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MASTER THESIS

in

Road Safety Engineering

Geometrical Design of Turbo Roundabout

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Abstract

The Turbo Roundabout is a roundabout fitted with spiral roads to efficiently counteract the complexities of the modern multilane roundabout. This roundabout has an edge over cutting-edge roundabouts regarding capacity and safety and was first invented by Professor Fortujin in 1996. Fast driving speeds and many possible conflicts at multilane roundabout approaches, exits and circulatory roadways are the reasons for this type of construction project. Road designers have been attempting to address these issues over the past few years by implementing new roundabout configurations. Turbo-roundabouts have also spread outside of the Netherlands over the last decade, mainly in Eastern Europe and Germany, but also in North America. While the Dutch model for turbo-roundabout design was strictly applied by some nations, others designed them on experimental sites, resulting in geometrical variations unique to the area. We have more than 390 turbo-roundabouts worldwide today.

In this paper, the measurement of sight distance on turbo roundabouts with an emphasis on "Intersection Sight Distance" to conflicting vehicle circulation will be studied. The traditional graphical approach has been supplemented with the analytical solution consisting of derivation of generalized mathematical equations for intersection sight distance for conflicting circulating vehicle at turbo roundabout.

To determine the design of turbo roundabout instead of standard type we collected numbers, iterations, flow rate and other information from the intersection in Neapol street - M.Hadi-Ashig Alaskar and Vungtau streets in the capital of Azerbaijan, Baku city. The current name of circle is "Ukraine circle" on behalf of friendship between Azerbaijan and Ukraine. Some of these collected specimens were used to perform the by using the software test at the University of Bologna and in Baku Transportation Agency by PTV VISSIM simulation and AutoCAD Civil.

Keywords: Turbo roundabout design, Intersection sight distance, visibility, Ukraine circle, Road Safety.

Contents

Contents of figures

Contents of tables

CHAPTER 1

WORLD EXPERIENCES

1.1 Introduction

Traditional multilane roundabouts with concentric circulatory lanes have lower functional capacity compared to the anticipated one and visit events of traffic accidents. The motive for these are high speeds of drivers and large number of conflict points which are located in the entrances, exits and circulatory lanes in roundabouts.

Road designers and mainly engineers were thinking on this problem in the past, and they have been trying to get any solution to solve these types of problems in the intersection of the streets especially which is designed as roundabouts connection in the junctions. On behalf of that reason, designers introduced one of the new and modern structure, which is used in the engineering practice in many cutting-edge countries (designed in a new roads or existing roundabouts), is so -called “turbo roundabouts”.

Turbo roundabouts are mostly designed as multilane roundabouts (at least two lane) with spiral circulatory intersection, where the traffic flows at the entrance, circular roads and exit are locally separated by increased mountable lane separates. Because of the physical divider of traffic lanes, driving speeds are decreased, conflict junctions are eliminated, and sideswipe collisions at roundabout entrances and exits are modified. Concurring to the information and last papers on web portal of Dirk de Baan, nowadays there are 408 turbo roundabouts constructed in 21 countries in Europe, North and South America and some parts of Africa. Many of the turbo roundabouts which are designed in European countries are constructed in Netherlands (302 turbo roundabouts), a country that special roundabout layout was improved, and mainly as a great information which we must know the first turbo roundabout layout was used and built. On the other hand, countries, and growing cities with many numbers of turbo roundabouts are Poland (35 turbo roundabouts), Germany (11 turbo roundabouts), Slovenia (11 turbo roundabouts),

Czech Republic (10 turbo roundabouts) and Hungary (7 turbo roundabouts). For Azerbaijan, there is not any type of roundabout, which has the same constructional elements with turbo type of roundabout. Because of these and more reasons, designed turbo roundabout layout for specific chosen area of problematical junctions of the streets.

In this project geometrical design of turbo type of roundabouts related to many European analogues are analyzed. The urgent aim of these analysis is focusing on importance of "state of the art" sample in turbo roundabout geometric scheme, and to publish possible development of existing standard roundabouts design processes.

1.2 Background

Advanced documentations and experiments related to turbo roundabouts which are mostly based on checking of their performances (capacity, delays, queue), and ecological, economical and safety proves, in simple single-lane or multilane standard roundabout, flower and target roundabouts. On behalf of the turbo roundabout geometric design there are many other studies, which were generally focused on improvement and analysis of Dutch turbo roundabout geometry and perspective view of new type of design approaches. These new motives, which are related to Dutch design procedure, are shown national guidelines of several European countries.

First regulations for turbo roundabout layout and design were improved by Dutch Information and Technology Platform CROW in year 2008. These guidelines were invented based on doctoral thesis of Dutch researcher Dr. Lambertus Fortuijn. Then, their release, Dutch regulations were used not only by the engineers of German, but also by road designers and engineers who are from another regions or countries. Honestly, it is obvious that some part of the system of traffic conditions and driving culture differ from country to country, many locations started to improve their regulations to driving standards, driver behaviors and winter control of the requirements.

After three years from Dutch guidelines, Slovenian engineers published a sample version of technical specifications on turbo roundabouts which are the specific for Slovenian roads. Nowadays, they improved their roundabouts till two types of for turbo types. Then they decided to improve their specific structure, and they have been examined and determined exact problems when they were constructed the structure of turbo roundabouts' elements.

As each designing divisions presently that, numerous nations are working on turbo circuitous plan, but Germany is the foremost inquisitive about the advancement of rules for turbo indirect formats.

A few analysts, particularly making a group with engineers come together and progressed the plan on turbo roundabouts. After they made a group in 2010 years, which was comprise on street creators was begun creating the most presumption on turbo development plan. Primary approaches of this group in extraordinarily they have centered on the information's and encounters which is valuable and more appealing strategies utilizing by outside originators and they got these sorts of information's and abilities to do household suspicion for the plan of unused sort of turbo roundabouts. Non regulation group was called FGSV. On the information and past papers they have made new guidelines of Germanian construction mechanics and in 2013 they published their first draft layout for turbo roundabouts. After 2 years, they had already design standards and methods to construct turbo roundabout. Not only made guidelines, but also, they wanted to implement these standards for "Guidelines for the design of urban streets" (RASt) and "Guidelines for the design of rural highways" (RAL).

Among European countries, especially Croatia constructed the first turbo roundabout in 2014 and they used for this purpose Croatian guidelines. Soon after other city of Croatia which is called Pula was constructed two more roundabouts of this kind and they opened at the same year.

Many countries in the world, such as America and Czech Republic, improving their standards in order to construct turbo roundabouts in their specific intersection. For America, engineers are only using key instructions. With this note, which is shown in American guidelines, American designers wanted to inform the United States famous roundabout layout. On the other hand, Czech road designers gathered information and specific guidelines under the construction and they have called "Modern turbo roundabouts and their application in design transport construction". This standard especially focused on the construction, which is only using to design and maintenance in winter days. Among these roundabout design regulations most chosen Serbian and Croatian, because nowadays these two type of regulations are recent useful.

