Scientific Journal of Silesian University of Technology. Series Transport
Zeszyty Naukowe Politechniki Śląskiej. Seria Transport

Volume 96 **2017**

p-ISSN: 0209-3324

e-ISSN: 2450-1549

DOI: https://doi.org/10.20858/sjsutst.2017.96.9

Journal homepage: http://sjsutst.polsl.pl

Article citation information:
Macioszek, E., Czerniakowski, M. Road traffic safety-related changes introduced on T. Kościuszki and Królowej Jadwigi Streets in Dąbrowa Górnicza between 2006 and 2015. *Scientific Journal of Silesian University of Technology. Series Transport*. 2017, **96**, 95-104. ISSN: 0209-3324. DOI: https://doi.org/10.20858/sjsutst.2017.96.9.

Elżbieta MACIOSZEK[1], Mateusz CZERNIAKOWSKI[2]

ROAD TRAFFIC SAFETY-RELATED CHANGES INTRODUCED ON T. KOŚCIUSZKI AND KRÓLOWEJ JADWIGI STREETS IN DĄBROWA GÓRNICZA BETWEEN 2006 AND 2015

Summary. This article discusses the results of an analysis of road traffic safety-related changes introduced in T. Kościuszki and Królowej Jadwigi Streets in Dąbrowa Górnicza between 2006 and 2015. These changes were caused by the redevelopment and traffic reorganization at two intersections on T. Kościuszki Street and one intersection on Królowej Jadwigi Street. Previously, the traffic flow through these intersections was controlled by means of road signs. Since then, traffic lights have been installed at two of them, while the third one has been converted into a single-lane roundabout.

Keywords: road traffic safety; road accidents; road traffic engineering

1. INTRODUCTION

From the road traffic engineering perspective, problems related to the analysis of road traffic safety are significant and frequently addressed. According to statistics for 2011-2014, Poland was ranked the highest among European countries in terms of the number of fatalities

[1] Faculty of Transport, The Silesian University of Technology, Krasińskiego 8 Street, 40-019 Katowice, Poland. E-mail: elzbieta.macioszek@polsl.pl.
[2] Faculty of Transport, The Silesian University of Technology, Krasińskiego 8 Street, 40-019 Katowice, Poland. E-mail: mateuszija@gmail.com.

per one million inhabitants. Safety has been systematically improving on Polish roads in recent years, which has led to declining numbers of accidents and related casualties. That said, Poland is still among the worst EU countries in terms of the number of persons killed in road accidents. It should also be noted that the risk of losing one's life on Polish roads is significantly above the European average and nearly three times higher than that of road traffic safety leaders. What one should also emphasize is the fact that nearly every fifth pedestrian casualty in the EU is someone who has been killed on Polish roads [3, 4].

In order to remove deficiencies identified in the road infrastructure, as well as eliminate transport network spots where traffic incidents tend to happen, different changes have been implemented with the aim of improving the current status. Some examples of such changes made at road intersections in urbanized areas include intersection upgrading through conversion into single-lane roundabouts [2, 5, 6]. Compared to other intersection types, single-lane roundabouts guarantee unparalleled traffic safety to road users, which explains their considerable popularity among engineers of road infrastructure elements [7, 9, 11]. Outside urban territories, one of the main reasons for fatal road accidents is speeding. Consequently, the road infrastructure changes introduced in these areas are mainly road geometry adjustments. In order to ensure the consistent implementation of what is referred to as *Vision Zero* on roads, the main goal of which is the complete elimination of fatal road traffic accidents, road traffic safety solutions been frequently modified along every street or across entire town districts of considerable sizes [1, 8, 10]. This article addresses road traffic safety-related changes introduced on T. Kościuszki and Królowej Jadwigi Streets in Dąbrowa Górnicza between 2006 and 2015. These changes were prompted by the redevelopment and traffic reorganization at two intersections on T. Kościuszki Street and one intersection on Królowej Jadwigi Street. Previously, the traffic flow through these intersections was controlled by means of road signs. Since then, traffic lights have been installed at two of them, while the third has been converted into a single-lane roundabout. These changes have resulted in diversely successful improvements to the safety of road traffic users in the streets of interest to this study.

