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## *The comparative analysis of selected cycling solutions from Copenhagen and the current pro-cycling actions in Wrocław*

### *Introduction*

In today's economic development of the cities and their urban transformation the city planners are looking for new convenient means of transportation in order to accommodate the mobility of people. The availability of affordable and high quality transportation solutions greatly contributes to the unobstructed flow of people, products, and services as well as to the improvement of social and economic cohesion and the market competitiveness. The necessity to find and develop new means of transportation is driven by the problems connected

with the congestion in and around the cities. Increasing mobility and at the same time decreasing traffic congestion, the number of road accidents and pollution is the real challenge for all large cities. Their inhabitants more than anybody else experience the negative effects of their own mobility firsthand and that is why they are open to innovative solutions aimed at sustainable transportation. One of such solutions includes a network of bikeways enabling people to get around the city comfortably and safely on their own bicycles.

### *How Copenhagen became a bicycle-friendly city*

Copenhagen is not much different than other European cities but it has always had a special affection toward its transportation system. This is why Copenhagen is a city whose inhabitants have been using an alternative means of transportation that is a bicycle for over a century.

Bicycles first appeared in Denmark in the 1860s. At that time the upper social classes suffered from "the incurable bicycle fever" as everybody wanted to be the first person to be seen on a bicycle which then was just a wooden construction with no pedals and no possibility to turn with the handlebars. It was then a luxury product and only the wealthiest could afford it. The attractive size of the city where you could easily get around by bicycle and its flat area proved ideal for the development of bicycles. Their mass production began, their prices fell, and their popularity grew very fast, which is presented in Table 1. In the

last decade of the 19<sup>th</sup> century, the number of cyclists grew from 3000 to 30000 and bicycles dominated the streets.

Such a dramatic growth of the number of cyclists would not have been possible without the Danish Cyclists Federation (DCF) established in 1905 which played a significant role in building the cycling infrastructure and providing the right conditions for growth. In 1912, Copenhagen had 50 km of bike lanes. The bicycle was slowly becoming a part of urban culture. During World War II,

Tab. 1. The growth of the number of cyclists in Copenhagen at the turn the 19<sup>th</sup> and 20<sup>th</sup> centuries, source: [1]

Tab. 1. Przyrost liczby rowerzystów w Kopenhadze na przełomie XIX i XX w., źródło: [1]

Year	Number of cyclists
1890	3000
1900	30000
1907	80000
1934	400000

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Fig. 1. Nørrebrogade Street in Copenhagen, 1953. Source: [4]

Il. 1. Ulica Nørrebrogade w Kopenhadze, rok 1953. Źródło: [4]



Fig. 2. Nørrebrogade Street in Copenhagen, 1973. Source: [4]

Il. 2. Ulica Nørrebrogade w Kopenhadze, rok 1973. [4]

despite financial problems the government funded the construction of bike and recreation ways around the city to enable people to commute to work and reduce unemployment. In the years 1940–1945, the city was under German occupation. As a result of the ubiquitous shortage of gas and spare parts the bicycle saved the inhabitants of Copenhagen. The bicycles which were home-made replaced taxis, and the cork as well as straw were used instead of

rubber tires. After the war, the ban on car import resulted in even greater popularity of bicycles [1].

The drastic drop in the use of bicycles occurred in the years 1950–1980 when a lot of people moved to the city suburbs. At that time, their number fell from 770 thousand to 500 thousand. It was clearly visible on the city streets. Figures 1–4 show the view of Nørrebrogade street over the years and the changes in transportation trends. They show the great significance of bicycle transportation until the 1950s.

In the 1950s, Copenhagen witnessed the automobile revolution. However, it was not as intensive as in other



Fig. 3. Nørrebrogade Street in Copenhagen, 1989.

Source: [4]

Il. 3. Ulica Nørrebrogade w Kopenhadze, rok 1989.

