Innovative Municipal Transport Stops for Opole

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Abstract. There were presented the conceptual design of innovative municipal transport stops for Opole in Poland. In Opole buses are the most commonly used means of transport. Their popularity is because they use a generally available road infrastructure. Unfortunately, municipal transport is still the weak point of the city. Thus, a project of innovative municipal transport stops for Opole has been conceived which you can learn more about here.

1. Introduction

Opole is a city belonging to the Opole voivodships and also its capital. Opole is also the main scientific, cultural, administrative, and economic centre for the whole province. It is a city with county rights, which occupies the area of Silesian Lowlands, located in the South-Western part of the country and is situated on the Odra River.

The turn of the nineteenth and twentieth century saw a rapid development of the city. The centre gets metropolitan character with elegant, eye-catching buildings and townhouses. Krakowska Street (in German: Krakauerstrasse) – a representative street of Opole – is full of life. It is a wealthy and at the same time peaceful and tolerant city. Unfortunately, municipal transport is still the weak point of the city. Thus, a project of innovative municipal transport stops for Opole has been conceived which you can learn more about here.

2. The development of municipal transport in the late nineteenth and early twentieth century

Buses are the most commonly used means of transport. Their popularity is due to the fact that they use a generally available road infrastructure. Transport infrastructure elements include routes, interchanges, all facilities used for passenger service and bus stops [1, 2].

3rd April 1953 marks the beginning of a true municipal transport in Opole. Then the Municipal Department of Communication (MZK) was established featuring 4 French Chausson buses. 10.5-meter vehicles served route number 2 extending from the housing estate (intersection of Ozimska and Wiejska) via Rynek to Półwieś. Vehicles were in poor condition, which caused constant trouble, and there was a lack of basic parts and tires.

In 1954, MZK received 6 MÁVAG TR5 buses, and they started servicing route 1 running from the Nowa Wieś Królewskas via Rynek to Zakrzów. A year later 4 new buses – Star N52 – were purchased.

In 1957, MZK was transformed into the Municipal Transport Company (MPK). In 1960, MPK began operation of 20 passenger taxis. In 1975, Regional Municipal Transport Company was established,
which organized transport not only in Opole, but also in Nysa and Kędzierzyn-Koźle. In 1977, WPKM had 205 vehicles and stopped operating taxis.

On 1st January 1992, Municipal Department of Communications was created in place of WPKM in the form of an establishment owned by local government as a result of the resolution of the City Council of Opole, and at the same time public transport in Nysa separated as an independent entity.

The first low-entry car – Jelcz M121MB – began to operate in Opole in October. 3 other similar vehicles were purchased in the course of the year.

On 19th December 1997 MZK was transformed into a limited liability company, and it has operated in this legal form ever since.

The current number of buses in MZK Opole is 85. The average age of rolling stock is about 13.1 years. The oldest bus – Ikarus 280 – is from 1983. The youngest buses are from December 2013, when 16 new Man Lion’ss City buses were delivered to Opole [13].

3. The current state of bus stops
Bus stop is a point element of infrastructure of public transport. It is a designated waiting area for passengers and stop and parking place for buses. We classify bus stops as:

- Regular – a bus line arrives and stops at a certain time
- Conditional – the bus of a given line does not stop at the bus stop unless passengers waiting at the bus stop give a sign to the driver or if persons in the bus let the driver know that they want to get off at the bus stop
- Final or initial (so-called terminus) – they are the beginning or end of the route, where the exchange of passengers takes place and stopping for technical purposes can take place [15,16].

![Figure 1](image_url). Diagram of current bus lines in Opole [14]
Typically, we find ourselves at places like bus stops out of necessity, rather than pure pleasure, because most of them do not encourage spending time, due to the appearance of nearby bus shelters.

At the moment, there are as many as 182 bus stops in Opole, located in strategic places and facilitating the efficient movement around the city (train station, schools, shopping centers, hospitals, housing estates, etc.). Most often, we can find bus shelters with open structure, which do not have four walls (usually three walls only) [17]. There are also versions without walls (only a bench, timetable, and trash can) and those with one or two walls. Unfortunately, such bus shelters do not meet the requirements of thermal insulation, and their only purpose is to protect passengers against rain and wind gusts. For the most part, bus shelter walls are used as a place for information and advertising. The most of bus shelters in Opole are equipped with:

- Frame with a timetable – the A2, A3, A4 frame, usually made of coated steel, glass, affixed directly to the bus shelter
- Plate with the name of the stop – sometimes it is placed directly on the structure
- Bus stop sign D-15 on the boom or pole
- Advertising showcases - made of aluminum
- Bench – most often made of white laminate
- Bus stop post – detached, where the stop sign, timetable, etc. is placed
- Trash can [6, 7]

Unfortunately, most of the bus shelters in Opole are set directly on the pavement surface (usually bolted to the sidewalk), which can bring about disaster to passengers on the bus stop when violent windstorms emerge. The foundation of bus shelters which are safe and compliant with standards requires the use of concrete foundations or footings. Anchoring elements should be in the ground at a depth of frost penetration. Some structures, especially those lacking side walls, require the use of foundation slabs.

