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Dysfunction of the road system connecting the left and right-bank part of Szczecin

Abstract: The article presents the current problems of the road system connecting Prawobrzeże with other administrative districts of Szczecin. The analysis and calculations were carried out based on the criterion of evaluation, scores and measurements of their own. They were conducted in standard situations (without delay) and critical blockages occurring in the main thoroughfares of the city. The possibilities of mitigate the difficulties and disadvantages in view of the actual regions of their occurrence. The final results are presented in tabulated form.

Keywords: Urban transport system; Traffic congestion; Causes and consequences of dysfunction

Introduction

The transport congestion is defined in different ways, including the difference in the cost of resources between the road network operated under current traffic conditions, to the ideal state (without delays, while maintaining the maximum secure communication speed) [5]. For many years it has been a widespread phenomenon, which due to its scale and size has been referred to as the social catastrophe [6]. Although the causes of congestion are well known and have long been defined, they are a growing problem for most large cities as well as for the surrounding peripheral areas. The most important factors influencing their growth include, among others: increasing motorization index, obsolete road and street network, transit traffic (lack of bypasses, urban and express roads), inefficient mass transit systems, signaling, telematics and marking, work (construction, renovation), communication preferences of inhabitants, incidents and road events [2, 7, 8, 9]. It follows that traffic restrictions may be short-lived due to time constraints or permanent (chronic) interruptions where the capacity of a given segment has been exhausted [3]. Regardless of the type of transport congestion, its effects are assessed unequivocally as costs directly affect the economic, environmental and social sphere. [4].

The problem of city transport connections

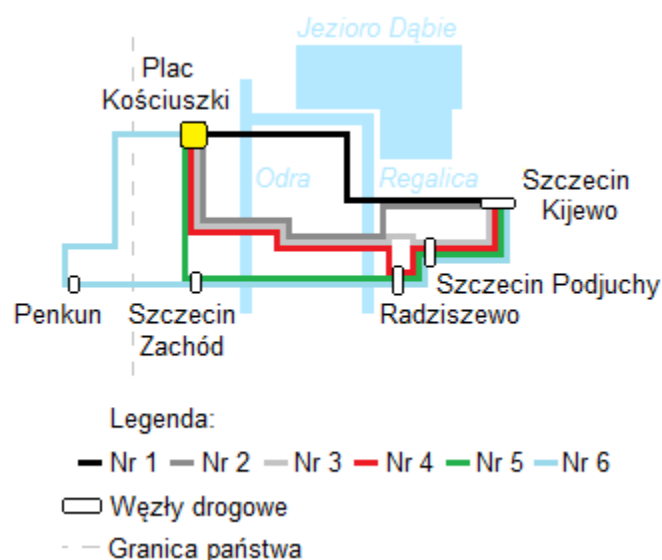
Szczecin is a vast urban agglomeration, divided into two central centers by both sides of the Odra River. This is some simplification, because in the village of Widuchowa the river is divided into the east and west stream, and in the vicinity of the Międzyodrze- Wyspa Pucka Housing is already flowing a few channels, e.g. Regalica, Duńczyca, Święta, Parnica. This unfavorable geographical position makes it problematic to provide the radial character of the local and peripheral network, which is the main communication hub of the whole region, concentrating on all branches of transport. Nevertheless, it is necessary to maintain a smooth system of road connections between the two poles, which is forced by the extremely intensive expansion of the Right Bank. Although this area concentrates on services of particular importance, it plays an important role in housing and transit. As Szczecin occupies third place in Poland in terms of surface area, special attention is paid to the handling of people and

goods on long distances, taking into account only a few bridges [9]. For this reason, they are crucial because any arbitrary factor that interferes with the flow of traffic within or within the access arteries causes paralysis of the city. As an example, there may be critical situations that have occurred in recent years, ie the crane dump and replacement of the asphalt pavement on Gdańska St (28.11.2012, 19-22.10.2016) and heavy snowfall in the Zachodniopomorskie province (11.01.2013r.). The consequence of this was the extensive transport disruption, which included the available bridges and the road and street network of the following administrative settlements: Międzyodrze- Wyspa Pucka, Dąbie, Zdroje, Podjuchy, Żydowce-Klucz, Słoneczne-Majowe, Kijewo. Attempts to bypass the drivers of critical points (inflammatory) influenced the congestion of remaining routes, forming the derivative of the communication block. This applies especially to Floriana Krygiera St as well as parts of the A6 motorway junction. Unfortunately, nothing has shown that similar problems have been avoided in the near future. West Road Bypass is still in the planning sphere, which is a 51 km bypass which makes it easy to reach the left bank of the city. This also applies to the construction of the Klodny Bridge, which is to be completed only in 2020 [12].

