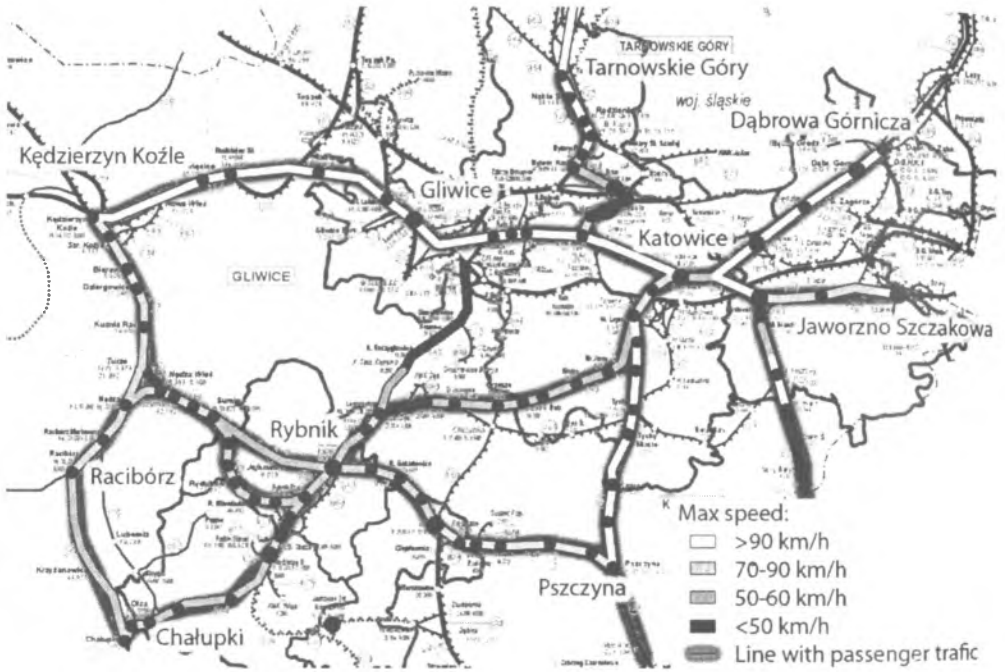


Fig.3. Permissible speeds used on the track

The comparison of both figures suggests that for tracks with automatic or semi-automatic block systems permissible speeds often exceed 90 kph, while for phone announcements the track speeds are mostly limited to 50-60 kph.

In passenger traffic, where transport competitiveness with respect to time is important, travel speeds lower than 70 kph will lead to drop in railway attractiveness as a means of transport in public communication. Organizational recommendations [3] state that travel time in public

transport should not be longer than 20% when compared with individual transport. According with information given in table 2, this condition has been fulfilled neither by the railway nor by public road communication, in any of the connections.

Considerable differences in travel times between the means of transport are caused mainly by presented differences in permissible speeds for trains and much better road traffic parameters – existence of roads with great capacity and permissible speed of 70-90 kph. Trains, despite their strong point, which is traffic separation in most intersections with road traffic, presently are not able to meet passenger demands for as short travel time as possible and high availability.

Availability is another factor which affects the choice of a means of transport. This is a criterion equally dependent on infrastructure condition and on applied railway traffic control devices. The offer addressed to passengers, in a similar way as in the case of travel time, does not comply with recommendations. According to recommendations, trains in the suburban zone should be running in 40- or 90-minute periods during the times of greatest demand within 24 hours and 60-120 for the times with lowest transport demands. Table 3 contains information on the number of running trains with a division into rush hours and remaining times. The morning rush hour has been set from 5.00 to 8.00, while the afternoon peak between 14.00 and 17.00.

Table 3  
Number of connections between cities of the Katowice agglomeration and Rybnik with division into rush hour and remaining time

		to Rybnik		from Rybnik	
		Rail	bus	rail	bus
morning rush hour	Katowice	1	0	3	0
afternoon rush hour		3	2	3	3
remaining time		10	10	7	9
morning rush hour	Gliwice	3	3	4	6
afternoon rush hour		4	5	4	9
remaining time		12	29	12	23
morning rush hour	Zabrze	3	1	4	1
afternoon rush hour		4	2	4	2
remaining time		12	8	12	7
morning rush hour	Bytom	0	0	2	1
afternoon rush hour		2	0	3	0
remaining time		9	2	9	1
morning rush hour	Sosnowiec	2	0	4	0
afternoon rush hour		4	0	2	0
remaining time		13	0	13	0

According to mentioned recommendations, the number of runs in the rush hours should be 6. This value has been reached only for connections by public road transport along the line of Rybnik – Gliwice, in remaining cases this assumption has failed. There is no need to change trains only in case of the railway connections from Katowice, the remaining ones involve a trip to Katowice where it is necessary to change trains. The only exceptions are connections from Gliwice where passengers can choose between the change in Katowice and Kędzierzyn Koźle, with similar travel times offered in both cases. Data for bus connections concern only direct connections.

What should be noted is the fact of impaired communication between the eastern part of the Katowice agglomeration with Rybnik (the Rybnik agglomeration). The eastern part of the Katowice agglomeration is inhabited by  $\frac{1}{4}$  of the whole population within the agglomeration, which significantly affects the degradation of cultural relations of this sub-region with the Rybnik agglomeration.

#### 4. SUGGESTED MODIFICATIONS

The basis for properly functioning regional communication system, whose aim is to strengthen the social and cultural bonds, is a timetable with equal time spaces in the runs with suitable – adequate trip frequency for transport needs. The guarantee of above properties is good condition of the infrastructure matched with reliability of the means of transport.

Presented analysis show weak points in the railway transport system – low permissible speeds and an old-fashioned system of traffic control. Modernization of particular sections in order to increase permissible speeds and introduction of more modern railway traffic control systems will increase the capacity of presently operating railway lines.

The fact that one of the two international routes runs across the Katowice agglomeration: the E-30 from the East to West and the E-65 from the North to South may hopefully lead to introduction of modern ERTMS control system which may increase the line capacity.

An opportunity for the development of the regional connections was introduction of centralized control system. It is also advisable to start a direct connection between Gliwice and Rybnik which would shorten the travel time by almost a half.

#### BIBLIOGRAPHY

- [1] REJMONIAK A., Kryteria sprawności działania systemu komunikacji miejskiej. Transport Miejski, Nr 12, 1985
- [2] Rozkład jazdy pasażerskiej komunikacji samochodowej. Województwo Śląskie 2004.06.27-2005.06.25, Polska Izba Gospodarcza Przemysłu Samochodowego i Spedycji
- [3] RUDNICKI A., Jakość komunikacji miejskiej. Zeszyty Naukowe – Techniczne oddziału SITK w Krakowie, Kraków 1999.
- [4] WIĘCKOWSKI M., Zasady projektowania obsługi osiedli mieszkaniowych i zespołów przemysłowych przez komunikację zbiorową. IGPiK, Warszawa 1988
- [5] Służbowy rozkład jazdy pociągów pasażerskich 2005, Zeszyt 405 oraz Zeszyt 406
- [6] Służbowy rozkład jazdy pociągów towarowych 1999, Zeszyt 420
- [7] Elektroniczny rozkład jazdy pociągów, rozkład.pkp.pl, 18.05.2005
- [8] [www.pl.map24.com](http://www.pl.map24.com)

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