Źródło: [4]



Fig. 4. Nørrebrogade Street in Copenhagen

(photo by A. Łukaszewicz, 2011)

Il. 4. Ulica Nørrebrogade w Kopenhadze

(fot. A. Łukaszewicz, 2011)

countries. Not everybody could afford a car and not everybody knew how to use it. The motorization lobby was not as strong either. The tax on car sale and car prices were very high. However, because of the layout of the districts it was necessary to use the car and public transportation system.

In the 1960s, the city authorities began the street layout reconstruction process to accommodate the needs of the growing number of cars and developed a plan of highway network. That decade became famous for the removal of a significant part of cycling infrastructure during that process. The development of road infrastructure cost a lot of time and money.

In the 1970s, the development of the highway network caused a lot of large-scale protests. During the first energy crisis in 1973, it became clear that the society based on fuel consumption is not sustainable and many groups of protestors cropped up. The protests reflected not only the care for the environment but also the deterioration of lifestyle of the city dwellers. The lack of public spaces, cars parked on sidewalks obstructing pedestrian traffic and car accidents were only some of the problems caused by the

advance of the car era. The 1970s were also marked by recession and huge congestion which also contributed to mass pro-cycling demonstrations. Most of them were coordinated by the Danish Cyclists Federation.

At the beginning of the 1980s, there was a 50% increase in bicycle traffic since its lowest level in the second half of the 1960s. It resulted from the decision of the government which could lead in two different directions of development: the expansion of cars and adjusting the cities to their needs for space or search for other solutions to accommodate comfortable mobility of the inhabitants. It was decided to invest in the public transportation system and in the development of cycling infrastructure. Beginning from 1981, a large part of the public budget has been provided for cycling improvement and modernization of existing bikeways. Before 1980, the city built 240 km of bikeways and greenways. Today, there are about 412 km of bikeways, including 346 km of bike paths, 23 km of bike lanes, 43 km greenways [8]. Figure 4 shows Nørrebrogade street in 2011. The picture was taken in the afternoon. It is clear that the car traffic is significantly smaller than pedestrian and cycling traffic.

### *Current activities and cycling statistics*

Copenhagen is greatly successful in promoting and developing cycling in the city, which is reflected in the statistics.

37% of all people who work and study in the city ride bicycles, which translates into 1.2 million km covered by bicycle daily (the data take into account the inhabitants of neighboring communes.) 55% of all inhabitants go to work or school by bicycle every day, even outside the city. Social research is conducted in order to evaluate the level of satisfaction in getting around the city by bicycle. This is how we know that 55% of the inhabitants go by bicycle because it is fast and easy. It should be noted that the average bicycle riding speed is 16 km/h, whereas the car riding speed is 27 km/h, which is not such a big difference. 32% of the inhabitants think that bicycle riding is a very good exercise and 29% of them think bicycle riding is inexpensive. Another significant factor in the popular use of bicycles is safety. 67% of the inhabitants of Copenhagen feel comfortable and safe in the city traffic [3].

Despite the use of bicycle in daily travel is high, Copenhagen conducts research and develops projects dedicated to specific social groups. This way it conducts several campaigns promoting bicycle riding among children, foreigners, and elderly people.

It is impressive how specific projects are financed. The budget for the development of the bicycle network by 2025 provides DKK 123 million (about PLN 74.5 million) and includes the modernization of existing routes as well as construction of new 50 km of bikeways. About EUR 15 million was spent on building new bikeways, cycling paths, and bicycle parking stands in the budgets for 2004 and 2005. In the years 2006–2010, the municipality of Copenhagen spent about EUR 27 million on various bicycle projects [2]. This is a lot of money which guarantees the effective development of the city and very good effects of the bicycle use by the inhabitants.

### *Polish reality*

Looking back at the history of the 20<sup>th</sup> century of Poland, it seems clear that it was very difficult. Ignoring the fact of huge war damage in Poland, the period after the war when socialism ruled did not positively affect the economic development of the country. The transformations of those times made a special imprint on the city fabric, changing the urban structure of the city until today. The post-war damage resulted in empty squares and spaces which were quickly filled during the communist modernism.