2. CHARACTERISTICS OF THE STUDIED STRUCTURES

The road traffic safety-related changes introduced along T. Kościuszki and Królowej Jadwigi Streets in Dąbrowa Górnicza were analysed with reference to data, which were provided by the Department of Transport and Road Management of the Town Office of Dąbrowa Górnicza, on the traffic organization and geometry of the intersections on the streets in question. Detailed information on road traffic incidents, provided by the Department of Road Traffic of the Municipal Police Station in Dąbrowa Górnicza and extracted from the System of Road Traffic Accident and Collision Records, was also consulted, as well as road traffic incident data sheets. The spatial arrangement of the transport infrastructure elements analysed in the article is presented in Fig. 1.

The intersection of T. Kościuszki Street and H. Dąbrowskiego Street was rebuilt in 2010. The traffic flow running through it is currently regulated by means of traffic lights. Prior to the redevelopment, T. Kościuszki Street had the right of way imposed by a D-1 sign, whereas H. Dąbrowskiego Street was regarded as minor on account of an A-7 sign. The intersection of T. Kościuszki Street and W. Przybylaka Street was redeveloped in 2013. It has been functioning as a single-lane roundabout ever since. Before being rebuilt, T. Kościuszki Street had the right of way imposed by a D-1 sign, while W. Przybylaka Street was regarded as

minor on account of an A-7 sign. The intersection of Królowej Jadwigi Street and Księdza G. Augustynika Street was redeveloped in 2010. The traffic flow running through it is currently regulated by means of traffic lights. Before the redevelopment, Królowej Jadwigi Street had the right of way on account of a D-1 sign, while Księdza G. Augustynika Street was regarded as minor on account of an A-7 sign.

