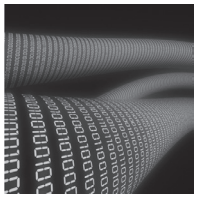

Archives of
Transport System
Telematics

Volume 6

Issue 1

February 2013

Turbo roundabouts signing and marking - current situation in Poland

E. MACIOSZEK
SILESIAN UNIVERSITY OF TECHNOLOGY, Faculty of Transport, Krasinskiego 8, 40-019 Katowice, Poland
EMAIL: elzbieta.macioszek@polsl.pl

ABSTRACT

Turbo roundabouts operating in Poland from not long time. Turbo roundabouts are one of kind of multilane roundabouts. Proper signing and marking multilane roundabouts is lacking in Poland. This signing and marking should completely emphasizing circular character of this kind of intersections and also would facilitate in the conviction that selected lane is proper and that this selected vehicle trajectory is also appropriate. The current state of marking and signing of turbo roundabouts operating abroad and in Poland have been presented in this article.

KEYWORDS: circular intersections, turbo roundabouts, traffic engineering

1. Introduction

There is a vast group of different types of roundabouts in Poland, which noticeably improve conditions of road safety. Intersections of roundabout type improve road safety conditions through insignificant number of collision points. Furthermore it is also important that the speed at the time of passing of this type of intersection is considerably low [5], [6], [7], [9], [11]. The speed of individual groups of roundabout users differs from each other. Hence their participation in the vehicle stream is also important, which was discussed in the studies [12], [13]. Although considered as the safest single-level solutions in the road infrastructure, roundabouts do not eliminate all the traffic accidents entirely. According to the data on French roundabouts, the most of the accidents occur as a result of not-giving way to the vehicles on the roundabout by the drives on the inlets. The percentage of this type of accidents reaches 36.6%. Other frequent accidents include a vehicle falling out of the roadway (16.3 %), losing control at the inlet to the roundabout (11.4 %), rear-end collisions and side impacts at the inlet to the roundabouts (7 %), driving into a pedestrian crossing the road in the prohibited places (3.5 %), losing control over the vehicle at the outlet from the roundabout (2.5 %). With different percentage structure of individual accidents, these regularities have been consistent with statistical data from Germany, Switzerland, Poland and Norway [8], [10]. Genesis of the causes of these accidents is connected with the values of traffic intensities, vehicle speeds and specific geometrical solutions. Therefore, the data from individual analyses of the status of road safety represent a starting point for making the decisions on improvement of design solutions and improving the level of road safety in different types of roundabouts.

A new type of multi-lane roundabout has been recently used in Poland, characterized by the capacity to handle high traffic intensity: a turbo roundabout, which, according to the international studies, is characterized by a high level of road safety, comparable with the level of safety achieved at single-lane roundabouts. The turbo roundabouts present in Poland can be divided into two groups. The first group is the group of roundabouts which were designed in a manner that meets the requirements imposed on this type of intersections where elevated lane dividers were used. The other group of roundabouts are those where road organization is similar to typical turbo roundabouts, but lane dividers are provided only by a single continuous lane of P-2 type. As demonstrated in a study [8], safety in the latter group of turbo roundabouts is comparable with the safety level on the multi-lane roundabouts and lower than in typical turbo roundabouts with elevated lane dividers. Road signs (both vertical and horizontal) are insufficient in Poland to fully reflect the roundabout character of the intersections and let

the drivers make fast decisions on choosing an adequate lane at the inlet, make them sure about the destination of the selected lane and unequivocally show the trajectory of vehicle movement. This situation concerns two groups of turbo roundabouts that are used in Poland. The paper presents the method of marking turbo roundabouts used abroad and current method of marking turbo roundabouts present in Poland.

2. Classifications of roundabouts in Poland

The guidelines on designing road intersections [17] define roundabouts as an intersection with a central island and one-way road around the island where vehicles are obliged to go around the central island in a counter-clockwise direction. Depending on the location (build-up area or outside build up-area) and the roundabout size (diameter of the central island and outer diameter), the four types of roundabouts are used: mini, small, medium and large roundabouts.

