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ANALYSIS OF THE SPEED OF CYCLING TRAFFIC IN NOVI SAD

Key Words
Speed
Cycling roads
Sections
Segments
Segment parts

Abstract

Within this article, based on the conducted research, the velocities of cycling traffic on all exisitng cycling paths and lanes in the street network of Novi Sad, were analysed. The analysis included 240 segments of the street network of cycling roads, which were, for the sake of analysis of speed variations, divided into four typical segement parts. Three typical segment parts were defined at the crossing, that is, the intersection of the cycling path or lane with the road intended for the traffic of motorized vehicles, and the fourth segment part is between the intersections, that is, segment part 3 and segment part 1 of the following section. The results of the analysis showed that in the largest part of the network of cycling roads in Novi Sad the average achieved speed is around 12.5 km/h, which can be considered favourable. However, the research showed that there is a significant part of the network of cycling roads where the achieved velocity is significantly lower than the average one.

1. INTRODUCTION

One of the basic parameters for defining the level of service in the street network is travel speed. Namely, speed is the basic parameter which affects the total travel time and indirectly the decision of citizens which transport mode they are going to use for the realization of mobility needs. The improvement of drive mechanism and a wide range of different types of bicycle in the market which are adapted to the needs of all potential users, as well as the occurrence of electric bicycles, positively affected a more widespread use of bicycles in cities. Many research studies in the cities which have an adequate cycling infrastructure showed that the travel time by bicycle is identical to the total travel time by car. These are the reasons for which in many European cities the bicycle started to be widely used for meeting the needs of mobility.

Novi Sad is a city which has a long tradition of bicycle use for the realization of mobility needs. Immediately after the appearance of the first bicycle in Vojvodina in 1880, Novi Sad got the first bicycle shop in 1894, and in 1900 its first cycling path [1]. In traffic counting on bridge sections for the needs of a traffic study in 1967, 7,200 bicycles were registered and 1,900 passenger cars. However, in the following years, with the increase of motorization rate, the participation of bicycles in modal split was reduced, and the trend continued to the end of the first decade of 21st century. Within the research, for the needs of NOSTRAM study in 2009, the participation of bicycles in modal split was 2.52% [2]. In accordance with the conclusion of the study, many measures were taken to increase the mobility based on bicycle use.

For the development of cycling traffic a network of cycling paths is necessary and it has to be harmonized with mobility needs. The network of cycling roads in Novi Sad is constantly being expanded, thus the current length of cycling roads in Novi Sad is over 100 km. Apart from the significant bicycle roads network expansion, certain parts of the city, such as Centar, Podbara, Salajka, Telep, Petrovaradin and Sremska Kamenica, almost have no cycling paths. In most cases the reasons are objective, most often it is the profile of the inherited street network which does not make it possible to form a cycling path. Apart from these, the terrain configuration, that is, longitudinal inclination, which is distinctive on the part of the city in Srem, in certain cases it represents the limiting factor.

In accordance with the taken measures related to the development of the basic cycling infrastructure and the popularization of the policy of sustainable urban mobility, the negative trend of bicycle use has been stopped. In the research study conducted in 2017 for the needs of SMART PLAN [3], the participation of the bicycle in the modal split was 8.84%. However, considering the tradition, climate and geographical characteristics, Novi Sad has the potential to significantly increase the participation of cycling traffic for meeting the needs of mobility. Apart from further expansion of the network of cycling paths and cycling parking lots, it is necessary to conduct activities and take measures for the increase of cycling traffic speed, that is, the increase of level of service of this transport mode. In the first step it is necessary to analyse and identify parts of the network of traffic roads with lower speeds, and

after that, in the following steps, determine the causes and define the measures for its increase.

2. REASEARCH METHODOLOGY

Within this article, the research on speeds on cycling roads was conducted. In Novi Sad these cycling roads were mostly formed alongside the primary street network, based on the data from a previos study [4].

Data collecting related to the characteristics of the cycling infrastructure and the speed realized on the network of cycling roads was conducted in the field reasearch which included necessary data recording on all built cycling roads, by means of the video camera “GoPro HERO BLACK 7“ set on a bicycle.