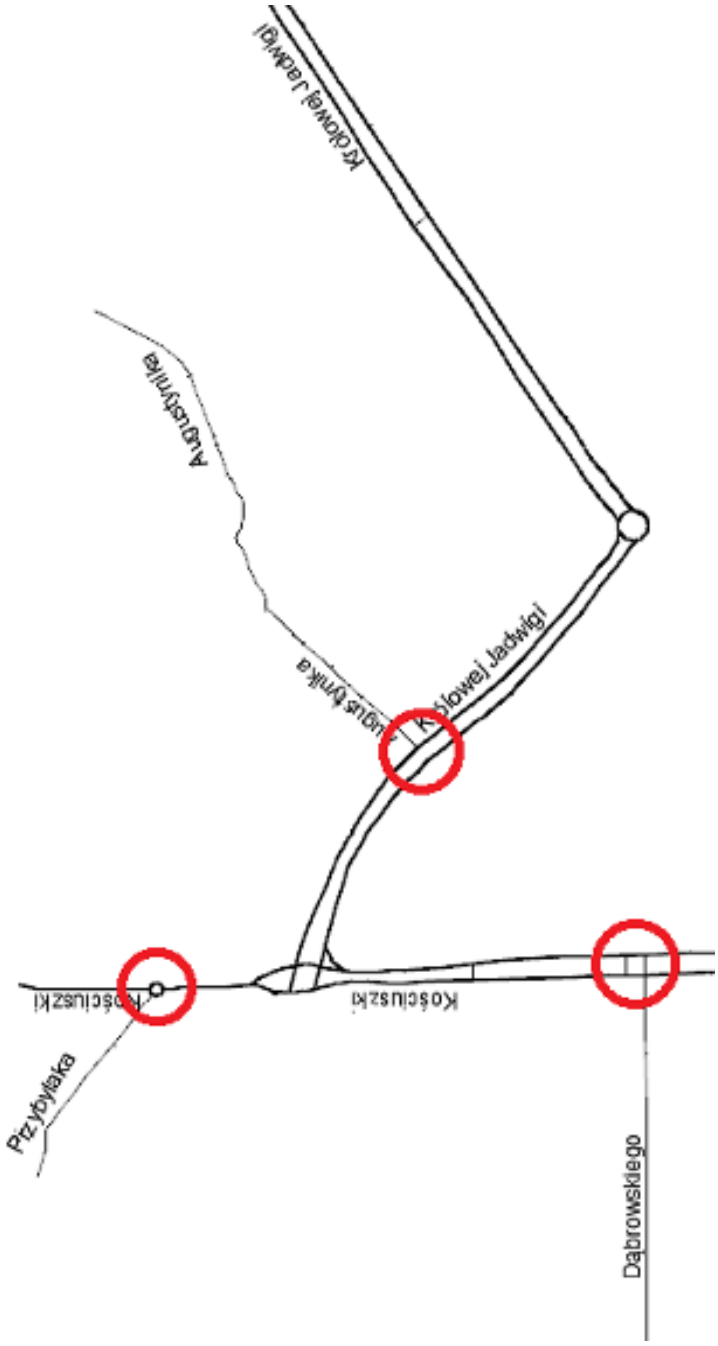

Fig. 1. Spatial arrangement of the transport infrastructure elements analysed in the article

T. Kościuszki Avenue is a district road cutting through downtown Dąbrowa Górnicza. At its middle point, it intersects with provincial road no. 910. The intersection of these two roads is the two-lane Żołnierzy Wyklętych roundabout situated next to the culture centre of Pałac Kultury Zagłębia. It is a landmark for this part of the town. Provincial road no. 910 divides T. Kościuszki Avenue between its northern and southern parts, which differ from each other, not only in terms of the street type but also the mode of its development. The northern section is a single carriageway two-lane road of technical class Z, extending from the Żołnierzy Wyklętych roundabout to the central railway station, which is the starting point of Kolejowa Street. The northern part of T. Kościuszki Avenue is a dual carriageway two-lane road of technical class Z, which connects the Żołnierzy Wyklętych roundabout with Graniczna Street. The carriageways are separated by a median strip. To the left of the carriageway, there are numerous town houses, which have remained from the old urban development of Dabrowa Górnicza. Królowej Jadwigi Street is a district road of technical class Z, which starts at the Żołnierzy Wyklętych roundabout.

3. ANALYSIS OF ROAD TRAFFIC SAFETY-RELATED DATA

The data subject to analysis comprised the number of road traffic incidents that took place on the streets and roundabouts in question. These traffic incidents were examined according to the following categories:

- traffic incidents and their effects
- traffic incidents according to types
- traffic incidents according to pavement conditions
- traffic incidents according to weather conditions
- traffic incidents according to illumination conditions
- traffic incidents according to causes
- traffic incidents according to types of defaulting vehicles

Tab. 1

Types of road traffic incidents of individual categories reported most frequently at the road structures studied

Street/ intersection of streets / Breakdown of road traffic incidents	T. Kościuszki Street	Intersection of T. Kościuszki Street and H. Dąbrowskiego Street	Intersection of T. Kościuszki Street and W. Przybylaka Street	Królowej Jadwigi Street	Intersection of Królowej Jadwigi Street and G. Augustynika Street
Traffic incidents according to types	Vehicle side collisions	Vehicle side collisions	Vehicle side collisions	Vehicle side collisions	Vehicle side collisions
Traffic incidents according to pavement conditions	Dry pavement	Dry pavement	Dry pavement	Dry pavement	Dry pavement

Traffic incidents according to weather conditions	Good weather conditions	Good weather conditions	Good weather conditions	Good weather conditions	Good weather conditions
Traffic incidents according to illumination conditions	Daylight	Daylight	Daylight	Daylight	Daylight
Traffic incidents according to causes	Failure to give way	Failure to give way	Failure to give way	Failure to give way	Failure to maintain a safe following distance
Traffic incidents according to types of defaulting vehicles	Passenger car	Passenger car	Passenger car	Passenger car	Passenger car

Under each category of the road traffic incidents analysed, one can determine the most frequent types of events. Table 1 provides a comparison of the most frequently reported types of road traffic incidents for individual event categories collated separately for each of the road structures studied.