Similarly, human mentality changed under the pressure of a number of regulations and the trouble purchasing various products, including cars. Unfortunately, the car revolution came to Poland much later than in Western Europe. Although the inhabitants of Copenhagen and other Western European countries “enjoyed” cars long enough until they became a burden, they are still a benchmark of prosperity and comfort for the Poles which everybody would love to have.



Tab. 2. The results of bicycle research in Wrocław<sup>1</sup>

Tab. 2. Zestawienie badań dotyczących ruchu rowerowego we Wrocławiu

Time	Place			
	Grunwaldzki Bridge		Junction of Swobodna and Powstańców Śląskich Streets	
	2006	2008	2006	2008
7:30–8:00 a.m.	97	81	75	73
8:00–8:30 a.m.	129	159	106	125
TOTAL	226	240	181	198
3:00–3:30 p.m.	171	194	125	125
3.30–4:00 p.m.	120	163	95	139
TOTAL	291	357	220	264

<sup>1</sup> Interview with Daniel Chojnacki, the Cycling Development Section at Wrocław City Office.

### *Bicycle revolution in Wrocław*

The bicycle revolution broke out in Wrocław when the first Bike Officer in Poland – Daniel Chojnacki, working in Wrocław City Office – was appointed in 2007. He is in charge of coordinating road works so that construction projects include cycling infrastructure. He heads the Cycling Development Section with two persons. In comparison, the municipality of Copenhagen has 540 thousand inhabitants and 15 people work in the city office bicycle department which is responsible for strategic designing of urban infrastructure. The municipality of Wrocław is bigger in respect of population by more than 90 thousand inhabitants and the two-person team coordinating road designs including cycling infrastructure is not able to coordinate all investments in the city.

Wrocław is one of the few Polish cities which dominate in developing their bicycle networks. The first advanced bicycle stop line in Poland was used in Wrocław, and because of it the cyclists can stop before traffic lights and they are visible to the car drivers. The success of the city bicycle rental “Wrocławski Rower Miejski” was greater than in Krakow where the bicycle rental has been operating since 2008. The statistics are self-evident. Over the first two days of its operation, the bicycle rental was used 7000 times. Such a result is close to that in Lyon, which

has more bicycles (about 2000) and the highest bicycle rental rate in the world [7].

Another breakthrough in the development of the bicycle promotion policy in Wrocław was the adoption of Wrocław Bicycle Policy (Resolution no. LV/1688/10 of Wrocław City Council from October 14, 2010 on Wrocław bicycle policy.) It provided the directions and objectives of the development of the urban cycling infrastructure. The main strategic objective is to reach by the bicycle traffic 10% share in the non-pedestrian traffic rate by 2015 and its further growth up to 15% by 2020. In order to achieve such results a number of regular activities are planned such as the development of a unified cycling network, changes in road traffic organization, taking into account the needs of the cyclists, increase in the number of bicycle parking stands, building social acceptance and support for utility cycling.

Traffic research is the basis for taking actions in the countries where utility cycling is treated seriously. The bicycle research conducted in Wrocław demonstrated a dynamic growth in the number of cyclists especially those who commute every day to work or school. Table 2 shows the results of bicycle research which demonstrate that Wrocław has a lot of bicycle lovers and over the years the interest has not declined.

### *Financing projects*

The key to success in each project is the adequate budget. Even the best project can fail with insufficient funds. The same principles apply to the execution of the plan of building the cycling infrastructure in Wrocław. With insufficient funds a lot of mistakes can happen. The concept of the basic network of cycling routes in Wrocław is the valid document providing the principles for the development of the cycling system. Furthermore, the study of land use conditions and directions for Wrocław provides the guidelines for cycling routes and their hierarchy. However, the study is not a document only providing the directions for actions; its guidelines are verified by good will and the engineering skills of the city officials. Consequently, the execution of the bicycle policy and the bicycle network

design can and unfortunately is disturbed from two sides. On the one hand, there is no transfer of information included in the Study into the local development plans and, on the other hand, the budget for the development of cycling infrastructure does not guarantee the comprehensive completion of the assumptions. Actually this means the coincidental character of constructed infrastructure for cyclists and its incoherence, which are the best criteria indicating the proper cycling structure.