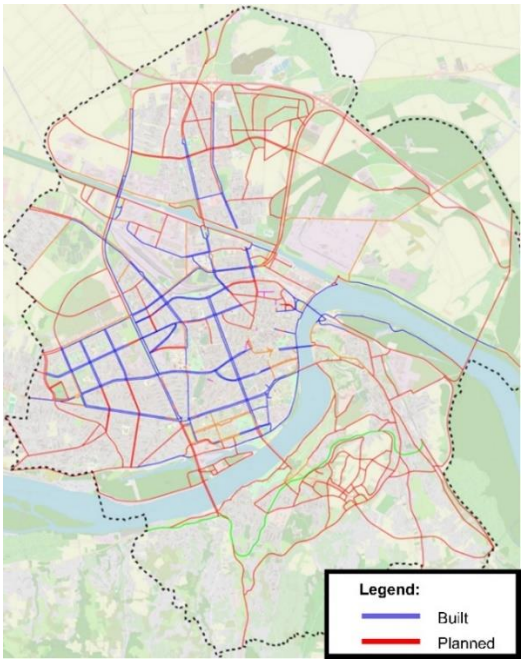


Figure 1. Network of cycling roads in Novi Sad

In this way the recording of the real situation was made, and the recordings were the starting point for further data basis forming, with all the parameters necessary for the analysis. The camera used for data collecting, apart from the video recording of a high resolution, also records the data on the exact position in the space at the moment of recording and the current bicycle speed. The position of the recording is registered in the intervals of 1 second, and it is defined by the point defined in coordinates of geographic latitude and longitude, by “WGS84“ referential geodesic coordinate system.

Figure 2. Touring-video recording of the cycling infrastructure

The collected video material was processed in a software package designated for this type of video material “DATAKAM Player“ by the defined parts of the network of cycling roads, that is, sections. Sections of the cycling network can contain one or more segments which are defined along the street, between two bordering intersections - entrance and exit. Segement labelling was done by means of numeration in the way that the first part of the label contains the number of the section, and the second part the position in relation to the belonging road for motorized traffic, that is, north, south, east or west, in relation to the roadway. The research on speed was conducted on the complete network of cycling roads, which included in total 204 defined segments between the intersections.

During the video material processing, the segments of the cycling paths were divided into segment parts. The purpose of segment division into segment parts was the analysis of speed, which in the following steps enables the analaysis of the influence of different factors on speed (pedestrians, parking, the quality of the roadway of cycling roads, other obstructions, etc). Entrance bordering intersection is at the beginning, and exit at the end of the segment observed in the direction of recording, that is, at the beginning of the following section. The beggining of the segment is measured from the beggining of cycling path crossing at the exit bordering intersection. A signalized intersection is always the bordering intersection, and in exceptional cases the bordering intersection can also be unsignalized intersection or a roundabout. In the aim of determining the speed variation, the segment was divided into the following typical segment parts:

Segment part 1	The zone of intersection is equal to the length of cycling path crossing at the intersection.
Segment part 2	The zone immediately after the intersection, where there is the increased probability for cyclists obstruction, the length of 30.0 metres.
Segment part 3	The central zone of the segment where there is a small probability for cyclists obstruction by other traffic participants (except on the places of crossing with approachable roads which are specially recorded).

Segment part 4 Pre-intersection zone where there is an increased probability for cyclists obstruction in the length of 30.0 m.