1.3 Review and characteristic of Turbo-roundabouts

Turbo-roundabouts are typical for multi-lane roundabouts which allow going through the intersection in given dimensions in one or more lanes without to change lanes. They are knowing by a smaller number of

conflicts points due to the elimination of weaving maneuvers on the roundabout's roadway. This effect is aimed to be part of the spiral layout of traffic lanes. No weaving to move any direction means that the chosen of the traffic lane must be made before entering the roundabout. The Dutch rules characterize exceptionally accurately the plan and organization necessities for a turbo- circuitous (Figure 1). A really solid and ordinary characteristic of turbo-roundabouts can be found both in remote (CROW 2008, Fortujin 2009, Verweij et al. 2009, FGSV 2014), and legitimate writing (Grabowski 2012, Sołowczuk et al. 2013). Within the five-stage planning prepare the geometry of a indirect counting all its components is chosen, starting from deciding the distance across of a indirect and the width of its activity paths (Verweij et al. 2009).

1. Selecting one of the available roundabout types.
2. Defining a relevant design vehicle.
3. Creating one of the given turbo block templates.
4. Designing the remaining turbo roundabout elements.
5. Conducting design vehicle horizontal swept path analysis and fastest path vehicle speed analysis.

However, it is not major approach, because real zones of the other countries can be especially different from others (Figure1). The spiral form of the roundabout is usually making through the geometric layout of lanes based on an ellipsis or an Archimedean spiral type (Grabowski 2012). Designing a roundabout based on an ellipsis allows controlling to a greater shape of extent the deflection of entering traffic, which is useful in deleting the speed of the vehicles passing through a roundabout. Physical divide of traffic lanes improves the clarity of a roundabout as well as keeping vehicles in their lane.

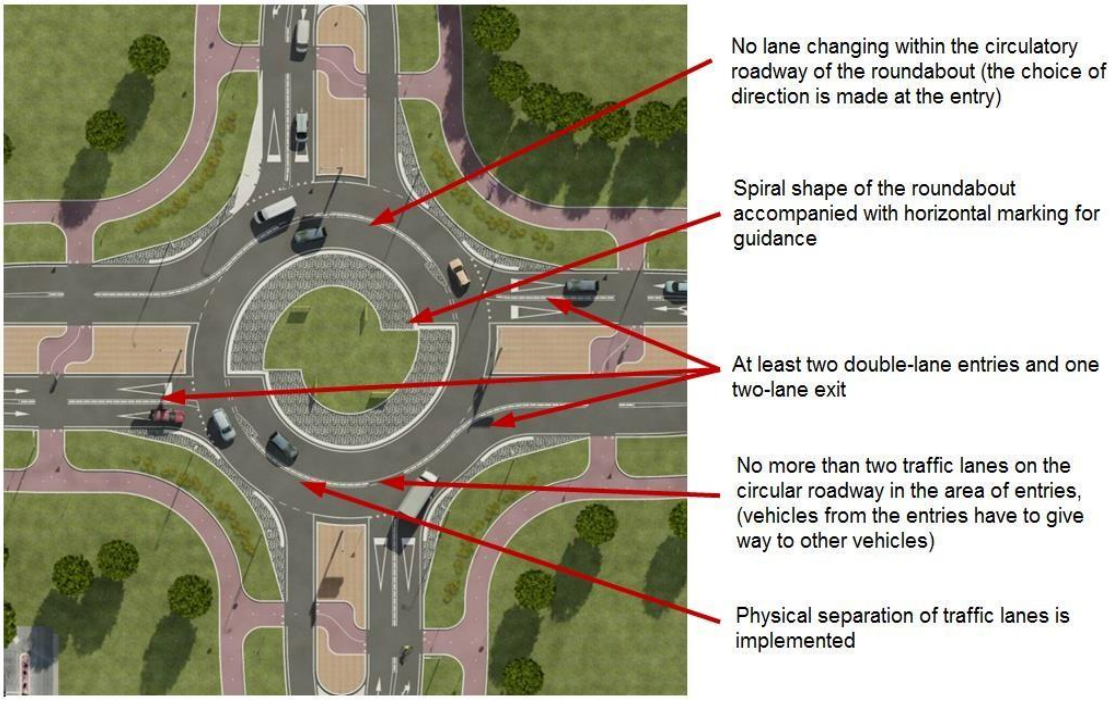


Figure 1. *Characteristic features of a turbo-roundabout*

Source: Verweij et al. (2009).

Based on a audit of worldwide experience, highlights that characterize turbo roundabouts incorporate the following (Figure 2):

• A moment circulatory lane is embedded inverse of at slightest one passage lane.

• Traffic drawing closer the circuitous on at slightest one leg must surrender to activity in two, and no more than two, circulatory paths within the roundabout.

• Smooth stream is empowered by a winding alignment.

• Lane dividers debilitate path changing inside the roundabout. Drivers, in this manner, select the correct path earlier to entering the indirect. Globally, alternatives for path division have included raised, mountable path dividers; flush path dividers; or strong asphalt markings.

• Each portion of the circuitous incorporates one circulatory lane from which drivers can select whether to exit or proceed around the roundabout.

• At slightest two exit legs are two-lane.

• The distance across of the circuitous is kept little to empower lower speeds through the roundabout.

• Approach legs and passage are regularly at right points to the roundabout.

• Roundabout directional arrow signs coordinate drivers and increment conspicuity of the central island.