The projects of cycling infrastructure are financed from a few sources. The Cycling Development Section has its own budget which grows year after year. The city's cycling investments such as contra-flow bike lanes separated in the roads or bicycle parking stands are financed from

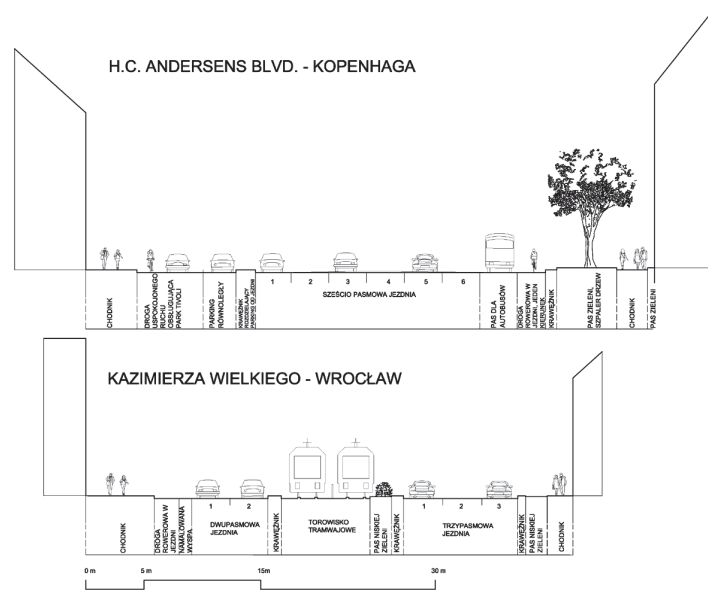


Fig. 5. Sections of Hans C. Andersen Street in Copenhagen and K. Wielkiego Street in Wrocław (ed. by A. Łukaszewicz, 2012)

Il. 5. Przekroje ulic Hansa C. Andersena w Kopenhadze i K. Wielkiego we Wrocławiu (oprac. A. Łukaszewicz, 2012)

the Municipal Road and Urban Maintenance Office budget for road maintenance. These are investments which are included in the cost of other investments connected with road maintenance and their modernization.

The utility cycling is promoted mainly on the grass-roots initiative and it is usually financed from the budget of the Sports, Tourism and Recreation Office. Unfortunately, its budget is smaller and smaller every year. Over the period of five years (2007–2011) the budget was decreased from PLN 1.4 million to PLN 500 thousand. The Sports, Tourism and Recreation Office financed such events as Wrocław by Bike, Alterrace, Wrocław Bicycle Picnics or Wrocław Cyclist Festival<sup>2</sup>.

Tab. 3. Budget of the section for bicycle infrastructure for 2007–2014<sup>3</sup>

Tab. 3. Zestawienie budżetu sekcji na infrastrukturę rowerową w latach 2007–2014

Year	Budget [PLN]	Year	Budget [PLN]
2007	14.000	2011	2.100.000
2008	208	2012	2.200.000
2009	1.029.000	2013	2.100.000
2010	1.461.742	2014	2.600.000

<sup>2</sup> Interview with Artur Wesołowski, the Sports, Tourism and Recreation Office, Wrocław City Office.

<sup>3</sup> Interview with Daniel Chojnacki, the Cycling Development Section at Wrocław City Office.

The money dedicated to the development of cycling infrastructure in Wrocław to the minimum extent allow for the effective development of cycling paths. This is why instead of being implemented comprehensively in the city the objectives included in the “Concept of the basic network of cycling routes in Wrocław” as well as in the “Wrocław Bicycle Policy” are implemented rather randomly over a huge period of time.

Table 3 presents the budget of the Cycling Development Section for the construction of cycling paths in Wrocław.