Scope and methodology

Six variants were analyzed, i.e. alternative routes from Szczecin Kijewo road junction to Kosciuszko Square (Figure 1, Table 1). For this purpose, the following stages of the procedure were carried out:

- criteria have been set that include distance and arrival time (standard, critical),
- six points were adopted, with 1 being the worst and 6 the best,
- weighted references to selected criteria were established,
- określono wartości liczbowe na podstawie dostępnych danych i pomiarów własnych (bezpośrednich Numbers based on available data and own measurements were determined (direct),
- number of points was assigned,
- final calculations were made.



1. Indicative diagram of the course of selected road routes

Source: own elaboration

Tab. 1. The details of the road directions to the destination

Starting point	Route number	Routing	Destination
Rode node Szczecin Kijewo	1	DK10	Plac Kościuszki
	2	DK10, Gryfińska, Batalionów Chłopskich, DK31, DK13, Aleja Piastów	
	3	Rode node Szczecin Podjuchy, Radosna, DK31, DK13, Aleja Piastów	
	4	Rode node Radziszewo, DK31, Aleja Piastów	
	5	Rode node Szczecin Zachód, DK 13, Aleja Piastów	
	6	Border crossing Kołbaskowo-Pomellen, Rode node Penkun, B113, B104, Border crossing Lubieszyn-Linken, DK10, Aleja Piastów	

Source: own elaboration

The survey was excluded crossing the bridge Cłowy and castle route the name of Peter Zaremba. The first one was closed for appeal on 30.05.2016. due to poor technical condition (the lowering of one of the main pillars), and for the second one, the results corresponding to the variant No. 1 were obtained.

Variant No. 1

From the data presented in Table 2, it follows that the length of the route is directly proportional to the travel time in standard situations. The most favorable results were obtained for the variant No. 1, because in this transmission line the most investments were made in recent years, including complex modernization of Andrzej Struga St, the dedication of the bridge the name of Pioneers of the City of Szczecin, the construction of two footbridges on Gdansk St, repair of the Long Bridge and the Port Gate. They aimed not only to modernize and expand the internal road system but also to provide better communication and the non-collateral integration into the external transport links of industrial and investment areas, mainly within the limits of the Międzyodrze- Wyspa Puck Housing. It is worth mentioning that, due to its dominant port function, it continues to be the second most important center of labor in the city and thus the destination for many travelers. [1]. Unfortunately, the efficiency of the streets of Energetyk and Gdansk, which constitute the main artery of road connections, has already been used extensively. In addition, it restricted the preferences for public transport vehicles, including dedicated bus and taxi lanes. This generates unnecessary impediments to the Long Bridge and torches on the Castle Route the name of Peter Zaremba in the neighborhood of the Baszta Siedmiu Płaszczy

Variants No. 2-6

Crossing the Regalica is also possible by Griffins Bridge (Route No. 2-4), which is a short distance between two nodes of the A6 motorway. Unfortunately, the existing street network of Osiedle Zdroje and Podjuchy, which has a far too low capacity, remains an essential problem. Nevertheless, DK 31 is the second major transport axis to the left bank of the city, and its importance has increased after the launch of the S3 expressway. Due to considerable distances, the remaining variants are chosen less frequently, with the exception of drivers commuting directly to the West and North Districts. For this reason, the smallest number of points was awarded to them (table 3).

Tab. 2. Results obtained in standard and critical situation

Evaluation criteria	Distance, d [km]*	Standard driving time, t _s [min]**	Travel time in critical situation, t _k [min]**
No. 1	12,9	16,2	89,3
No. 2	19,8	24,4	94,1
No. 3	21,9	26,1	56,5
No. 4	31,1	31,9	68,8
No. 5	32,5	35,8	72,6
No. 6	62,3	54,3	54,3

* - Data read from the satellite navigation systemj,
** - arithmetic mean of three measurements.