• Mountable overskirts offer adequate maneuvering space for longer vehicles

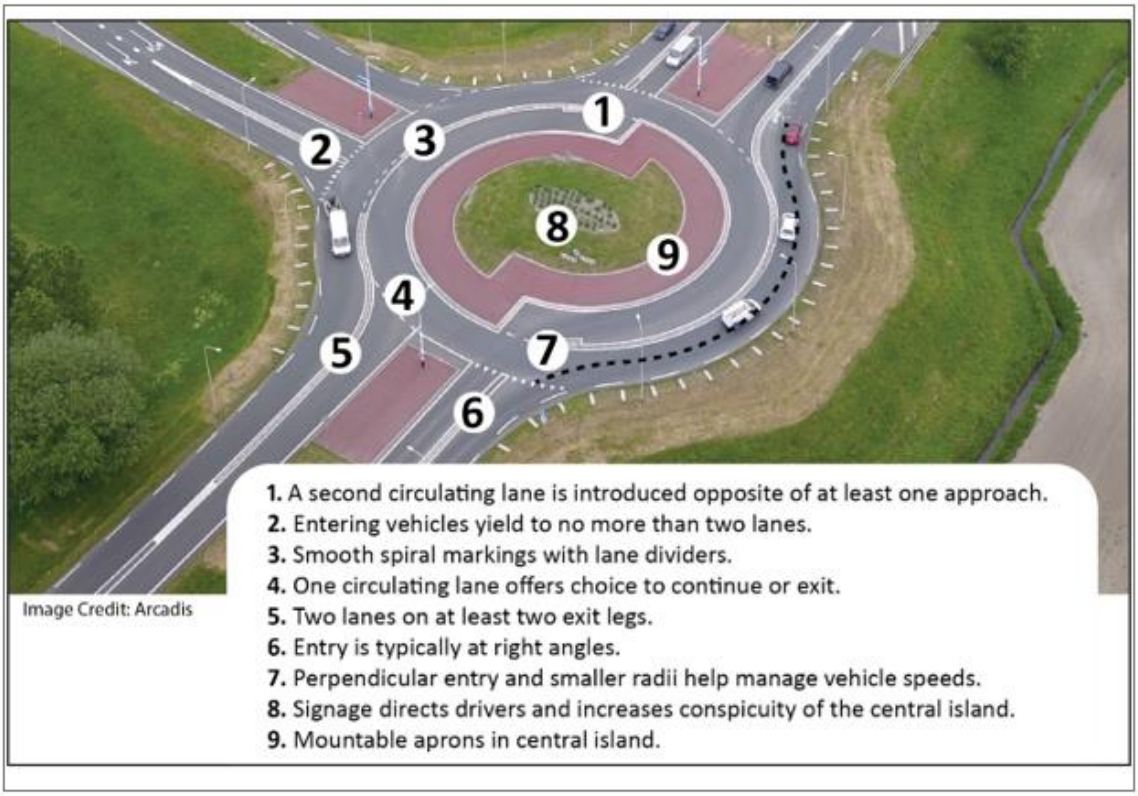


Figure 2. *Turbo roundabout features. Image based on Fortuijn, 2009.*

There are diverse sorts of turbo roundabouts, counting the essential, egg, knee, spiral, and rotor turbo roundabouts. These choices contrast with regard to central island plan, number of circulating paths, and number of approach paths, as depicted below:

• Basic – interior lane included on major approaches, two paths on each approach (see figure 3).

• Egg – comparable to a essential turbo indirect, but with as it were one approach lane on minor approaches (see figure 4).

• Knee – the interior lane is as it were included on one approach, two paths on each approach (see figure 5).

• Spiral – three circulatory lanes, interior path as it were included on two approaches, two approaches with three lanes and two approaches with two lanes (see figure 6).

• Rotor – three circulatory lanes, interior path included on each approach, three lanes on each approach (see figure 7).

Note: The varieties in turbo indirect plans vary in terms of add up to capacity accessible, so the sort chosen may be directed by crossing point request. The capacity values given in figure 3 through figure 7 speak to capacity within fundamentally intelligent of anticipated capacity values somewhere else.

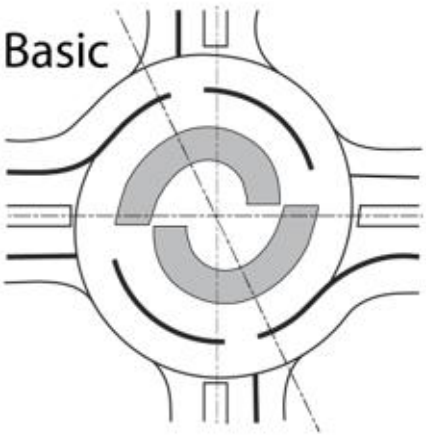


Figure 3. *Basic turbo roundabout. 2017 with capacity value from Fortuijn, 2009.*

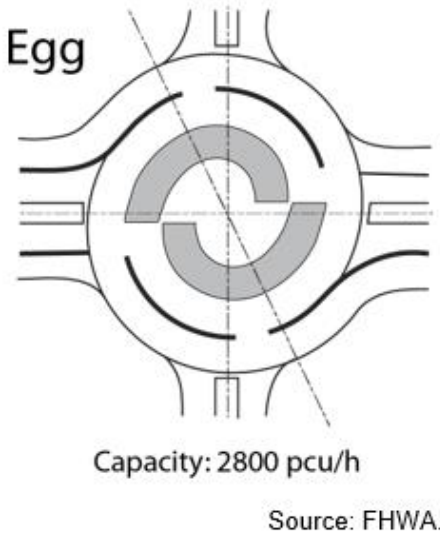


Figure 4. *Egg turbo roundabout. 2017 with capacity value from Fortuijn, 2009.*

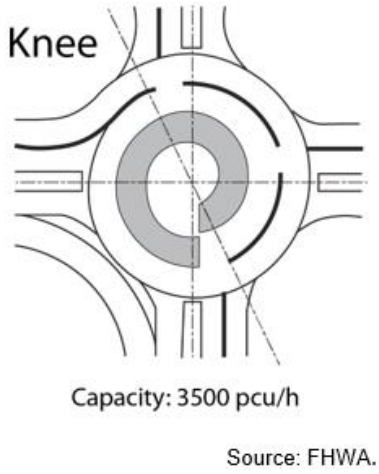


Figure 5. *Knee turbo roundabout. 2017with capacity value from Fortuijn, 2009.*

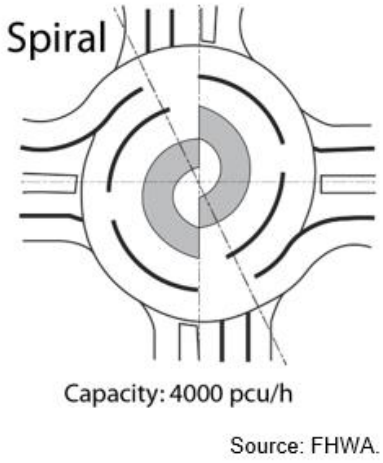


Figure 6. *Spiral turbo roundabout. 2017 with capacity value from Fortuijn, 2009.*

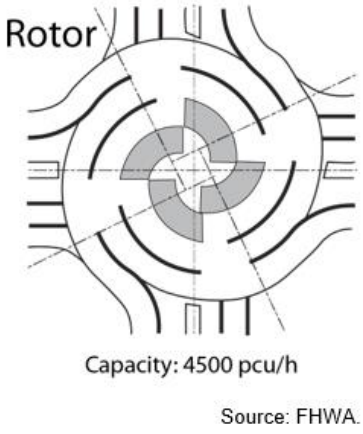
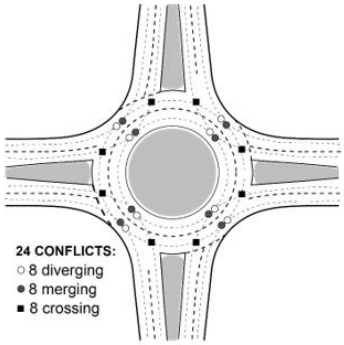


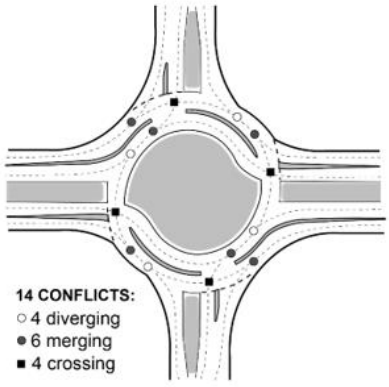
Figure 7. *Rotor turbo roundabout. 2017with capacity value from Fortuijn, 2009.*

Figure 8 and figure 9 appear that the turbo roundabout dispenses with a few of the clashes related with the common crash sorts in present day 2 x 2 multilane roundabouts. At the two-lane exits of a turbo roundabout, drivers within the interior lane execute a "turn" to exit the circuitous, as in concentric roundabouts. In any case, the turbo roundabout disposes of the necessity in concentric multilane roundabouts of leaving drivers within the interior lane having to to begin with cross the exterior lane. Typically done by physically driving drivers within the exterior lane to exit. The geometry of turbo roundabouts moreover makes a difference to oversee the speeds of vehicles entering, exploring, and leaving the indirect. Operationally, the capacity of a turbo roundabout is anticipated to be comparative to other present day multilane roundabouts.