The funds for bicycle investments in 2007 were not fully used because there is no office that would be responsible for spending the funds on cycling infrastructure. The Bike Officer appointed in December 2007 did not have enough time to spend the money. The budget for 2008 was dramatically small (PLN 208) as this is the money that was spent only on the development of design documentation. The works on new projects whose approval as well as the development of documentation requires compliance with official procedures, which unfortunately take a very long time, began. On average it takes about two years from the development of a new project to its implementation.

As the position of the Bike Officer coordinating the bicycle policy promotion in Wrocław is relatively new, the budget for the Cycling Development Section was at the beginning very small. Over the years, the budget grew up to PLN 2.1 million in 2011. Over the next years, the funds shall grow up to PLN 2.6 million in 2014.

### Preliminary analysis and conclusions

In order to be able to compare the examples of utility cycling solutions applied in Copenhagen with the solutions applied currently in Wrocław on the basis of urban design

analyses similar streets were selected. As the analysis regards the inner city center the streets used in the comparison are located downtown. Bearing in mind the differences

in the development policies in Copenhagen and Wrocław as well as the differences in approach to the general principles of traffic organization, the analysis of the sections of the streets shall demonstrate the differences in the street space management. In order to classify the streets the following urban design categories were defined which were used in further analyses: location – close proximity of the center, market square; road class in the hierarchy of road network – main road; presence of cycling infrastructure, width. The comparison of similar street sections in the centers of different cities is the introduction to the analysis allowing for the detection of differences and similarities in the structure of the cities and their urban design solutions taking into account the cycling infrastructure. The main streets located close to the center due to their representative and communication character were selected for this purpose.

With those assumptions Kazimierza Wielkiego Street in its section with the segregated bike lane was chosen in Wrocław. The street meeting those criteria was Hans Christian Andersen Boulevard which was chosen in Copenhagen.

The Andersen Boulevard ranks high among the streets as it connects the very center with the south and north districts as well as it goes right next to the market square with the city hall. The Boulevard is about 50 m wide that is about 10 m wider than Kazimierza Wielkiego Street by the Europeum Hotel. Copenhagen has a subway system which in the city center goes underground, thus saving precious area on the ground. The infrastructure of the street has six lanes, three each direction, a separate lane for buses and a wide bikeway.

The bus lane protects the cyclists against cars. On the other side of the street, there is Tivoli Amusement Park that has a traffic-calmed service lane for both cyclists and cars. It is separated from the roadway by a wide curb facilitating safe getting in the car. Additionally the service lane provides a pull-over area for buses and a parking space for curb parking. Its end merges the main traffic stream and provides a safe connection with the bikeway. Fig. 5 presents the street section.

The street in Wrocław is slightly different. Although cycling changes have been implemented relatively recently, they should guarantee the minimum level of comfort and safety. The example of K. Wielkiego Street is rather controversial and the cycling infrastructure appeared when the pedestrian crossing was built by the Museum National. A bike lane was separated on the south section from

Sądownicza Street to Świdnicka Street at the expense of one car lane. The bikeway was segregated from the high speed traffic by a meter wide painted island. This is a rather effective solution and the drivers do not drive on it so the cyclists are safe. More problems appear at the moment when the bike lane ends and the cyclist must go onto the car lane. This place is marked neither for cyclists nor for car drivers. Cyclists either stop and wait for the cars to drive by or go onto the lane parallel to the cars without hand signals. Fig. 5 presents the street section.

There is an advanced bicycle stop line at the pedestrian crossing by the museum. This solution is very popular in Great Britain and Ireland. The stop box provides a place to stop for a number of cyclists in front of traffic lights so that drivers can see them. The problem with the stop box in Wrocław is that the cyclists do not know how to use it. The stop box is often confused with the bike crossing. Unfortunately, that investment did not take into account the bicycle traffic in the opposite direction.

The analysis of that simple comparison of the street sections connected with the information gathered during on-site visits leads to a number of interesting conclusions. The width of the streets is comparable. It cannot be said that in Wrocław there is no room for cycling infrastructure or that traffic lanes are too narrow. Everything depends on good will of officials and road engineers.