Regarding traffic organization, the following roundabouts can be distinguished:

- single-lane: with one traffic lane at each inlet and one lane on the circular roadway,
- semi-double-lane: with at least one inlet with two lanes and with the width of the roadway which allows for parallel passage of two vehicles (without lanes marked on the circular roadway),
- double-lane: with two lanes at each of the inlets and two lanes on the roadway (with the lanes marked with the horizontal signs on the roadway),
- with a lane (lanes) for relation to the right outside the roundabout: these can be single- or double-lane,
- spiral: with single-lane or double-lane inlets and different number of lanes on the roundabout (one or two),
- turbo: with two-lane inlets (unnecessarily all of them), at least one two-lane outlet and with different number of lanes at the roadway (one, two or three). The traffic streams from the internal and external lanes do not intersect. Depending on the number of lanes at the inlets and outlets, it is possible to configure the roundabout so that returning on one of the directions is impossible.

Initially, turbo roundabouts were planned in the non-build-up areas, where second class roads intersected high-class technical roads. Later, various types of turbo roundabouts were built, with different number of lanes and different number of inlets, adjusted geometrically to specific intersections of the streams with different values of road intensities. The most frequent geometrical forms of turbo intersections include basic turbo roundabout, egg turbo roundabout, knee turbo roundabout, spiral turbo roundabout, rotor turbo roundabout, stretched-knee turbo roundabout, star turbo roundabout, turbo roundabout with traffic lights. Figures 1 and 2 present example turbo roundabouts from the group of three-lane roundabouts with three or four inlets.

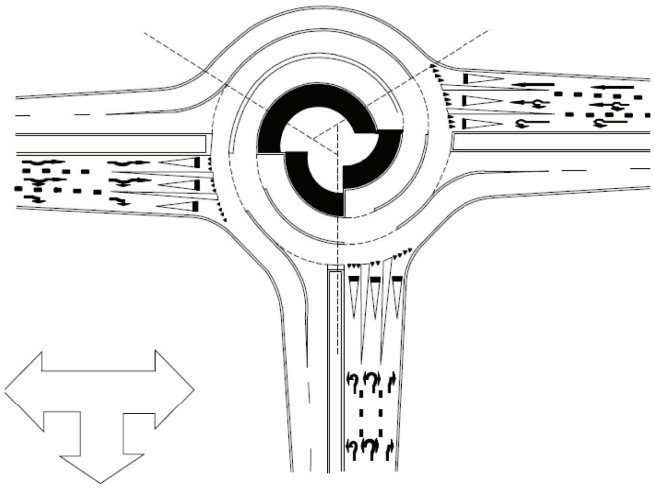

Fig. 1. Star turbo roundabout [own based on 3]

Despite differences in traffic organization, all turbo roundabouts are designed according to the same principles. Geometrical elements of turbo roundabouts constitute two or more concentric circles shifted along the roundabout's axis by a lane width. This shift along the roundabout's axis causes that the vehicle that drives into the internal lane is automatically located at the outermost traffic lane.

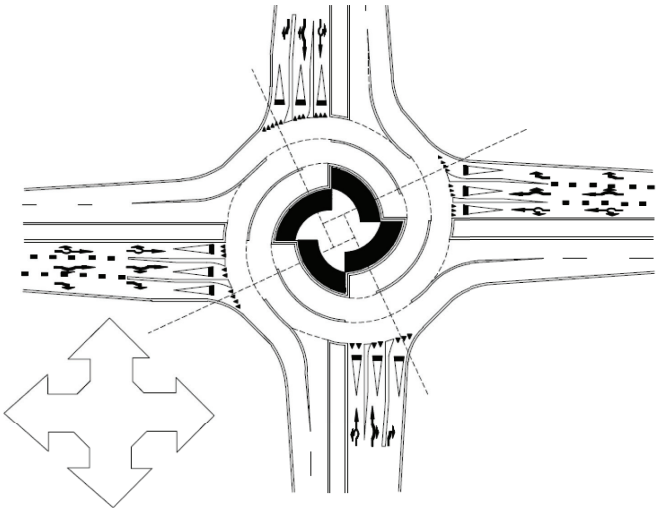

Fig. 2. Rotor turbo roundabout [own based on 3]

3. Turbo roundabouts signing and marking in another countries

Because of the impossibility of changing lanes on the roadway, choosing the lane at the inlet determines how the vehicle moves on the roundabout. Therefore, the necessary element that characterizes turbo roundabout are vertical and horizontal traffic signs which should inform the driver early enough about which lane to take when they approach the roundabout in order to continue driving towards the selected destination. Apart from the traffic signs

typical of roundabouts, the roundabouts (not only turbo type) designed abroad have been marked with vertical and horizontal signs that provide information about the number of lanes at the inlet and acceptable relations from a particular lane (Fig. 3a ÷ 3d, Fig. 4). There is a variety of forms of marking. Sometimes the presence of the central island is emphasized or symbols of the central island is added at one (Fig. 3b, 3c) or both (Fig. 3d) arrows. Sometimes the labels "Left lane" or "Right lane" are used under the arrows (Fig. 3d).