Source: FHWA.

Figure 8. *Conflict point frequency for* ***modern multilane roundabout.***



Source: FHWA.

Figure 9. *Conflict point frequency for* ***turbo roundabou****t*

CHAPTER 2

ROAD NETWORK

2.1 Concept of sustainable safety

Road safety may be a major concern in numerous nations. Frequently the approach on street security is based on distinguishing proof and investigation of dark spots, giving uncommon consideration to powerless street clients (people on foot and cyclists) or overwhelming sorts of mishaps (deliver way, speeding, liquor). In nations such as the Joined together Kingdom, Sweden, the Netherlands and Denmark, this arrangement has demonstrated exceptionally effective in lessening the number of mischances and fatalities.

Be that as it may, in arrange to proceed the descending in fatalities and wounds, it has ended up fundamentally to create a more comprehensive approach, based on the interaction between people, vehicles and framework. Within the Netherlands this approach is known as 'Sustainable Safety'. Such approaches have been created in other nations, e.g., Sweden's 'Vision Zero' (no one murdered or seriously injured in activity mishaps). Within the past decade this pro-active approach demonstrated to be viable in bringing change in street security and mischance figures (Figure 10). The point of maintainable security is to dodge burdening future eras with the results of street activity mishaps resulting from current and future portability requests. Avoidance rather than remedy is the reasoning of this approach.

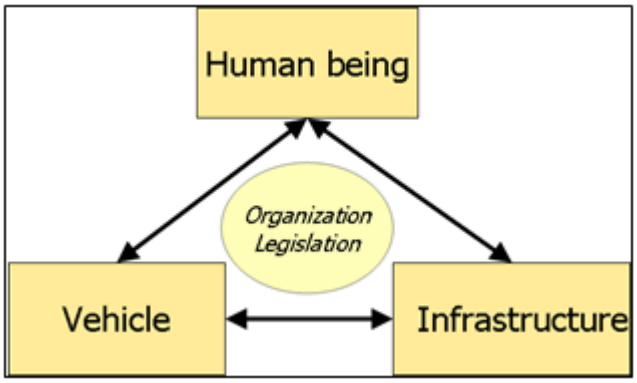


Figure 10. *Concept of general safety*

On a very basic level, in a reasonably safe traffic and transport framework, smart and safe plan of infrastructure limits the chance of an mischance to a least; and for cases that mishaps that still happen, since people are by definition at risk to error, circumstances are such that the chance of genuine harm is minimized. Essential in this reasoning is the well-thought infrastructural plan of streets and its environment.

The concept is based on the guideline that ‘man is the reference standard’ (the human figure will continuously be display). A sustainably safe traffic system hence has:

– an foundation that's adjusted to the restrictions of human capacity, through appropriate street design;

– vehicles prepared with devices to disentangle human assignments and built to ensure the helpless human being as viably as possible;

– a street client who is satisfactorily taught, educated and, where necessary, controlled.

The capacity and powerlessness of a human being ought to be the reference standard. The key to the accomplishment of a sustainably safe traffic system lies within the precise and steady application of safety standards. Road safety ought to be tended to at all levels.

2.2 Safety principles

The beginning point for maintainable safety is the human being, with his cognitive and physical restrictions as a reference standard. The whole activity and transport system ought to be balanced to the impediments and capabilities of street clients. The foundation ought to avoid collisions between moving vehicles with huge contrasts in heading, speed and mass, and ought to moreover advise the street client what conduct is anticipated. Sustainable safety is based on a orderly approach in which all components of street security and the transport framework are adapted to one another. At the most noteworthy level traffic can be respected as a framework with foundation, controls, vehicles, and activity members as the most components. In arrange to provide ideal road safety, feasible security instructs that three components must be in concordance (Figure 11): work, plan and utilize.

– function: relates to the use of the infrastructure as intended by the road authority;

– design: relates to the physical design and layout properties of the infrastructure;

– use: relates to the actual use of the infrastructure and the behavior of the user.

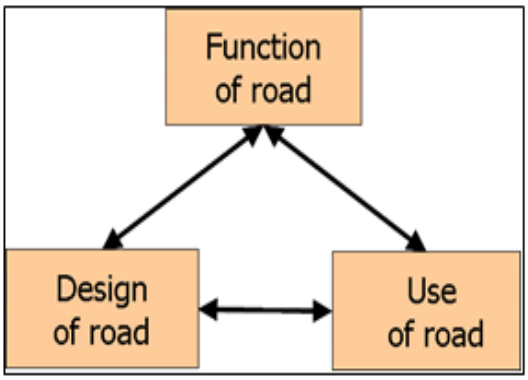


Figure 11. *Main functions or principles of road users*

Each category of road requires a plan appropriate with its work, whereas at the same time guaranteeing ideal security. To meet the last-mentioned prerequisite, all road categories ought to comply with the taking after four fundamental security principles:

– Functionality: avoiding unintended utilize of the foundation. Activity ought to be dispersed over the road organize as was planning and the different streets ought to be utilized by the sorts of activity for which they are designed.

– Homogeneity: maintaining a strategic distance from noteworthy contrasts in speed, driving course and mass of vehicles. Contrasts in speed and mass between transport modes utilizing the same connect or crossing point at the same time is decreased to a minimum.

– Recognizability: maintaining a strategic distance from vulnerability among street clients. As much as conceivable, activity circumstances ought to be unsurprising. Street clients ought to be able to expect the format of the street correctly.

– Forgivingness: permitting for people to create botches by orchestrating the physical environment so that the results of botches are minimal. Obstacle-free zones are the foremost imperative in this regard.

2.3 Road functions

Directly, streets and roads frequently have more than one activity work. This does not coordinate with the safety standards as specified here. This blend of capacities makes risky conditions. Multi-functionality leads to conflicting plan prerequisites, additionally to higher accident risks. The concept of reasonably safe road transport comes down to the expulsion of all work combinations by making all streets in

guideline mono- functional, and by making clear categories of streets: through streets, collector streets and get to roads:

– **through streets** fundamentally have a activity stream work for long separate activity, giving fast and continuous vehicle development, over a long remove ((inter)national roads);

– collector streets lead activity from locale to through roads (and bad habit versa) and interface adjoining areas to each other (territorial roads);

– **access roads** give get to homes, shops and businesses, whereas moreover guaranteeing the security of the road as a assembly put and a living range, as well as for cyclists and people on foot (nearby streets).

