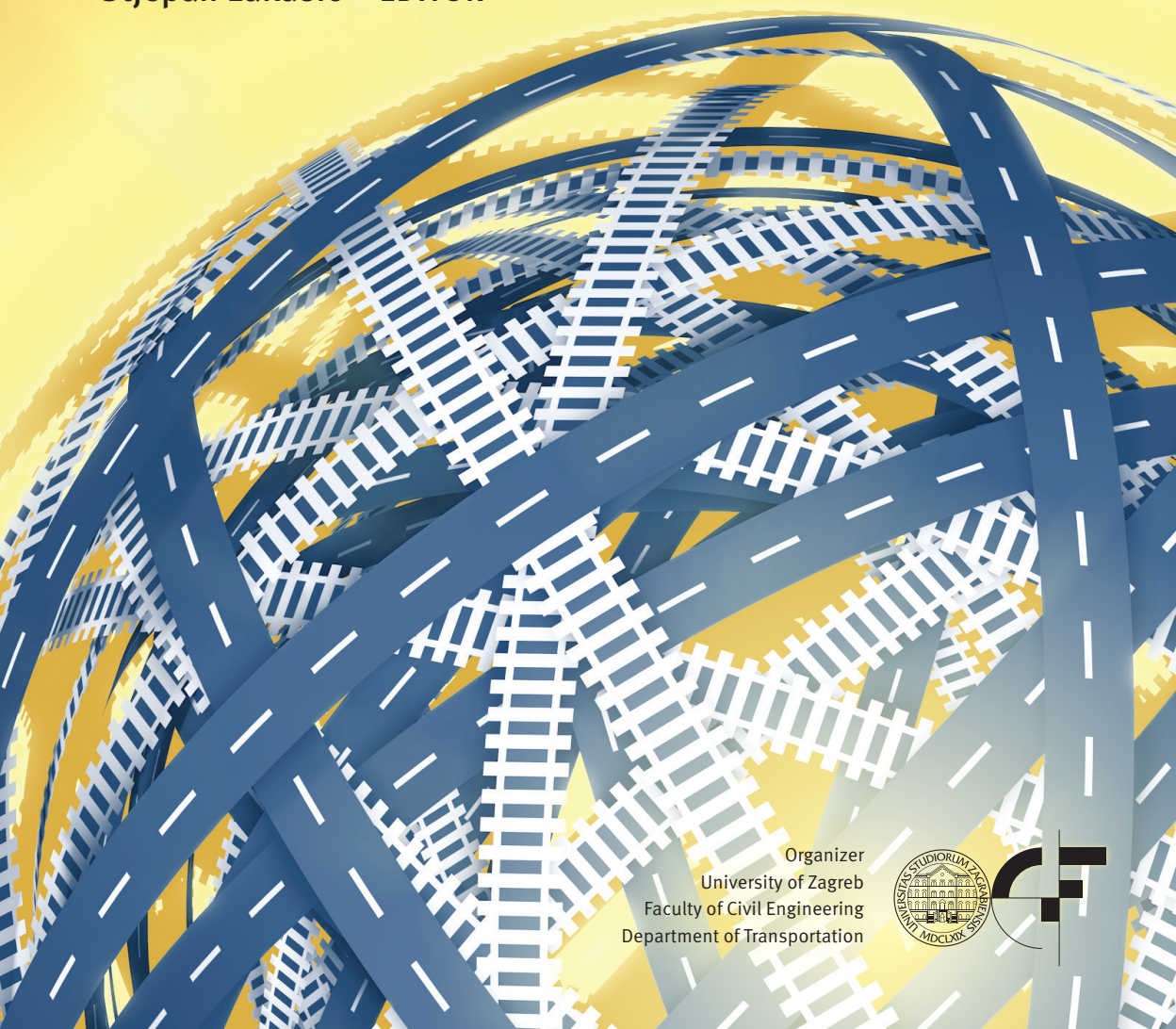
CETRA 2016

4th International Conference on Road and Rail Infrastructure
23-25 May 2016, Šibenik, Croatia