In 2015, the largest number of road traffic incidents (54 incidents) within the period subject to analysis took place on T. Kościuszki Street (Fig. 2). Over the entire period of analysis, the number of traffic collisions notably exceeded the number of road traffic accidents in general. Road traffic accidents were happening sporadically, which translated into a small number of persons injured and killed. As a result of the analysis, 19 causes for road traffic collisions and accidents were identified. It was found that road traffic collisions were most frequently caused by a failure to give way and to maintain a safe following distance. However, having analysed the causes of road traffic accidents, one can determine that they were rather diversified, except for 2014 when the majority of traffic accidents happened due to a failure to give way.

Having analysed the road traffic incidents that took place at the intersection of T. Kościuszki and H. Dąbrowskiego Streets in the period 2006-2015, one can determine that the predominant type was a road traffic collision (Fig. 3). From 2011 onwards, one can observe an abrupt decline in the number of road traffic incidents (by around 50-70%). The most frequent cause of road traffic collisions up until 2010 had been the failure to give way. Starting from 2011, on the other hand, it is difficult to determine the predominant cause of traffic collisions.

The number of road traffic incidents that took place in the period of analysis at the intersection of T. Kościuszki and W. Przybylaka Streets was subject to considerable fluctuations (Fig. 4). The two predominant causes behind road traffic incidents were the failure to give way and the failure to maintain a safe following distance.

The largest number of road traffic incidents occurring on Królowej Jadwigi Street was reported in 2010 (135), and a decrease trend in this respect is observable at this intersection. A decisive majority of road traffic incidents accounts for collisions. The most frequent causes of road traffic collisions were the failure to maintain a safe following distance, the failure to give

way and improper lane changing. However, the causes of road traffic accidents were diversified (Fig. 5).