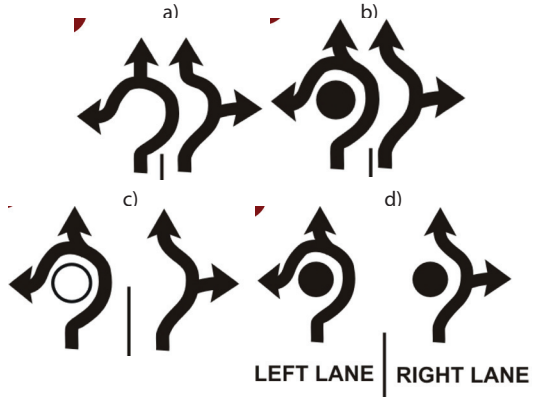

Fig. 3. Signing for multilane roundabouts used in different countries [4], [16]

Fig. 4. Examples of markings at turbo roundabouts used abroad. a) [15], b) [2]

The tables before road signs placed at the inlets to multi-lane roundabouts that warn drivers about the type of intersections differ in their forms from those used in Poland. Depending on the type of roundabout, several versions can be used (Fig. 5a ÷ 5c). However, each version emphasizes not only the circular character of the intersection but also the number and destination of each traffic lane.

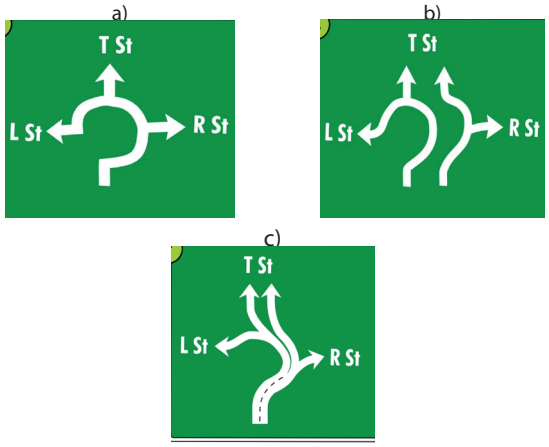

Fig. 5. Examples of tables before road signs used abroad at multilane roundabouts [4]

In order to use turbo roundabouts properly, the lanes on the roadway and inlets are divided from each other by means of not only horizontal signs but also by means of convex elements on the road, termed lane dividers, which effectively prevent from changing lanes in the forbidden places (Fig. 6). The use of elevated permanent lane dividers improves road safety. The drivers are informed about the lane dividers present on the roundabouts by means of special warning signs.

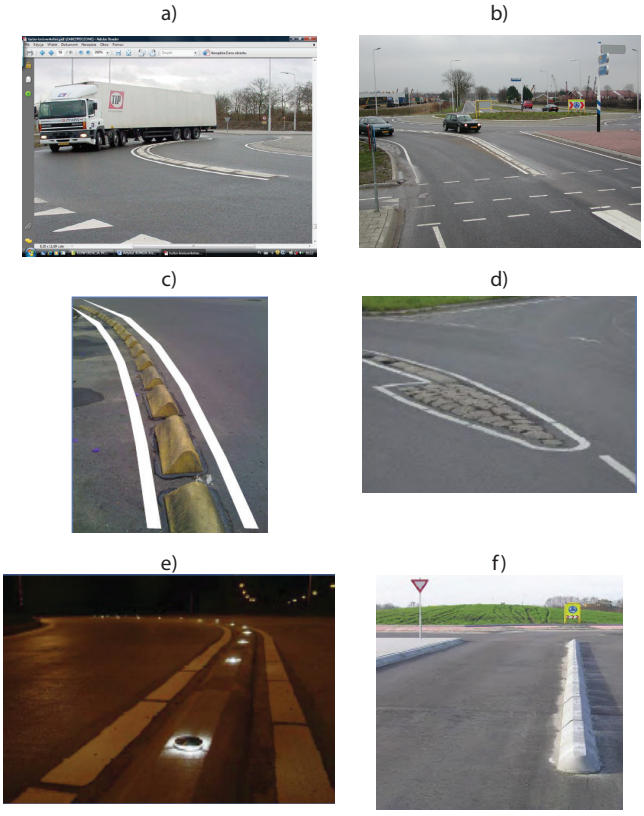

Fig. 6. Lane dividers used at turbo roundabouts. a) [3], b) [2], c), d), e), f) [1]

4. Signing and marking of turbo roundabouts in Poland

Turbo roundabouts built in Poland are marked with conventional vertical and horizontal signs. In the case of vertical signs, they include: circular traffic sign (C-12), give way sign (A-7), pre-road-sign tables, signs that inform about pedestrian crossings (if present) and signposts on the splitter islands. Furthermore, some inlets of turbo roundabouts have tables with the directions on lanes (F-10). Some roundabouts do not have vertical signs that indicate the direction of driving, which are placed on posts or frames over the lanes.