Road and Rail Infrastructure IV

Stjepan Lakušić – EDITOR



Organizer
University of Zagreb
Faculty of Civil Engineering
Department of Transportation

CETRA2016
4th International Conference on Road and Rail Infrastructure
23–25 May 2016, Šibenik, Croatia

TITLE
Road and Rail Infrastructure IV, Proceedings of the Conference CETRA 2016

EDITED BY
Stjepan Lakušić

ISSN
1848-9850

PUBLISHED BY
Department of Transportation
Faculty of Civil Engineering
University of Zagreb
Kačićeva 26, 10000 Zagreb, Croatia

DESIGN, LAYOUT & COVER PAGE
minimum d.o.o.
Marko Uremović · Matej Korlaet

PRINTED IN ZAGREB, CROATIA BY
"Tiskara Zelina", May 2016

COPIES
400

Zagreb, May 2016.

Proceedings of the
4th International Conference on Road and Rail Infrastructures – CETRA 2016
23–25 May 2016, Šibenik, Croatia

Road and Rail Infrastructure IV

EDITOR
Stjepan Lakušić
Department of Transportation
Faculty of Civil Engineering
University of Zagreb
Zagreb, Croatia

CETRA 2016
4th International Conference on Road and Rail Infrastructure
23–25 May 2016, Šibenik, Croatia

ORGANISATION

CHAIRMEN

Prof. Stjepan Lakušić, University of Zagreb, Faculty of Civil Engineering
Prof. emer. Željko Korlaet, University of Zagreb, Faculty of Civil Engineering

ORGANIZING COMMITTEE

Prof. Stjepan Lakušić
Prof. emer. Željko Korlaet
Prof. Vesna Dragčević
Prof. Tatjana Rukavina
Assist. Prof. Ivica Stančerić
Assist. Prof. Saša Ahac
Assist. Prof. Maja Ahac
Ivo Haladin, PhD
Josipa Domitrović, PhD
Tamara Džambas
Viktorija Grgić
Šime Bezina

All members of CETRA 2016 Conference Organizing Committee are professors and assistants of the Department of Transportation, Faculty of Civil Engineering at University of Zagreb.

INTERNATIONAL ACADEMIC SCIENTIFIC COMMITTEE

Davor Brčić, University of Zagreb
Dražen Cvitanić, University of Split
Sanja Dimter, Josip Juraj Strossmayer University of Osijek
Aleksandra Deluka Tibljaš, University of Rijeka
Vesna Dragčević, University of Zagreb
Rudolf Eger, RheinMain University
Makoto Fujiu, Kanazawa University
Laszlo Gaspar, Institute for Transport Sciences (KTI)
Kenneth Gavin, University College Dublin
Nenad Gucunski, Rutgers University
Libor Izvolt, University of Zilina
Lajos Kisgyörgy, Budapest University of Technology and Economics
Stasa Jovanovic, University of Novi Sad
Željko Korlaet, University of Zagreb
Meho Saša Kovačević, University of Zagreb
Zoran Krakutovski, Ss. Cyril and Methodius University in Skopje
Stjepan Lakušić, University of Zagreb
Dirk Lauwers, Ghent University
Dragana Macura, University of Belgrade
Janusz Madejski, Silesian University of Technology
Goran Mladenović, University of Belgrade
Tomislav Josip Mlinarić, University of Zagreb
Nencho Nenov, University of Transport in Sofia
Mladen Nikšić, University of Zagreb
Dunja Perić, Kansas State University
Otto Plašek, Brno University of Technology
Carmen Racanel, Technological University of Civil Engineering Bucharest
Tatjana Rukavina, University of Zagreb
Andreas Schoebel, Vienna University of Technology
Adam Szeląg, Warsaw University of Technology
Francesca La Torre, University of Florence
Audrius Vaitkus, Vilnius Gediminas Technical University

DID CYCLING POLICY AND PROGRAMS ADVANCE CYCLING IN THE CITY OF ZAGREB?