4. A modern bus stop

How a modern bus stop, combining safety with modernity, should look like? In response to this question, the students of the Faculty of Civil Engineering and Architecture in Opole designed two stops on both sides of the Katowicka street, located near the hospital.

4.1. Location of bus stops

The main reason for the location of bus stops in this part of Opole was the thought of East Junction to be created in the future, which will surely result in increased traffic on the Katowicka street and the high probability that the Municipal Department of Communications will introduce a new bus line here, and thus the bus stops would be often used by city dwellers.
Beginning from the East Junction. There are: a language school, campus of the University of Opole, blocks of flats and a hospital nearby.

After completing the inventory, stops were arranged as follows: the width of the bus stop – 3 m, the distance from the bus shelter to the bus – 2.9 m, the width of the bus shelter – 1.5 m. A place was left for pedestrian walkway behind the bus stop – 2 m. The length of the entire bus bay is 36 m with entry and exit adjusted so that the bus could get as close to the pavement as possible – the entry is longer than the exit [8, 9, 12].

4.2. Appearance
When designing the stop, its aesthetic appearance has been also taken care of. Glassed shelter with rounded edges has been designed. The stop is characterized by simplicity and excellent functionality.
Equipped with modern technology (touch screens), it will certainly get attention to residents and tourists. The example visualization of the bus stops on Figure 5.

4.3. Modern technology
The bus stop is equipped with electronic equipment, namely:

- Touch screen ticket machine with a built-in sensor, which allows a disabled person or one using crutches to notify the bus driver that such a person is waiting at the bus stop
- Electronic board with the sound system announcing when the bus of a given line arrives and departs
- A button helping the person walking on crutches to get up from the bench
- Smart air conditioning, which adapts to the outside conditions
- An alarm that notifies the police if someone wants to damage the stop
- The stop is equipped with Wi-Fi integrated into the network available in each bus
- Along with the modernization of the bus stops, we also plan to put signs with GPS on buses showing exactly at which stop we are, what will be the next stop or how many stops we have to drive, and the exact current location will be displayed on the map.
- It will certainly facilitate orientation.
- Touch screen panels:
  - “jak dojadę” – enabling to find the right bus by typing the origin and destination, date and time (Figure 6).
  - “kiedy przyjedzie” – entering the name or number of the stop or pointing to the map shows the line, direction and the time the bus departs in minutes from now (Figure 7).

The cost of electricity used for the panels is reduced by using solar panels on the roof of the bus stop. The energy will come from sunlight. It was used LED lamps within the stop providing better visibility and lower costs.

Figure 5. Visualization of the bus stop [11]
4.4. Accessibility solutions

All public transport users were considered when designing the municipal transport stops. We are an aging society, and therefore we should also take care of the elderly, diseased, and those with disabilities.
First of all, the edge of the platform is adjusted so that the vehicles could easily come as close to the curb as possible. Then it is possible that the platform and the bus floor are on one level for people getting on the bus. The profile is adapted to the shape of the vehicle tire, guiding it smoothly along the platform edge. The curb height is 19 cm, which is the same height as the bus floor [3, 4, 5].

![Figure 8. Cross-section of the curb](image)

Unfortunately, the curbs themselves will not solve the problem for blind and visually impaired people. Therefore, in order to mark the route to the bus for such persons, indicator slabs were, which guide the blind and visually impaired person in the right way.

![Figure 9. Directional slab [15]](image)

![Figure 10. Warning slab [15]](image)

It is recommended to level the designed lanes for pedestrians with the roadway for easier movement of a wheelchair.
The entire bus stop platform will be in concrete in order to improve movement of people in wheelchairs. A system for rapid drying of the substrate (when it rains) and heating (in winter) is mounted in the platform that will reduce the number of accidents.

5. Conclusions
To sum up, bus stops in Opole are currently in poor condition, so the designed stop will certainly make life easier for the citizens of Opole.

Municipal transport in Opole is rapidly growing and thus more and more bus stops are created. With such a large number of bus stops, the city can quickly and easily cope with the high flow of passengers in traffic during the rush hour. Such a number of stops is related to the strategy adopted by the Municipal Department of Transport, which tends to intensify the rail, road and extra-urban transport by transferring the main passenger streams to municipal transport. To make such a system more easily accepted by the passengers, bus stops located at main railway stations and entrances to the city are usually regular, so that the passenger can be sure that the bus will definitely stop and the trip with interchanges will not pose any problems. Both comfortable and safe way to get around by municipal transport from one part of the city to the other is possible given that appropriate conditions are provided. These include providing bus stops which are safe and suitable for the people with disabilities. They consist of flat and equal platform surfaces, profiled curbs, modern electronics and properly marked crosswalks. Providing these fundamental conditions can guarantee the success of the project to create an innovative bus stop, creating a city friendly to persons with disabilities.

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