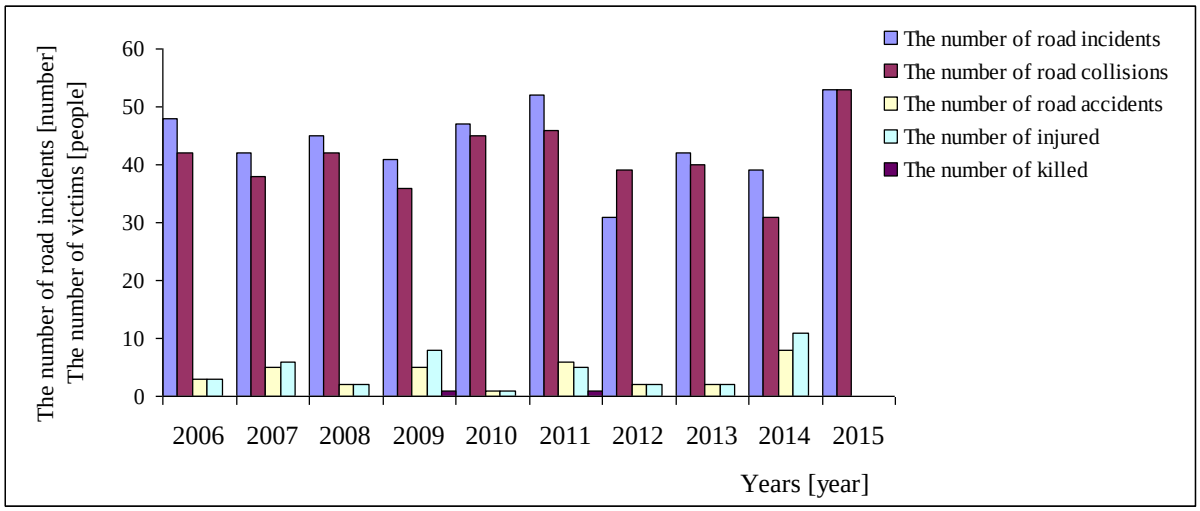

Fig. 2. Number of road traffic incidents and accident casualties on T. Kościuszki Street in Dąbrowa Górnicza in the period 2006-2015

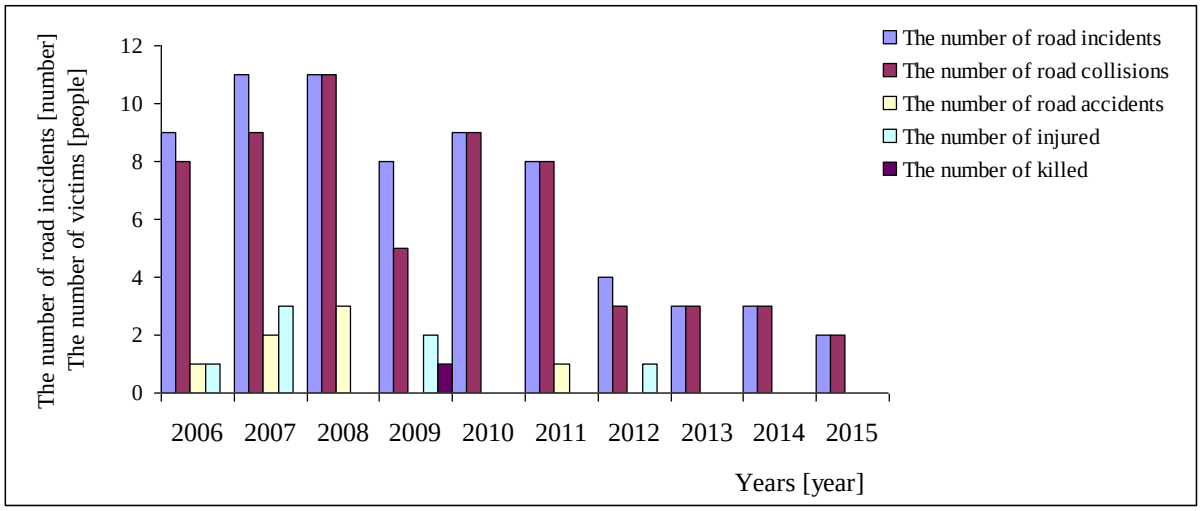

Fig. 3. Number of road traffic incidents and accident casualties at the intersection of T. Kościuszki Street and H. Dąbrowskiego Street in Dąbrowa Górnicza in the period 2006-2015