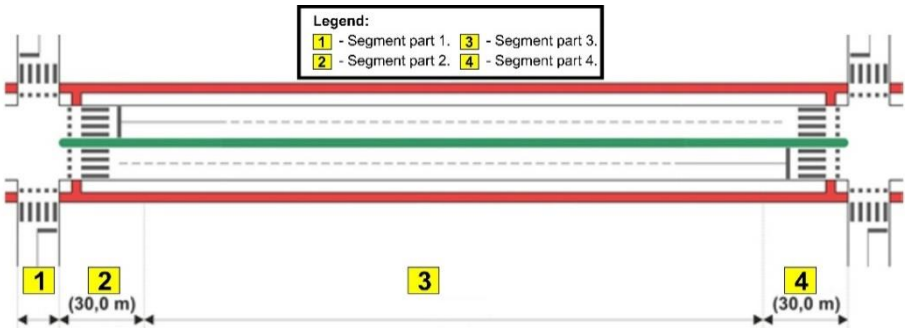


Figure 3. Division of segments into segment parts

3. RESEARCH RESULTS

The speed of the cycling flow is a general indicator of the problem in the network of cycling roads. The measured speed by segment parts on cycling roads segments in Novi Sad are shown in the following figure.

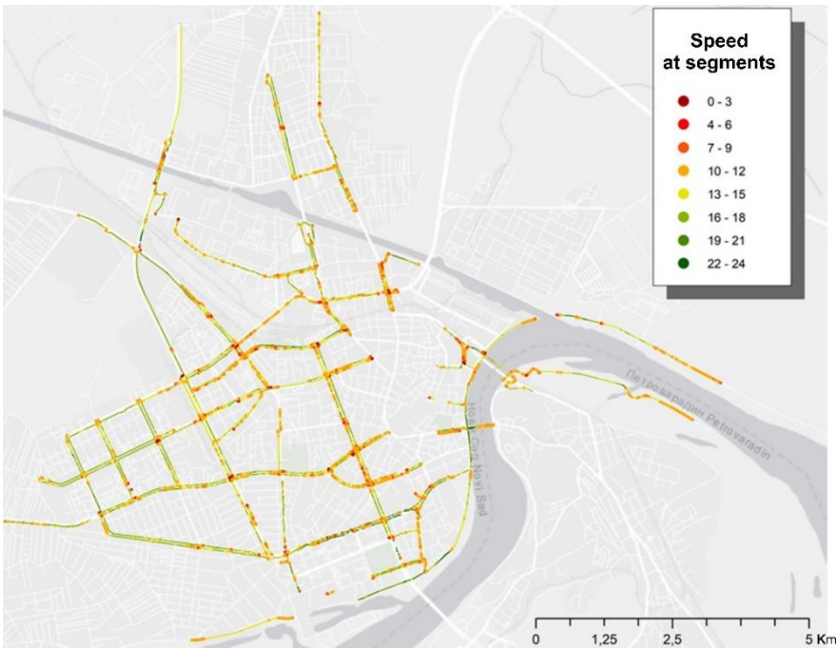


Figure 4. Speed by segment parts on cycling roads segments

The average speed in the network of cycling roads is 12.5 km/h. On the largest part of cycling roads, that is, on more than 78% of the total length, the achieved average speed was higher than 12 km/h. The following graph shows the speed distribution on the network of cycling roads.

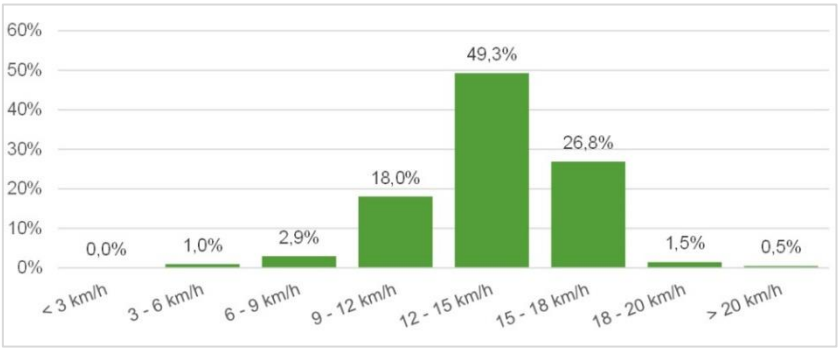
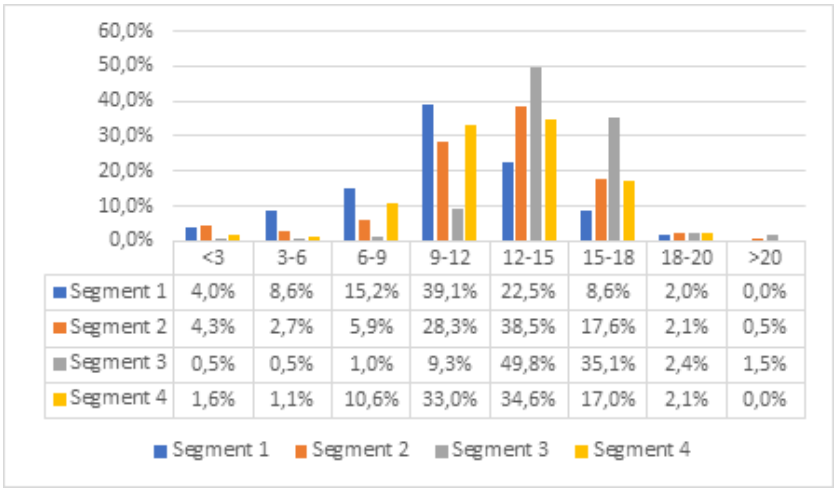