Wrocław has big plans regarding building adequate position of the bicycle in the traffic hierarchy. The problem is in raising sufficient funds for the implementation of those plans. It is very good that the city is trying to improve its cycling environment whenever it is possible. That investment would be much more effective and impressive for the inhabitants if for instance it would have been made later but on both sides of the street and all the way to the junction with Szewska Street.

This is the least invasive solution that does not disturb the motorized space – hatched. The 1.8 m wide bikeway was designed in the grass lane along the sidewalk. It is not an important element due to the composition or aesthetics character of the place. The pedestrian traffic is not too heavy on the sidewalk itself as it attracts little activity and few services. This is a self-contained solution – a comprehensive design for that specific road section.

Wrocław applies a lot of cycling improvements, however, the knowledge in that respect leaves much to be desired. The cyclists often do not know the road traffic regulations and cannot use the cycling infrastructure. Unfortunately, the city does not have funds for promotion campaigns.

## Conclusion

The development of utility cycling in the city as an important component of the city transportation system is nothing new. Many European cities have started to develop that alternative means of transportation a long time ago. Each of the cities apply their own solutions to the technical problems, adjusting their cycling infrastructure to the urban design. Some cities impose numerous restrictions on driving cars around the city centers by increas-

ing the number of speed limit zones, laying out one-way streets accessible to cyclists, decreasing the number of car parking lots or by significantly increasing the cost of parking in the city center. Some cities have worked out a compromise including the solutions consisting in sharing the space by pedestrians, cyclists, and cars. Some cities offer their inhabitants such conditions that getting around by car is simply unattractive and they choose the bicycle or pub-

lic transportation as it is faster, comfortable, and pleasant. Such patterns should be followed and mistakes should not be repeated in order to develop our own most efficient municipal transportation system so that the inhabitants could get around fast and comfortably.

Insufficient funds create a significant problem that appears at each stage. The budget of the cycling section and the budget of the Sports, Tourism and Recreation Office which is smaller and smaller every year are evidently the biggest problems for Wrocław on its way to become a bicycle-friendly city. The example of Copenhagen clearly

demonstrates that the city spends huge funds on cycling facilities which, however, in comparison with the costs of road infrastructure or a subway system are still low. The money spent translates into happy people, energy and time saving as well as improved health.

What is really significant about Copenhagen and enviable is that everybody there rides the bicycle, regardless of social status, age or sex, including politicians, senior citizens, businessmen, women with children and young people, which is the most convincing proof of the bicycle success.

Translated by  
Tadeusz Szalamacha

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### *Analiza porównawcza wybranych rowerowych rozwiązań z Kopenhagi i aktualnych działań prorowerowych we Wrocławiu*

Poszukiwanie alternatywnych rozwiązań transportowych w mieście jest niezwykle istotne z punktu widzenia aktualnego rozwoju gospodarczego miast oraz ich urbanistycznych przemian. Jednym z rozwiązań problemów komunikacyjnych, jakie dotyczą miast, a w szczególności ich zatłoczone centra, jest rozwój sieci rowerowej. Istnieje wiele miast w Europie, które zainwestowały w komunikację rowerową i do dziś zajmuje on istotne miejsce w strukturze komunikacyjnej tych miast. W artykule jako przykład przedstawiono Kopenhagę, miasta wzorcowego, które przystosowało się przestrzennie do komunikacji rowerowej w takim stopniu, że ten środek transportu przejmuje ok. 30% wszystkich podróży dziennie.

**Key words:** bicycle, city, urban design

Na podstawie analizy porównawczej miast, ich sposobów kreowania polityki przestrzennej i jej egzekwowania można wyciągnąć interesujące wnioski, które mogą przyczynić się do poprawy działań przestrzennych w polskich miastach.

W artykule przedstawiono rozwiązania infrastruktury rowerowej, jakie występują w Kopenhadze, jednym z najbardziej rowerowych miast na świecie. Przytoczono również oraz porównano rozwiązania rowerowe jakie w ostatnich latach zostały stworzone we Wrocławiu.

**Słowa kluczowe:** rower, miasto, urbanistyka