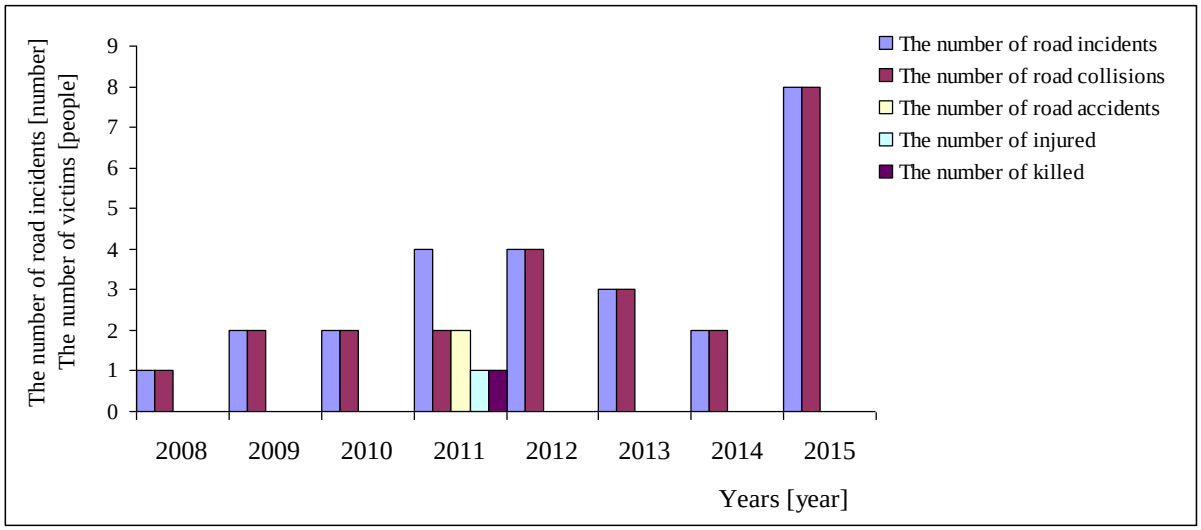

Fig. 4. Number of road traffic incidents and accident casualties at the intersection of T. Kościuszki Street and W. Przybylaka Street in Dąbrowa Górnicza in the period 2006-2015

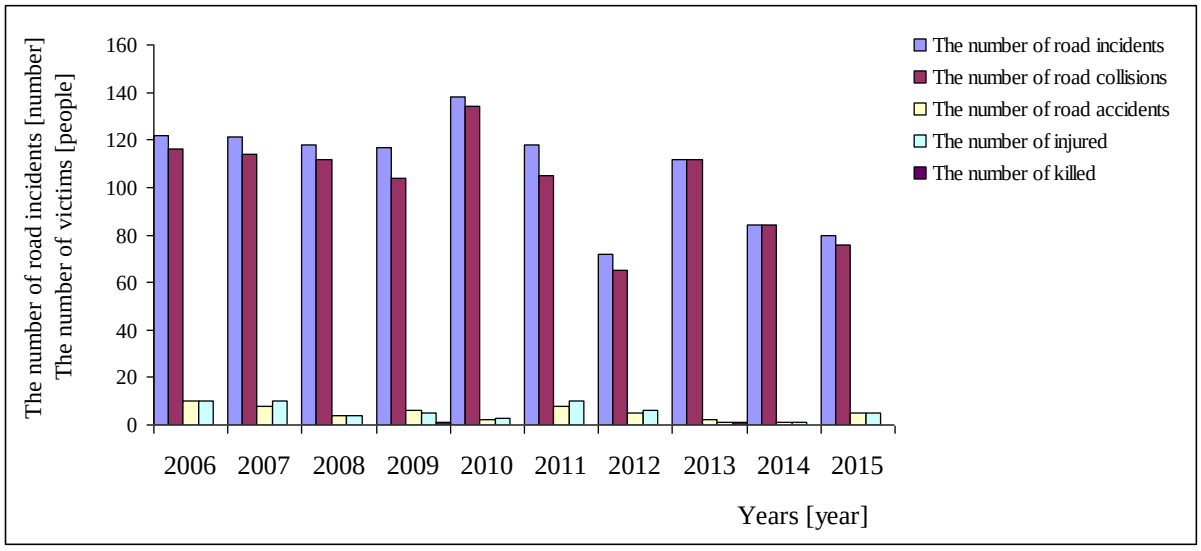

Fig. 5. Number of road traffic incidents and accident casualties on Królowej Jadwigi Street in Dąbrowa Górnicza in the period 2006-2015

The largest number of road traffic incidents occurred at the intersection of Królowej Jadwigi and G. Augustyniaka Streets in 2009 (22). The incidents that took place at the intersection were dominated by road traffic collisions, which were mainly caused by a failure to give way and maintain a safe following distance, as well as neglecting the obligation to observe pedestrians' right of way. Road traffic accidents, on the other hand, were mainly due to improper passage across pedestrian crossings (Fig. 6).