Figure 5. Speed distribution on cycling roads segments

The analysis of the formed data base implies that the speed distribution by the defined segment parts of cycling road segments is significantly different, which is ahown in the following graph.



	<3	3-6	6-9	9-12	12-15	15-18	18-20	>20
Segment 1	4,0%	8,6%	15,2%	39,1%	22,5%	8,6%	2,0%	0,0%
Segment 2	4,3%	2,7%	5,9%	28,3%	38,5%	17,6%	2,1%	0,5%
Segment 3	0,5%	0,5%	1,0%	9,3%	49,8%	35,1%	2,4%	1,5%
Segment 4	1,6%	1,1%	10,6%	33,0%	34,6%	17,0%	2,1%	0,0%

Figure 6. Speed distribution by segment parts of cycling road segments

The achieved average speed by segment parts of cyling road segments, as well as the average speed achieved in the total network of cycling roads are shown in the following graph.

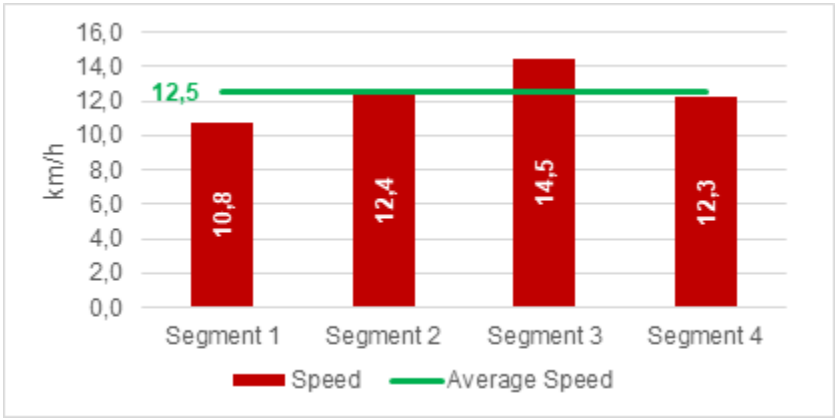


Figure 7. Average speed by segment parts of cycling roads segments

4. CONCLUSION

The possibility of travel for the purpose of meeting the mobility needs at a certain speed represents one of very important elements when planning a trip and the choice of transport mode. One of the basic advantages of bicycle travel is a relatively constant speed in city traffic conditions, which in cases of high demands for the flow of motorized traffic in the street network, can be equalized with the average speed of travel by car and vehicles of public transport. This effect is particularly distinctive on shorter relations in urban city environment.

The analysis of cycling traffic speed on the complete network of cycling roads in Novi Sad showed that the average speed of travel by bicycle is 12.5 km/h. According to the manual HCM [5], the established speed value is considered favourable. Namely, this speed features favourable conditions for cycling traffic. However, on around 22% of the total number of segments of the cycling roads network, especially those in the central city zones, the bicycle travel speed is under 12.0 km/h. In the following step it is necessary to analyze samples on the identified segment parts with the speed below the average one and define the measures for the improvement of cycling traffic conditions.

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