Road links are aiming for activity stream; convergences are expecting to permit activity to switch from one street to another. An special case is the road interface for get to streets, on which halting and turning is permitted. Through roads ought to not have crossing points but part level trading to ensure a nonstop stream work. In expansion to a traffic (get to) work, get to lanes and streets in urban zones ought to permit individuals to move around the region of their houses safely and comfortably. This private work can be combined with the get to work. A private work for ranges implies that people on foot, playing children, cyclists and stopped cars can utilize the same range. The roads in these regions ought to be outlined in such a way that the private work is quickly recognizable and avoids driving speeds of more than 30 km/h inside urban ranges or 60 km/h inside rustic zones. The plausibility of clashes between non-motorized and motorized activity may still exist, but the lower speeds on get to streets permits great expectation and evasion of hazards, and ought to reduce the results of any accident that does happen.

2.4 Recognizable road categories

In a sustainably safe traffic system street clients know, for each sort of street category, what activity behavior is anticipated of them, and what to anticipate from other road users. Emphasizing the recognizability of each category increments the consistency. The component that guarantees accomplishing the required level of consistency comprises of two steps:

1. road clients must be able to recognize the street category by a (little) number of plan elements.

2. based on instruction and involvement, street clients ought to know which conceivable activity circumstances are related with the street category. The point of this component is to lower the workload (or mental stack) of drivers. This will have a positive impact on the execution of the driving task.

A little set of design features ought to guarantee the recognizability and consistency of activity circumstances (see Table1). Among the foremost vital highlights are ceaseless longitudinal road components Key highlights are:

– longitudinal street markings;

– separation of driving directions;

– type of pavement;

– presence of vehicle breakdown office zones (crisis path on motorways) and impediment free zones;

– distinct crossing point sorts inside a street category.

Characteristics	*Through road*	*Collector road*	*Access road*
Speed limit	120 / 100 km/h	80 km/h	60 km/h
Longitudinal edge marking	Continuous	Dotted	None
Cross section	2x1, 2x2 or more	2x2 or 1x2	1x1 (one undivided small lane serving traffic in both directions)
Oncoming traffic	Physical separation	Visual separation	No separation
Emergency facilities	Emergency lane	Semi-hard shoulder	Verge
Obstacle free zone	Large (8 – 13 m)	Medium (4.5 – 6 m)	Narrow (1.5 – 2.5 m)
Slow traffic	Separated	Separated preferably	Mixed, in the carriageway
Intersection	Grade separated	At grade (priority indicated by traffic signs)	At grade

Table 1: *Main characteristics of road categories outside built-up areas*

2.5 Methods of dividing traffic lanes in the turbo- roundabout's element

Physical separation of traffic lanes, which is usually feature of turbo-roundabouts should be make sure a higher level of road safety to compare to multi- lane roundabouts, because it precludes waving maneuver. The Dutch guidelines (CROW 2008) suggested solutions in details (Figure 12). In this figure you can see general width of the lanes for specially turbo spiral movements. A concrete curb, increased over the surface of the roadway by 7 cm, is placed at the axis separating traffic lanes (in order to drain rainwater another water which demonstrate the roadway it has gaps every 1 m). Both sides of the divider are made more unmistakable by marking the roadway with a strong white line. The rules require the dividers to be prepared with reflectors on the inclines, which move forward their perceivability amid nighttime.

In accordance with German technical standards, vertical separation of the traffic lanes is not required. In spite of the fact that teach of drivers isn't idealize and infringing on neighboring path is watched, the investigate has appeared that well connected level stamping and marking may be adequate to decrease illicit path changing.

In Poland, the physical partition of activity paths is frequently substituted with level checking as it were ("no passing" strong line). Typically, due to specialized prerequisites (discouraging waste and snow furrowing), low social acknowledgment for this arrangement and the next danger for cruiser riders.

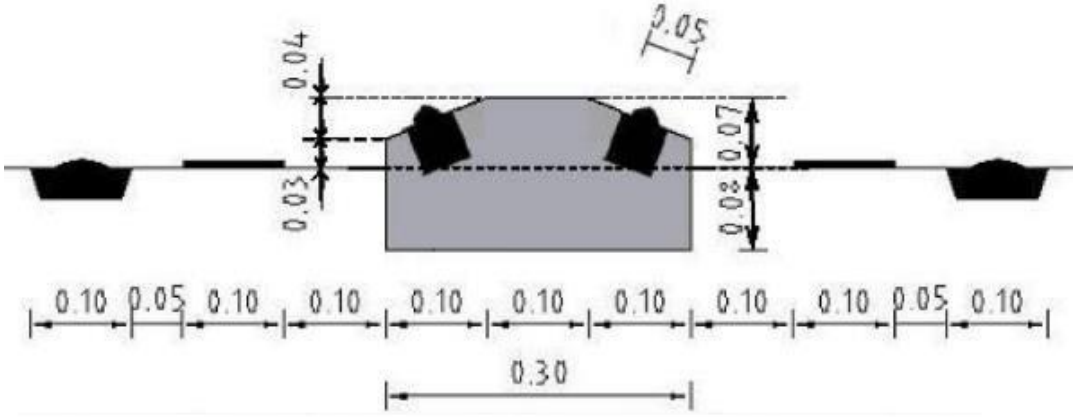


Figure 12. *An example solution of lane dividers in accordance with the Dutch guidelines Source: CROW (2008), Verweij et al. (2009).*

2.6 Road safety

Outside encounters demonstrate that turbo-roundabouts are a secure arrangement. Be that as it may, it is troublesome to appraise the potential for lessening mischances by actualizing turbo-roundabouts in comparison to other sorts of crossing points. Since of a restricted number of dissected convergences and the technique of examinations, most reports demonstrating the positive impact of utilizing turbo-roundabouts do not constitute a premise for a solid quantitative evaluation. The results of Dutch estimates based on "before and after" analyses show that the potential for reducing accidents is similar to single-lane roundabouts. In Germany, turbo-roundabouts are considered a secure sort of crossing points, comparative to compact one-lane roundabouts. propose surmised mishap rate break even with to 0.9.

Applying their created potential mishap rate show, decided that the level of street security danger characterized as the number of harm accident is around 25-30% lower, whereas for all collisions it is 40-50% lower than for multi- path roundabouts. The creators underline the reality that the comes about were gotten by applying the hypothetical show for multi-lane roundabouts to turbo- roundabouts without calibrating, and hence the calculations ought to be debilitate as preparatory sign. An endeavor to appraise street security was made in Poland based on the information concerning mischances gotten from the database of mischances and collisions in Poland. One of the points of the investigations conducted was to compare the operation of roundabouts with physically isolated activity paths with those with no raised dividers. In case dividers are executed, they have distinctive shapes and measurements. These can be different sorts of street controls, side boundaries, clearing, additionally prefabricated components. The nearness of a divider isn't continuously underlined with flat stamping. Illustrations of arrangements are displayed in Photo 1, whereas more can be found.