Source: own elaboration

Tab. 3. Evaluation of connections according to accepted criteria

Evaluation criteria	Standard driving time, t _s [min]		Travel time in critical situation, t _k [min]		Weight [%]
	Points	Weighted average	Points	Weighted average	
Nr 1	6	1,80	2	0,60	30
Nr 2	5	1,50	1	0,30	30
Nr 3	4	0,80	5	1,00	20
Nr 4	3	0,30	4	0,40	10
Nr 5	2	0,10	3	0,15	5
Nr 6	1	0,05	6	0,30	5
Final weighted average assessment (max)		4,55		2,75	

Source: own elaboration

Excessive loading of routes No. 2-5 occurs in the case of blockade of Energetyk and Gdansk streets (line DK10), where the highest number of traffic incidents occurs (figure 2). In many cases, especially in the vicinity of the Górniczy Pool's tram and bus loop, this leads to a complete paralysis of Right Bank. Avalanche growth is observed on almost all road junctions, which, like the entire communication system, are becoming inefficient. The measurements show that the journey time to the destination can be over five times longer. This parameter was, therefore, the primary evaluation criterion, since no additional distances were considered in the study, which usually beat drivers trying to avoid congestion. In this situation, the highest rating was issued to the last variant, where it is assumed to use the A6 motorway section (Figure 3) and the national roads B113, B104 (Bundesstraße). Because it is selected sporadically, the time of travel in standard and critical situations is essentially unchanged. In the absence of periodic border controls, the introduction of which would have to be related to extraordinary threats or geopolitical circumstances constitutes an interesting alternative to the passage. Unfortunately, due to transportation problems on the other routes, the final rating was lower by almost half.



2. Traffic congestion after a road accident on Energetyków St (Międzyodrze)
Source: own elaboration



3. Section of the A6 motorway near the road junctions of Szczecin Kijewo (starting point)
Source: own elaboration

Possible solutions

In publications [8, 9, 10] it has been shown that the improvement of the current state will only be possible after completion of all stages of the inner city bypass as well as the West Bypass Road. However, it is necessary to solve the problem of the Odra-Święta crossing, which was

considered as a bridge or a tunnel. However, regardless of the concept adopted, this investment would undoubtedly yield benefits such as:

- rationalization of internal traffic,
- to relieve the city from transit,
- improved access to ports (sea, air),
- eliminating the transportation of hazardous materials by left-bank center,
- improved communication between neighboring municipalities and the whole region,
- economic activation of the northern and western areas,
- facilitating access to planned investment areas, border crossings and ferry crossings.

Unfortunately, the lack of clear declarations of the government's position indicates that within the next few years implementation of this variant will not be finalized. In this way, the lack of peripheral systems translates into an overload of the road and street network of the whole city, including heavily urbanized areas on the left side of the Odra River. There is no possibility of such modernization of sections of national roads in the area of Śródmieście so that it is not inconvenient for the existing, to a large extent historic, development. The radiant street layout makes the vast majority of inter-city links take place through the center of the left bank. Because of this, there are numerous traffic disruptions, which are at the expense of public transport, and the area of this phenomenon is constantly expanding.

Summary

The transport congestion should be considered in the broad context of the city's development, taking into account all aspects that influence its development. In the context of the global growth of the automotive industry, it is the basis of many transport problems. Increasingly, congestion affects not only large agglomerations but also less urbanized ones. It seems that at the moment their complete elimination is not possible. However, negative effects can be mitigated provided that the scale of the phenomenon is correctly assessed and that appropriate measuring tools are used [11]. This is due to the cyclical nature of current transport needs, the concentration of which takes place in a strictly defined time and space.

The transport and transport situation in Szczecin is constantly changing, which undoubtedly influences the social and economic progress of the whole region. Due to the bipolar nature of the city, whose intensive expansion is observed on both sides of the Oder River, the overriding goal is to strive for a smooth connection. The construction of Szczecin's Fast Tram (SST) has also contributed to the already mentioned investments which have contributed to the improvement of the current transport situation. The launch of the first phase allowed the congestion phenomenon to be minimized as a result of the elimination of part of the bus lines, providing a network of collision-free and fast connections by separating the tracks from the traffic. It does not protect the inhabitants from critical situations, which are usually random and difficult to predict, but is another step towards limiting their undesirable consequences..

Source materials

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