Hrvoje Pilko[1], Tadej Brezina[2], Krunoslav Tepeš[3]
[1] *University of Zagreb, Faculty of Transport and Traffic Sciences, Department of Road Transport, Croatia*
[2] *Vienna University of Technology, Institute of Transportation, Research Center for Transport Planning and Traffic Engineering, Austria*
[3] *City of Zagreb, City Office for Physical Planning, Construction of the City, Utility Services and Transport, Department for Roads, Croatia*

Abstract

Developing cycling traffic helps urban centres to advance sustainable citizen mobility. The reason for researching cycling traffic issues in a beginner city (City of Zagreb) stems from poor safety numbers, an increase in volume, unclear development policy, an inadequate infrastructure and legislation. The question arises, did current cycling policy and programs advance cycling? We analyse the current state of cycling traffic and cycle promotion policy in order to assess the actual impacts of these various interventions on the level of cycling. A comprehensive search of available literature, including data from the City Office, has been made. This review paper suggests that development of cycling traffic requires coordinated programs and a holistic planning strategy which includes all stakeholders. Results could serve as a beacon light for similarly sized beginner cities, especially those who are located in Eastern Europe.

Keywords: cycling traffic; policy and safety; sustainable urban mobility

1 Introduction

Systematically developed cycling traffic is, along with adequate public transportation, one of the most significant forms of achieving sustainable level of citizen mobility. Certain cities have in the last ten years doubled or quadrupled the number of cycling trips while serious cyclist injuries decreased by 10 to 40 % [1]. Studies [2,3] conclude that main attributes which define a quality cycling infrastructure are: a roadway's physical, functional and operational characteristics (lane width, design speed, manoeuvring space, existence of sharp turns and obstacles), motor vehicle speed, intersection sight distance, presence of intersections and street trees (shading). Experiences of cities and countries under evaluation of cycling traffic policy and program measures are demonstrated in detail by Pucher et al. [1]. A similar framework to study the City of Zagreb (Zagreb) is applied here.
From conducted studies on cycling traffic in Zagreb, one can conclude that the initial research was the critical analysis of the current state. Kelčec-Suhovec [4] presents the possibilities and the general need for considering the development of cycling within the General Plan for Urban Zoning (GPUZ), and the utilisation of the bicycle as a means of commuting. Matos et al. [5] state the importance of city authorities in the development of cycling traffic. Later research emphasises the advantages of cycling for the environment and human health [6], and the need to implement a public bicycle sharing systems (PBSS) [7]. An insufficiently clear development policy, a non-existing systematic monitoring and analysis of the current

state, an increase in volume, a large number of traffic accidents, inadequate infrastructure and legislation, a small number of high quality studies raise the question: Did current cycling policy and programs advance cycling in Zagreb?
This paper aims to review the current state of cycling traffic, its policy and program interventions and assess the actual impacts of these interventions on the level of cycling in Zagreb. For this purpose, a comprehensive search of relevant and available literature has been made. Data from the departments of Urban Development and Traffic were also used. Section number two enumerates known basic cycling data of Zagreb in terms of volumes and safety, while the development of infrastructure, of PBSS, of legislation and of promotional activities are described in section three. Section four draws final conclusions.

2 Basic Cycling Data in Zagreb

The administrative surface area of the City and County of Zagreb covers 3,701 km^2 (6.53 % of the Republic of Croatia), and is inhabited by 1,107,623 residents, according to the census of 2011, or 25.84 % of Croatia's population [8]. In 2013, there were 470,787 motor vehicles registered, constituting a motorization rate of 425 vehicles per 1,000 inhabitants [9]. The City of Zagreb covers flat and hilly terrain of 641 km^2. Planning of cycling traffic began in the 1980s when the first GPUZ was passed. At that point, cycling traffic and provided infrastructure were exclusively oriented toward recreational and sports purposes (e.g. recreational and sports centre "Jarun").