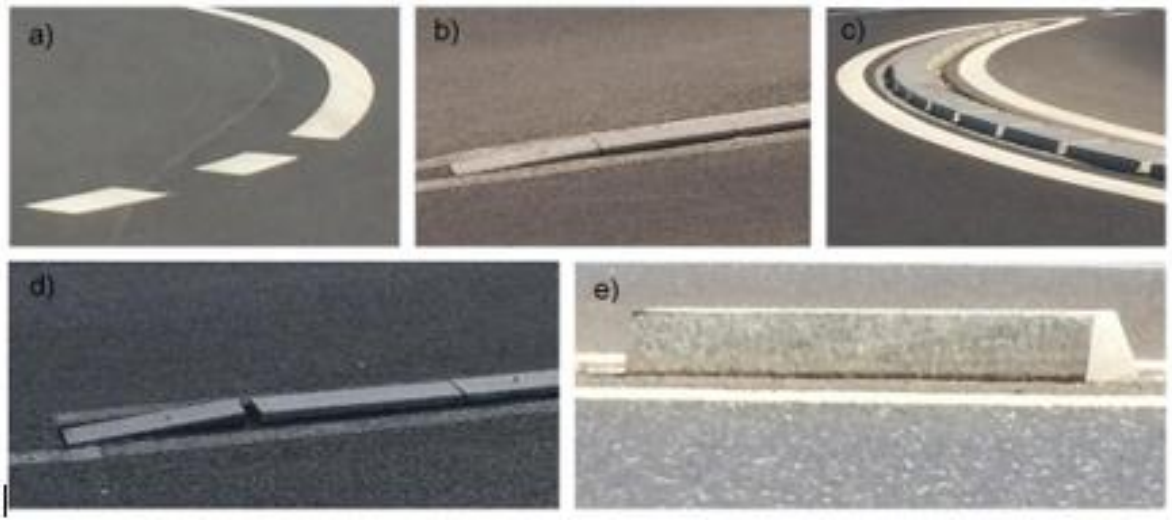


Photo 1. Examples of methods of separating traffic lanes in Polish turbo-roundabouts: a) horizontal marking, b) low divider , c) high and massive divider,, d) wide divider with reflexive elements , e) high and impassable divider .

One of the conclusions was that the level of street security in turbo-roundabouts with no physical division between activity paths was comparable to multi-lane roundabouts, whereas utilizing raised dividers moved forward security. At roundabouts with no raised path dividers 56% of accident are point crashes, whereas with physical partition decreases the share to 24%. Illicit path changing caused 18% of all crashes for both sorts of turbo-roundabouts, whereas disappointment to provide a right of way 30%-40%. This appraisal was conducted based on a little number of roundabouts, specifically 17. Since mischance information is

frequently restricted and wrong and there's a trouble in getting the vital information to carry out a comparison of the relative risk for street security on distinctive crossing points (such as for e.g. activity volume), it gets to be vital to create an roundabout security measures. One of the criteria of such an evaluation would be share of dishonorable driver behavior. Another one can be the speed of vehicles. Speed or speed distinction are one of the illustrative factors in displaying mischance rates (Turner et al. 2009). In this way relative speed alter may be utilized to anticipate impacts of changes in indirect geometry on street security danger.

CHAPTER 3

STUDY OF TRAFFIC FLOW

3.1 Driver behavior at the turbo roundabouts

Due to the preparatory character of the inquire about into the conduct of drivers at turbo roundabouts, test destinations chosen for the inquire about had a discernible geometrical difference and a comparative association of activity. Estimations were carried out within the zone of two-lane sections into the circuitous, circular roadway and the exit situated straight ahead. Within the lion's share of roundabouts leaving to the cleared out can take place from the inward path, leaving to the correct as it were from the external path, whereas through development may utilize both paths. All the roundabouts were initially outlined as turbo-roundabouts, and in this way, they met most of the Dutch necessities (but the indirect in Tarnów). Be that as it may, the strategy of depicting activity paths takes after a more seasoned plan strategy which exhorts a smooth move into circular activity around the island on the passage paths (CROW 2008). Customary activity signs and flat stamping characterized within the Thruway Code come up short to compare to the modern sorts of roundabouts. In a few occasions activity engineers attempt to adjust outside signs to back standard signs and checking. The issues related with the adjustment of Clean signs and stamping to the turbo-roundabouts were depicted in (Macioszek 2013d). Activity estimations within the roundabouts were conducted employing a observing framework permitting for getting and handling film from a few cameras. The test location included the approach segment to a indirect (ca. 60 m), the section, the circulatory roadway around the island and the exit. The gotten video film made it conceivable to reproduce the direction of vehicles of chosen streams and to appraise the immediate speed for chosen cross- segments of the circuitous.

3.2 Propensity of drivers

Particular character of turbo-roundabouts operation may lead to compounding driver choice making handle and an increment of driver blunder. This applies in specific to choosing the proper path (in

connection to the aiming course) on the approach, and to proceeding to remain within the assigned activity hallway. The estimations made within the turbo-roundabouts recorded given a premise for a preparatory appraisal of the recurrence at which occasions of inaccurate conduct happen. A few illustrations of such conduct (outlined in Figure 13) were singled out:

- driving over the edge of the activity lane (independently for the external and internal paths, when it comes to the internal path of a circuitous this (Figure 13a);
- manifests itself through moving over to the neighboring activity path at the passage or exit, or through pointless infringing on the circulatory street by traveler cars) (Figure 13b);
- needlessly changing activity paths which isn't a result of off-base path determination at entry (changing paths isn't caused by the failure to proceed driving within the chosen course in a given lane) (Figure 13c);
- passing through a circuitous in other ways which are against the activity rules (counting path changing in arrange to proceed driving in a heading which isn't permitted from a given activity path, or indeed driving within the off-base way) (Figure 13d);