An important element which forms the character of turbo roundabouts is proper horizontal signs. Horizontal signs in Poland do not provide information about the circular character of traffic in the intersection. The horizontal signs for turbo roundabouts have not been defined in the relevant ordinances so far [18]. Apart from separating and edge lines, other horizontal road signs used in Polish turbo roundabouts are directional arrows from P-8 group. The horizontal signs from P-8 group are used in order to indicate that driving is only allowed along the directions shown by the arrow. However, these signs do not have a circular form in Poland to emphasize the circular character of the intersection, as it is the case in a number of countries abroad (see Fig. 7).

As mentioned before, part of turbo roundabouts use lane dividers made of plastic (which is sometimes covered with chemically-hardened masses, which often leads to enhanced durability of the colour despite being frequently driven onto by cars), curbs or setts which divide traffic streams on individual lanes and effectively prevent from changing lanes in prohibited places. During initial period of using turbo roundabouts in Poland, lane dividers were not entirely accepted by Polish society. In the majority of turbo roundabouts in Poland lane dividers are reduced to a single continuous lane of P-2 type.

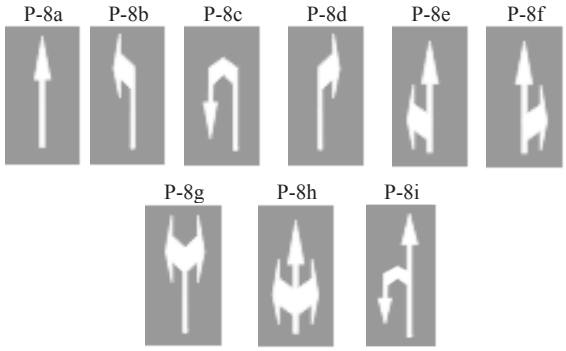

Fig. 7. The typical directional arrows used at turbo roundabouts in Poland [14]

5. Conclusions

The intersections of turbo roundabouts have not been described in a separate chapter in the Polish Traffic Code. Moreover, they do not have any detailed definition. When passing this type of the intersections, drivers should remember about several principles of taking an appropriate lane before they enter the roundabout. Through vertical and horizontal signs, vehicles on the turbo roundabouts are naturally guided towards appropriate outlets, which reduces the risk of collisions. The A-7 road sign is present only before the inlet to the roundabout and no points of collision with other vehicles are present neither at any location on the roadway nor at the outlet. Contrary to the regular roundabout, there is no possibility of changing lanes from external to the internal and the other way.

With the number of turbo roundabouts that is growing year by year in Poland, the problem of clear and uniform principles of marking these intersections arises, which is justified by the safety of the users of these objects of road infrastructure. Such roundabouts have been so far build in Prądy k/Opola, Płock, Bielsko-Biała, Puławy, Zabrze, Dziwnówek, Oława, Stalowa Wola, Szczecin, Gdańsk, Bytom, Chorzów, Sosnowiec, Radom, Chrzanów, Żory, Jaworzno and Chełm and other construction works are being planned. Marking of these relatively new roundabouts in Poland often differ from typical marking of turbo roundabouts used abroad. The difference results from the lack of proper guidelines for the road signs contained in national regulations.

Bibliography

[1] CRUZ L. A. B.: Metodologia Para La Evaluaction Tecnica Y Operativa De Turboglorietas Como Alternativa De Interseccion Vial En El Ambito Urbano, p. 136, Bogota (2010)

[2] FORTUIJN L.G.H.: Pedestrian and Bicycle - Friendly Roundabouts, Dilemma of Comfort and Safety. Province of South-Holland and Delft University of Technology. Source: www.mnt.ee/atp/failid/SlowTrRoundb.pdf, Seattle (2003)

[3] FORTUIJN L. G. H.: Turbo-Roundabouts. Development and Experiences. Seminar "Aktuelle Themen der Strassenplanung". Source: www.bast.de/nn_789794/DE/Publikationen/ Veranstaltungen/Downloads/turbo-kreisverkehre,templateId=raw,property=publicationFile. pdf/turbo-kreisverkehre.pdf. Bergisch Gladbach (2007)