2.1 Volume

First official cycling volume data was recorded in 1999 for the purpose of a traffic study [10]. This study showed that only 0.7 % of the daily trips were made by bicycle. It is interesting to note that 51 % of households claimed to have at least one bicycle. In the study performed by ISIP-MG [11], measurement of cycling traffic at 16 locations was carried out, mostly on the city's busiest traffic corridors. Measurements were conducted for one week in April 2010 from 11.00 a.m. to 1.00 p.m. and from 3.00 to 5.00 p.m. (Figure 1.a). Weather conditions were appropriate: it was mostly sunny with dry pavement, but data about air temperatures is not known. Based on these limited measurements, it can be assessed that there is a certain amount of increase in cycling traffic (Figure 1.a). Furthermore, the Faculty of Transport and Traffic Sciences (FTTS) from the University of Zagreb measured cycling traffic at certain locations for the needs of the project CiViTAS ELAN Zagreb [12]. Measurements were conducted for one week in April 2008 and 2012 from 4.00 to 5.00 p.m. Weather conditions were appropriate: it was sunny with dry pavement and air temperatures were normal for this time of year in these areas (Figure 1.b).

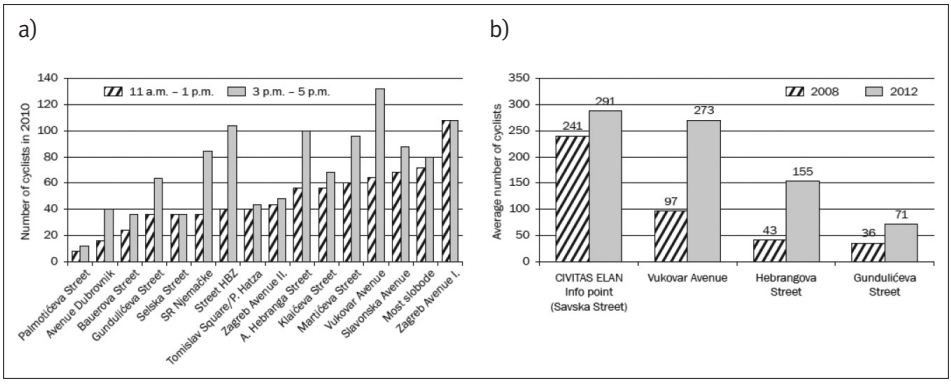


Figure 1 Cycling volume: a) hourly at 16 locations [11] and b) average number at four locations [12]

By comparing the results one can conclude that at the observed locations a significant increase in cycling traffic was recorded between 2008 and 2012, ranging from 17.2 % to even as much as 72.3 %. The PRESTO project in 2010 showed that a third of the students use the bicycle to get to the University on a daily basis [13]. The census from 2011 gathered data on commuting to work/school, but it is not analysed in general and here.

2.2 Safety

The Zagreb Police Department is responsible for traffic safety monitoring in the city and county. The data for 2011 and 2015 on the number and consequences of traffic accidents involving cyclists is shown in Table 1. In general, the number of traffic accidents with 355 per year is high. For 2015, in relation to 2011, Table 1 shows a significant reduction in all classifications where the total number of accidents fell by 30.43 %, and fatalities by 85.71 %. According to statistical reports [9], the most frequent causes of traffic accidents involving cyclists are the following: failure to use cycling paths/lanes, riding on sidewalks, and no lights at night.