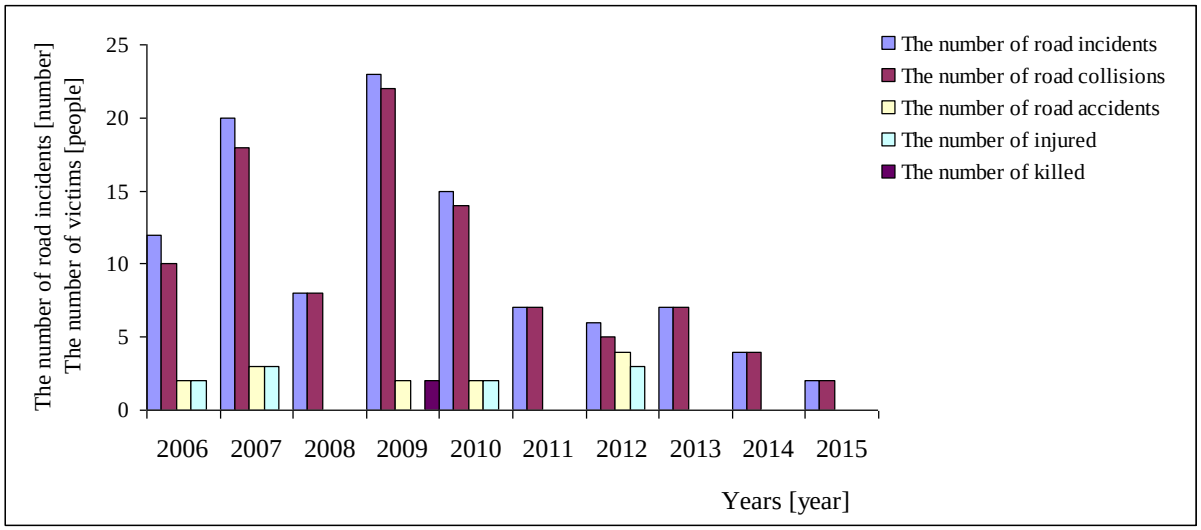

Fig. 6. Number of road traffic incidents and accident casualties at the intersection of Królowej Jadwigi Street and G. Augustynika Street in Dąbrowa Górnicza in the period 2006-2015

4. CONCLUSIONS

Based on results of the analyses addressing the state of road traffic safety on T. Kościuszki and Królowej Jadwigi Streets in Dąbrowa Górnicza in the period 2006-2015, one can reach the following conclusions:

- The changes introduced in relation to the traffic organization and geometry of the intersection of T. Kościuszki and H. Dąbrowskiego Streets triggered the effect of a reduced number of road traffic incidents. This reduction was particularly evident in terms of the number of road traffic accidents (a drop from six before to one after the changes). Owing to the foregoing changes, a general improvement in road traffic safety was successfully attained.
- The changes introduced in respect of the traffic organization and geometry of the intersection of T. Kościuszki and W. Przybylaka Streets also exerted a positive influence, which translated into the reduced overall number of road traffic incidents reported for this intersection. 2015 was an exceptional year in this respect, since an abrupt increase in the number of traffic incidents was observed. However, in order to establish the direct reasons behind this state of affairs, further detailed analysis is required.
- The changes to the traffic organization and geometry of the intersection of Królowej Jadwigi Street and Księdza G. Augustynika Street triggered the effect of a reduced total number of road traffic incidents. This reduction was particularly evident in the number of road traffic accidents (a drop from five before to one after the changes). As a consequence, a general improvement in road traffic safety was achieved. Owing to the installation of traffic lights at the intersection, traffic safety also improved in respect of pedestrian safety at road crossings.
- Despite the reduced number of traffic incidents at the intersection of T. Kościuszki and H. Dąbrowskiego Streets and the small number of traffic incidents at the intersection of T. Kościuszki and W. Przybylaka Streets, no significant drop in the number of road traffic incidents was observed on T. Kościuszki Street.