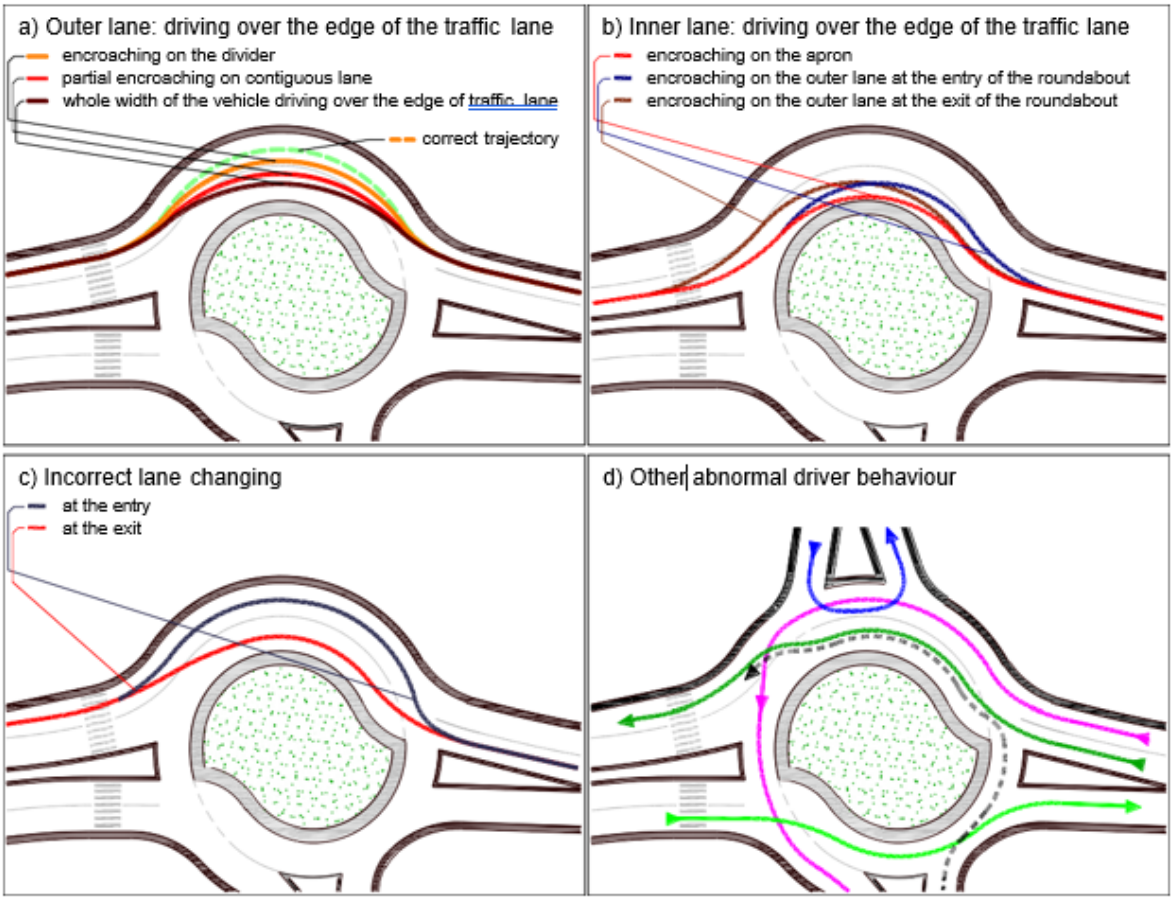


Figure 13. *Incorrect driver behaviors in a turbo-roundabout.*

The conducted estimations affirmed the effectiveness of raised dividers in controlling the traffic at roundabout. Their presence practically eradicates some illegal behavior (driving over the edge a traffic lane – Figures 14a and 14b), but it does not dispose of the lane changing which can be wiped out areas with no dividers, planning so as to guarantee pass ability.

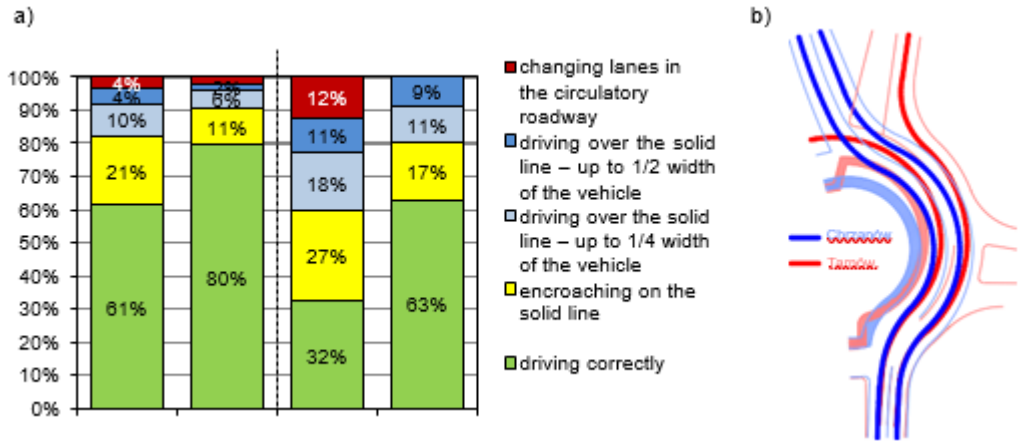


Figure. 14. *Propensity of drivers in the outer lane to follow the designated traffic corridor at roundabouts with no physical separation of traffic lanes: a) empirical data, b) comparison of the geometry and trajectories of passing through both roundabouts*

Figure 14 should be a realistic representation of the rate of drivers utilizing the external lanes whereas going straight for two roundabouts which have no physical partition between activity lanes. Less than 20% of light vehicles drive over to the neighboring activity lane, whereas several percent of drivers disregard the level checking totally and fixes bend. The turnaround of this circumstance (moving from the inner lane onto the external one), happens much more occasionally and is watched for the most part within the region of passages and exits. The roundabout in Chrzanów was characterized by an expanded rate of infringing the neighboring activity passage, which likely needs to do with the littler distance across of the indirect and with the bigger diversion point shaped by the and exit tomahawks (Figure 14b). These were, among others, occurrences of: unlawful path changing and infringing on the neighboring activity path, as well as driving over the truck cook's garment (which isn't forbidden but within the case of light vehicles it isn't propelled by the requests of pass ability). Within the roundabouts with raised path dividers infringing on neighboring activity paths happens generally within the passage and exit zones. Such circumstances were most visit at the indirect in Bielsko-Biala.

Roundabout		outer lane			inner lane		
		lane change		Driving over the line	lane change		Driving over the apron
		at the entry	at the exit		at the entry	at the exit	
1	**Bielsko-Biala**	0.0%	0.0%	11.5%	0%	0%	1.5%
2	**Świlcza 1**	0.0%	0.0%	0.0%	0.8%		0.0%
3	**Świlcza 2**	0.0%	0.0%	0.0%	0%	0%	2.3%
4	**Stalowa Wola**	0.6%	0.0%	0.0%	1.8%	43.3%	-
5	**Chorzów**	-	0.3%	0.1%	0.2%	1.2%	1.0%
6	**Chrzanów**	2.2%		2.0%	2.5%	5.5%	2.5%
7	**Tarnów**	0.1%		-	0.0%	1.28 %	1.9%
1 – **concerns light vehicles**							
2 – **changing lanes is related to continuing in the desired direction**							

Table 2. *Improper behavior at turbo-roundabouts*

Changing paths inside the circulatory roadway can be the source of the foremost genuine activity clashes. When path dividers are actualized, such occurrences take put over all at the sections and exits. The conducted examinations shown that the issue happens generally at the exits. As it were a little number of unlawful paths changing was the result of the ought to proceed driving in a distinctive course than allowed. The biggest rate of such instances was recorded in Stalowa Wola (45%). It can be clarified by moo activity volume, the noteworthy direction avoidance of the inward path at the exit, and the finishing of the cleared-out path adjacent the exit. Within the circuitous in Chorzów one seems recognize a gather of drivers who changed paths by moving into the internal lane in spite of there being no require for such a move (this case was appeared with a dashed line in Table 2), which may cruel, among other things, a issue with distinguishing activity paths caused by the geometric format of the passage and/or with newness with driving rules in turbo- roundabouts. Occurrences of illicit conduct turned out the slightest visit within the roundabouts in Świlcza, indeed in spite of the fact that it was there that one might anticipate the biggest number of drivers who are new with the street (as the roundabouts are portion of a turnpike compatibility). In these roundabouts' activity paths are isolated with a massive divider, both within the roadway and at the passage, which, alongside exceptionally clear signs and level stamping, brings around the required impact.