Table 1 Number and consequences of traffic accidents involving cyclists in the area of the City of Zagreb from 2011 to 2015 [9]

Number of traffic accidents involving cyclists	Year					Difference 2011/2015
	2011	2012	2013	2014	2015	[%]
participants	414	404	345	327	288	-30,43
fatalities	7	2	1	3	1	-85,71
injured	297	309	251	242	224	-32,59
seriously injured	84	85	69	90	72	-14,28
slightly injured	229	238	188	157	157	-31,44

3 Cycling Policy and Programs in Zagreb

In this chapter only the most significant and latest cycling policy and programs activities are shown.

3.1 Administrative framework

Responsible for the planning, implementation and coordination of the cycling traffic program in the city and county is the municipal "Traffic Section" department. This department is responsible for proposals preparation and technical solution regulations of cycling traffic. The broader coordination includes representatives of the Cyclists Union and cycling associations and defines implementation priorities for individual activities. Their activities are: visiting disputed locations and suggesting measures that can therein be implemented; taking part in the design process for the forthcoming reconstructions and building of public traffic surfaces; and analysis of the cycling safety level. So, development and improvement of cycling traffic in Zagreb is focused on interventions that can be listed as follows: the development of cycling infrastructure, implementation of a PBSS, amending legislation for cycling traffic and various educational and marketing activities.

3.2 Cycling infrastructure

As of 26th of January 2016, there are 138 km of recreational and sports cycling trails on the Zagreb side of Medvednica Nature Park (Figure 2), which sums up to approximately 390 km in total. Technological measures are being taken to further develop cycling infrastructure: lowe-

ring of curbs and bevelled ramps, adjusting the signal equipment on signalized intersections, marking cycling surfaces red, installing fixed/elastic posts and staplers for the protection of cycling lanes and creating cycling lanes during the reconstruction of important roads.
Over 90 % of cycling routes have been arranged as cycling lanes on the walkway of city roads separated from the pedestrians by a yellow line. Only in the city centre on one main longitudinal road a cycling lane was established in the pavement section of the road spanning 1,300 m. Project ELAN [12] resulted in a significant improvement of the cycling infrastructure within the ELAN corridor (Figure 2) and outside of it as well. Thus, 150 parking spaces at 15 locations were introduced within the corridor, while 190 additional parking spaces were introduced outside of it at different points-of-interest (shops, theatres, concert hall, PT stations etc.). In 2015, 212 and in first two months of 2016, 16 bike racks were added at various locations.
Within the GPUZ cycling paths are projected to be extended by 5 to 7 km per year. The priority for expansion are directions and branches of the central part which are not adequately interconnected as well as parts where entirety and continuity of a certain direction have not been ensured. In collaboration with the cycling associations a need arose to build the cycling magistral (Figure 2). This would enable an unobstructed connection from East to West. The cycling magistral would be two-way and at least 2.5 m in width. Further extension ~20 km of it is planned in 2016. In 2016, another cycling path 2.0 km long is planned connecting Veliko Polje and Buzin in the south part of the city. Also, Greenway project in 2017 is going to extend another 121 km of cycling paths/lanes throughout the city.