- As a consequence of the traffic organization changes introduced at the intersection of Królowej Jadwigi and Księdza G. Augustynika Streets, road traffic safety was considerably improved on Królowej Jadwigi Street.

References

1. Baric Danijela, Pilko Hrvoje Strujic Josip. 2016. ”An analytic hierarchy process model to evaluate road section design.” *Transport* 31(3): 312-321. ISSN: 1648-4142. DOI: http://dx.doi.org/10.3846/16484142.2015.1058292.
2. Coelho Margarita, Farias Tiago, Rouphall Nagui. 2006. “Effect of roundabout operations on pollutant emissions.” *Transportation Research Part D: Transport and Environment* 11(5): 333-343. ISSN: 1361-9209. DOI: http://dx.doi.org/doi.org/10.1016/j.trd.2006.06.005.
3. Czech Piotr. 2017. “Physically disabled pedestrians - road users in terms of road accidents.” In: E. Macioszek, G. Sierpiński, ed., Contemporary challenges of transport systems and traffic engineering. *Lecture Notes in Network Systems*, Vol. 2: 157-165. Springer. ISSN: 2367-3370. DOI: https://doi.org/10.1007/978-3-319-43985-3_14.
4. Czech Piotr. 2017. “Underage pedestrian road users in terms of road accidents.” In: G. Sierpiński, ed., Intelligent Transport Systems and Travel Behaviour. *Advances in Intelligent Systems and Computing,* Vol. 505: 75-85. Springer. ISSN: 2194-5357. DOI: https://doi.org/10.1007/978-3-319-43991-4_4.
5. Flannery Aimee, Lily Elefteriadou, Paul Koza, John Mc Fadden. 1998. “Safety, delay and capacity of single-lane roundabouts in the United States.” *Journal of the Transportation Research Board,* 1646: 63-70. ISSN: 0361-1981. DOI: http://dx.doi.org/10.3141/1646-08.
6. Flannery Aimee. 2001.” Geometric design and safety aspects of roundabouts.” *Journal of the Transportation Research Board* 1751: 76-81. ISSN: 0361-1981. DOI: http://dx.doi.org/10.3141/1751-09.
7. Małecki Krzysztof, Piotr Pietruszka, Stanisław Iwan. 2017. ”Comparative analysis of selected algorithms in the process of optimization of traffic lights.” *Lecture Notes in Computer Science* 10192: 497-506. ISSN: 0302-9743. DOI: http://dx.doi.org/10.1007/978-3-319-54430-4.
8. Persaud Bhagwant, Richard Retting, Per Garder, Dominique Lord. “Safety effect of roundabout conversion in the United States: empirical Bayes observational before-after study.” *Journal of the Transportation Research Board* 1751: 1-8. ISSN: 0361-1981. DOI: http://dx.doi.org/10.3141/1751-01.
9. Retting Richard, Bhagwant Persaud, Per Garder, Dominique Lord. 2001. “Crash and injury reduction following installation of roundabouts in the United States.” *American Journal of Public Health* 91(4): 628-631. ISSN: 0090-0036. DOI: http://dx.doi.org/10.3141/1751-01.
10. Sadeghi Mohsen, Gholamali Shafabakhsh. 2017. “Minlp model for optimum traffic counting location for origin-destination matrix correction.” *European Transport/Transporti Europei* 63: 1-7. ISSN: 1825-3997.
11. Cunningham Mitchell L., Michael A. Regan. 2016. “The impact of emotion, life stress and mental health issues on driving performance and safety.” *Road & Transport Research: A Journal of Australian and New Zealand Research and Practice* 25(3): 40-50. ISSN: 1037-5783.

Received 13.04.2017; accepted in revised form 29.07.2017