[4] KINZEL CH. S.: Signing and Pavement-Marking Strategies for Multi-Lane Roundabouts: An Informal Investigation. Urban Street Symposium 2003. Source: www.iso.k-state.edu/roundabouts/news/Kinzel.pdf, p. 17, USA (2003)

[5] MACIOSZEK E.: Analiza Prędkości Przejazdu Wyróżnionych Grup Rodzajowych Pojazdów na Skrzyżowaniach Typu Rondo. Zeszyty Naukowe Politechniki Śląskiej nr kol.1862, seria Transport z.74, pp. 59 -- 66, Gliwice (2012)

[6] MACIOSZEK E.: Analiza Prędkości Przejazdu Pojazdów Przez Skrzyżowania z Ruchem Okrężnym. Prace Naukowe Politechniki Warszawskiej, Transport z. 82. Oficyna Wydawnicza Politechniki Warszawskiej, pp. 69--84,Warszawa (2012)

[7] MACIOSZEK E.: Stan Wiedzy na Temat Prędkości Przejazdu Pojazdów Przez Skrzyżowanie Typu Rondo. Logistyka 4/2011, pp. 600 – 609, (2011)

[8] MACIOSZEK E.: Stan Bezpieczeństwa Ruchu Drogowego na Rondach Turbinowych Funkcjonujących w Polsce z Separatorami Pasów Ruchu w Postaci Pojedynczej Linii

Ciągłej. Prace Naukowe Politechniki Warszawskiej, seria Transport. Oficyna Wydawnicza Politechniki Warszawskiej (in press), p. 13, Warszawa (2013)

[9] MACIOSZEK E.: Geometrical Determinants of Car Equivalents for Heavy Vehicles Crossing Circular Intersections. [in:] J. Mikulski (ed.) Transport Systems Telematics. Communications in Computer and Information Science. Springer, Volume 329, pp. 221--228, Berlin, Heidelberg (2012)

[10] MACIOSZEK E.: Safe Road Traffic on Roundabouts as an Element Assisting Efficient Road Transportation System Development in the Upper Silesia Region. Contemporary Transportation Systems. Selected Theoretical and Practical Problems. The Transportation as the Factor of the Socio-Economic Development of the Regions. Monograph 386. Silesian University of Technology, pp. 85--95, Gliwice (2012)

[11] MACIOSZEK E.: The Influence of Motorcycling and Cycling on Small One-Lane Roundabouts Capacity. [in:] J. Mikulski (ed.) Transport Systems Telematics. Communications in Computer and Information Science. Springer, Volume 239, pp. 291--298, Berlin, Heidelberg (2011)

[12] SIERPIŃSKI G.: Theoretical Model and Activities to Change the Modal Split of Traffic. [in:] J. Mikulski (ed.) Transport Systems Telematics. Communications in Computer and Information Science. Springer, Volume 329, pp. 45--51, Berlin, Heidelberg (2012)

[13] SIERPIŃSKI G.: Travel Behavior and Alternative Modes of Transportation. [in:] J. Mikulski (ed.) Transport Systems Telematics. Communications in Computer and Information Science. Springer, Volume 239, pp. 86--93, Berlin, Heidelberg (2011)

[14] Strona internetowa: http://www.znaki-drogowe.pl (Views Data: 28.12.2012)

[15] TOLLAZZI T., TOPLAK S., JOVANOVIC G.: Ocena Prepustne Sposobnosti Turbo-Kroznega Krizisca, p. 17. Source: http://www.appia.si/reference/raziskave/ap000-07-turbo_rondo-reference-raziskave.pdf

[16] WEBER P.: Internationally Recognized Roundabout Signs. Transportation Research Board. National Roundabout Conference. Source: www.docstoc.com/docs/24545077/internationally-recognized-roundabout-signs, Colorado (2005)

[17] Wytyczne Projektowania Skrzyżowań Drogowych. Część II. GDDP, Warszawa (2001)

[18] Załączniki 1 – 4 do Rozporządzenia Ministra Infrastruktury z dnia 3 lipca 2003 roku, w Sprawie Szczegółowych Warunków Technicznych dla Znaków i Sygnałów Drogowych oraz Urządzeń Bezpieczeństwa Ruchu Drogowego i Warunków ich Umieszczania na Drogach. Dz. U. Załącznik do nr 220, poz. 2181 z dnia 23 grudnia 2003 roku. Warszawa (2003)