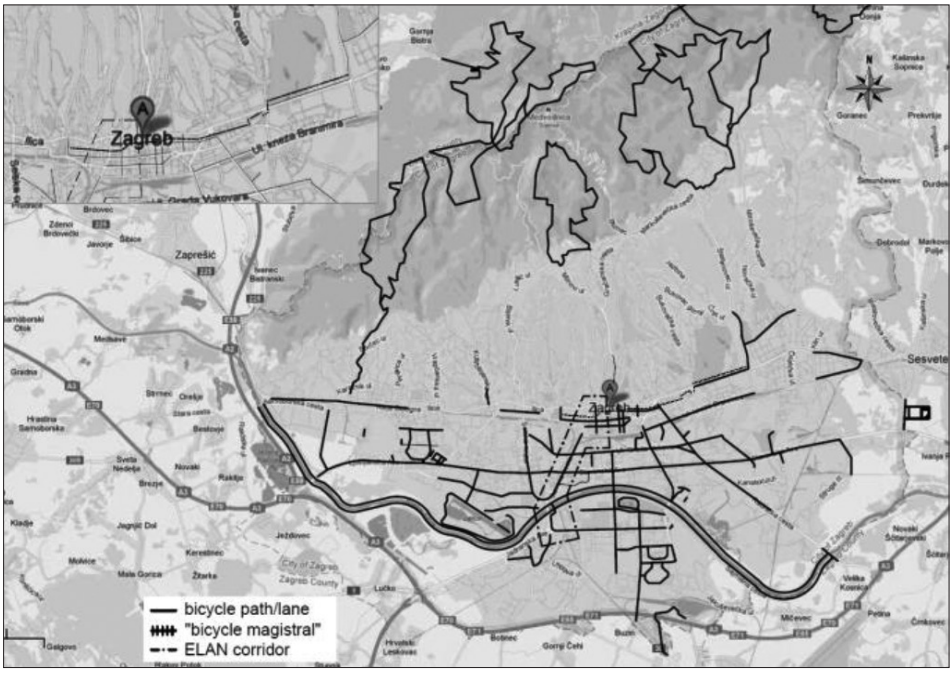


Figure 2 Existing cycling network in Zagreb, 26th January 2016

3.3 Public Bicycling Sharing System

A PBSS pilot project led by a private partner nextbike was started in June of 2013. At the moment 16 locations with around 100 bicycles are in operation. Bicycle stations have been placed in city locations with highest frequencies of pedestrians. The Studocikl pilot project providing a

PBSS to the University of Zagreb's Borongaj campus was designed and initiated within CiViTAS ELAN [12]. The idea was to provide students and faculty staff easier transportation between the two remote locations of the FTTS. The Borongaj campus currently consists of three faculties with a total of 4,500 students. The FTTS currently has about 1,450 full-time students, 710 part-time students and 179 members of staff. The Studocikl project has three basic features: 20 blue bicycles with logos, two depots (headquarters of FTTS at Vukelićeva Street and at Borongaj campus) for bike disposals and a web portal for login and logout. The service is free of charge for users, and maintenance costs are covered by FTTS. The rentals and disposals can be done during workdays (8.00 a.m. – 8.00 p.m.) and Saturdays (8.00 a.m. – 4.00 p.m.). At Sundays the service is not available. All the bicycles meet the requirements of current Croatian legislation. The web portal is used to monitor bicycle depots in real-time in order to provide information about currently available bicycles and depot occupancy online [14].

3.4 Cycling traffic legislation

Existing cycling legislation consists of national legislation: Law on the Safety of Road Traffic (NN 158/13), Ordinance on Traffic Signs, Signalization and Road Equipment (NN 14/11), Ordinance on Ensuring Accessibility of Buildings for Persons with Disabilities (NN 78/13), Ordinance on Basic Conditions to Which Public Roads Outside of Settlements Must Adhere from the Traffic Safety Aspect (NN 110/11), Ordinance on Technical Requirements for Vehicles in Road Traffic (NN 51/10), and local legislation: Decision on Traffic Regulation in the City of Zagreb (SGGZ 23/03) and Decision of Adopting the GPUZ (SGGZ 7/13) [15–21].
The Law [15] defines: cycling areas (paths/lanes), behaviour and movement of cyclists in/on traffic/roads exclusively for motor traffic, the movement of motor vehicles with regard to cycling, and the ability to ride a bike according to age. Management of cycling traffic through the signalization is defined in [16]. Width, clearance of cycling paths and lanes are defined in the regulation [18] as the conditions for setting cycling racks and design of demarcation of cycling paths/lanes from public area is defined in [17]. Technical requirements and traffic equipment that bicycles must meet for safe traffic are defined in the technical guidelines [21]. During this study a new Ordinance on cycling traffic and Ordinance on cycling infrastructure [22] is in the process of public announcement. Review of this legislation should be the subject in next papers.

3.5 Promotional activities

The Department's promotional activities consist of financing various educational, and sports activities related to cycling safety and different modes of transport (regulation checks, driving skills, production of cycling maps, manuals and others).
As part of the European Mobility Week, every year expert conventions on traffic safety and sustainable mobility in urban centres are held. The activities are focused on educating citizens and children about traffic culture and to encourage the use of public transportation, bicycles and walking. To promote the cycling culture by organizing targeted educational and promotional activities, in 2012 the Cycling Information Centre was opened. Also in the Centre, there is a European Cyclists Federation (ECF) point where citizens can get current information about their activities and programs [23]. Since 2012 the Cyclists Union has been organizing the biannual cycling festival Pedalafest. Being part conference part festival it aims to popularize the bicycle as a means of transport in the city. The program encompasses panels and workshops led by distinguished lecturers from abroad who present concrete solutions for improving the conditions for the use of bicycles as an sustainable and healthy means of transport [24]. Pedalafest also hosts a Critical Mass. In 2015, the "Police on bicyles" initiative was introduced, starting with 18 fully equipped bicycles. Also, the Orange bike ride will be organized at the beginning of May for the first time in Zagreb as a part of European cycling challenge.

4 Conclusion

This review sums up the available evidence of a wide variety of cycling policy measures in the beginner city of Zagreb. Sections 2 and 3 show that a lot of policy measures have been introduced. Nevertheless, the crucial limitation is that there is generally insufficient data and before/after research. This is especially true for data on the volume, structure and movement of cyclists on paths/lanes and the state of traffic safety. As a result, these data do not adequately address the direction of causality, such as whether current cycling policy and programs advance cycling or whether cycling demand led to increased levels of cycling. Therefore it's not possible to evaluate which measures and pro-bicycle policy packages are the most effective.

Experiencing cycling in Zagreb reveals that one of the most pressing problems remains the cycling network's discontinuity, i.e. the lack of wholeness, connectedness and compactness. As far as sustainable urban mobility is concerned, cycling traffic in Zagreb is a relatively new area of action. Bearing this in mind, inexperience of all stakeholders is present, especially with the city's executive and its experts. This poses a complex challenge. Results may serve as a basis for the creation of a coordinate and holistic planning strategy for development of cycling traffic in Zagreb. Also, they could serve as a beacon light for similar size beginner cities, especially those that are located in South-eastern and Eastern parts of Europe. The need for further research implies the implementation of: systematic measurement and analysis of volume, structure and movement of cycling traffic; extensive expert studies; improving and extending the existing cycling network; connecting the cycling network with the near-by cities and EuroVelo corridors [25]; upgrading PBSS and preventive activities. Also, the existing cycling-related legislation should be extensively complemented, according to local characteristics and aligned with European recommendations and standards.

Acknowledgements

The authors would like to thank the City of Zagreb, City Office for Physical Planning, Construction of the City, Utility Services and Transport, Department for Transport and Roads for enabling access to the data-sets, supporting research questions and discussing research findings.

References

[1] Pucher, J., Dill, J., Handy, S.: Infrastructure, Programs, and Policies to Increase Bicycling: An International Review. Prev Med, 50, pp. 106–125, 2010.

[2] Providelo, J. K., da Penha Sanches, S.: Roadway and Traffic Characteristics for Bicycling. Transportation, 38, pp. 765–777, 2011.

[3] Brezina, T., Ibesich, N., Niegl, M., Lemmerer, H.: Requirements for High Quality Cycling Infrastructure Design. 2nd International Conferenece Road and Rail Infrastructure, Dubrovnik, Croatia, pp. 953–959, 2012.

[4] Kelcec-Suhovec, S.: Green Modes of Transport and Traffic Safety – The Zagreb Case. Proceedings of 9th ICTC, Zagreb, p. 1–5, 1996.

[5] Matos, S., Krapac, L., Krapac, J.: Cycling in Zagreb. Acta Medica Croat, 61, pp. 27–31, 2007.

[6] Bogović, I.: Cycling as Recreation and Transportation Necessity. Promet-Traffic&Transportation, 13, 349–354, 2001.

[7] Halgota, V.: Planiranje gradskog prometa: Javni bicikli kao dio prometnog identiteta Zagreba. Diskrepancija, 10, pp. 61–71, 2010 (in Croatian).

[8] Državni zavod za statistiku Republike Hrvatske. Statistički ljetopis Republike Hrvatske. Zagreb: 2013 (in Croatian).

[9] Policijska uprava Zagrebačka. Stanje sigurnosti u cestovnom prometu na području Policijske uprave Zagrebačke. Zagreb: 2013 (in Croatian).

[10] MVA. Prometna studija grada Zagreba. MVA; 1999.

[11] ISIP-MG d.o.o. Biciklistički promet i površine – smjernice za planiranje i regulaciju. Zagreb: ISIP-MG d.o.o.; 2011 (in Croatian).

[12] Engels, D., Mrvelj, Š., Cauwenberge, Van., Valkova, J., Vilarinho, C., Tavares, P., et al.: CIVITAS ELAN Final Evaluation Report, ELAN Deliverable No.10.11. Brussels: European Commission; 2012.

[13] Geografski fakultet, Institut društvenih znanosti Ivo Pilar. Planning More Human City: Students Attitudes Towards Cycling and Transport in Zagreb. Zagreb: Grad Zagreb; 2010.

[14] Šimunović, L., Ćosić, M., Slavulj, M.: Student Bicycle Sharing System in Zagreb – Studocikl. 3rd International Conferenece on Road and Rail Infrastructure, Split, 2014, pp. 961–967.

[15] Hrvatski Sabor. Zakon o sigurnosti prometa na cestama NN 80/13. Hrvatska: 2013 (in Croatian).

[16] Ministarstvo mora, prometa i infrastrukture. Pravilnik o prometnim znakovima, signalizaciji i opremi na cestama NN 14/11. Hrvatska: 2011 (in Croatian).

[17] Ministarstvo graditeljstva i prostornog uređenja. Pravilnik o osiguranju pristupačnosti građevina osobama s invaliditetom i smanjene pokretljivosti NN 78/13. Hrvatska: 2013 (in Croatian).

[18] Ministarstvo pomorstva, prometa i veza. Pravilnik o osnovnim uvjetima kojima javne ceste izvan naselja i njihovi elementi moraju udovoljavati sa stajališta sigurnosti prometa NN110/01. Hrvatska: 2001 (in Croatian).

[19] Skupština Grada Zagreba. Odluka o uređenju prometa na području Grada Zagreba SGGZ 23/03. Hrvatska: 2003 (in Croatian).

[20] Skupština Grada Zagreba. Odluka o donošenju Generalnog urbanističkog plana grada Zagreba SGGZ 7/13. Hrvatska: 2013 (in Croatian).

[21] Ministarstvo mora, prometa i infrastrukture. Pravilnik o tehničkim uvjetima vozila u prometu na cestama. Hrvatska: 2010 (in Croatian).

[22] Ministarstvo pomorstva, prometa i infrastrukture. Pravilnik o biciklističkoj infrastrukturi. 2016 (in Croatian).

[23] http://mojbicikl.hr/hr/vijesti/klub-bicikl/bic---prvi-biciklisticki-info-centar-u-hrvatskoj,344.html (April 2016)

[24] http://pedalafest.eu/ (April 2016)

[25] Šimunović, L., Pilko, H., Banožić, M.: Development of National Cycle Route Induced by EuroVelo Cycle Networks – Danube Cycle Route Case Study. Suvremeni Promet, 32, 241–247, 2012.