3.3 Vehicle speed at turbo-roundabouts

The moo speed at which vehicles pass through roundabouts is one of the reasons for the number of mishaps being little, and particularly for the constrained seriousness of episodes (concurring to Macioszek (2013c), enrolled PDO collisions account for ca. 95% of mishaps). The speed of vehicles passing through roundabouts may moreover be valuable in creating models of capacity of roundabouts (Macioszek 2013a). The estimations of immediate speed were made by measuring the time of passing through the given areas. Five segments were singled out (Figure 15):

1. approach section.
2. entry region (ca. 20 m of the section to the halt line).
3. conflicting area.
4. circulatory roadway.
5. exit area.

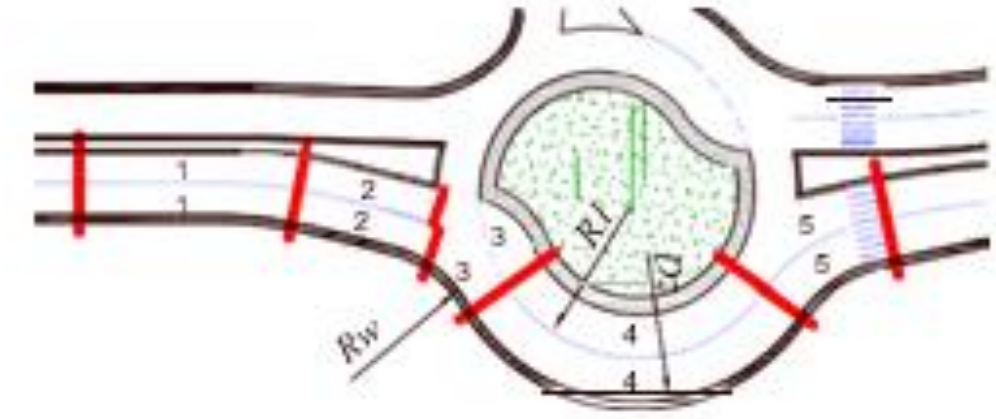


Figure 15. *Measurement distances for instantaneous speed*

Investigations were conducted independently for the external and inward paths, isolating the vehicles into light ones (traveler and conveyance cars) and overwhelming ones (buses and trucks). Due to a little nearness of overwhelming vehicle activity, a measurably dependable test for this category was gotten as it were for several streams.

The strategy of isolating activity lanes may have an vital effect on the speed at the conflicting a indirect. Much higher speed within the conflicting region (around ca. 10 km/h) was watched within the internal

path in comparison with the neighboring path: when the paths were isolated as it were with level stamping, whereas in these roundabouts with dividers this distinction measured to 3 km/h on normal. Comparing the speed at circulatory roadway in roundabouts with the physical separation of activity paths too uncovers critical differences: within the to begin with case the mean speed was 27 km/h, whereas for roundabouts without dividers (checks) it was 35 km/h. The look for the impact of geometric highlights on the speed of vehicles passing through a circuitous was conducted independently for the outer and the internal lanes. It ought to be focused that these investigations have preparatory character and are pointed transcendently at setting modern bearings within the development of speed models for activity in turbo-roundabouts, instead of at defining conclusions of measurement relevance. None of the geometric parameters characterizing a turbo-roundabout did not turn out to be an important figure deciding the speed of vehicles at the section region and within the roadway of the indirect.

3.4 Driver behavior in the turbo-roundabouts

Obtained comes about were concurrent with the speed demonstrate displayed by Macioszek (2013a), in which the as it were free variable is the span R1 (the primary span of the roundabout's circular way). The adjusting span at the section to the roundabout does not have a critical effect on the speed of vehicles. Essentially weak relationships were gotten for the diversion of direction and the rate of extension. Since planning turbo-roundabouts is more complicated than that of conventional one- and multi-lane roundabouts, the impact of geometry on speed may demonstrate much more troublesome to describe and require taking under consideration a few variables within the model. The constrained number of roundabouts examined does not permit to depict speed employing a different. The differences in speed are statistically significant ($\alpha = 0.05$). The vehicles driving over the solid line or driving slightly outside of their designated traffic corridor were moving at speed like this of the vehicles which were driving in accordance with the horizontal marking.

Raised path dividers may have impact on crashes at clashing zone. Concurring to speed demonstrate displayed in (Macioszek 2013a) and the comes about appeared over, path dividers somewhat diminish speed at circulatory roadway. Vehicle speed is one the foremost imperative non-flow factors in crash forecast models.

Since the raised path dividers decrease the cruel stream speed ca. 1.5 km/h (Macioszek 2013a) as well as the number of vehicles voyaging at higher speeds which cut corners on circulatory roadway, the

number of crashes at clashing range diminishes by 10% to 17%. Figure 16 outlines the impact of executing path dividers in roundabouts on crash lessening.

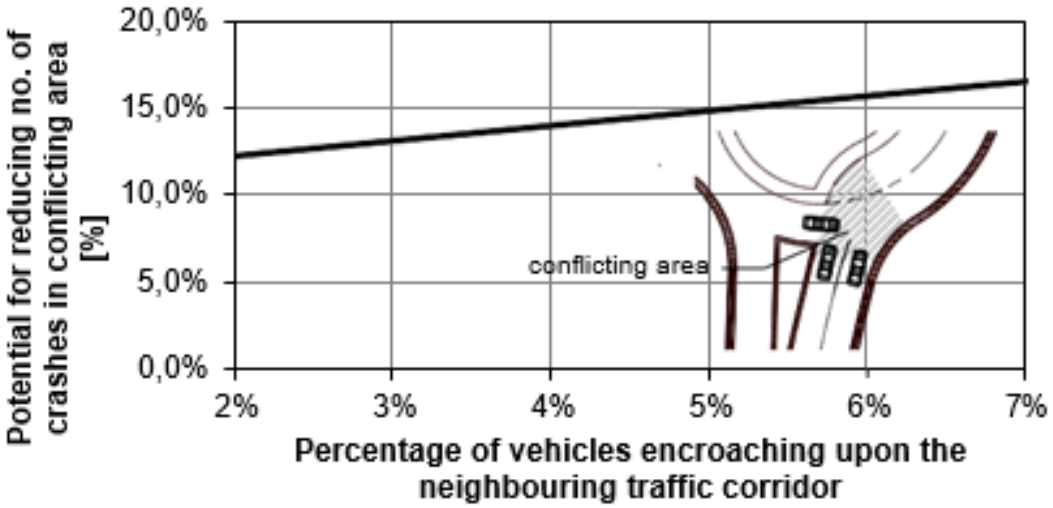


Figure 16. *Influence of raised lane dividers on road safety improvement*

It ought to be taken into thought that the displayed comes about are as it were characteristic. The chosen crash expectation demonstrate has been created for standard roundabouts. The relationship between geometry and vehicle speed in turbo-roundabouts may vary altogether. In any case, a positive impact of raised path dividers is unmistakable and profoundly plausible. The displayed examinations ought to be treated as preparatory. They point to the need of conducting advance inquire about into the working of turbo-roundabouts from the point of see of security, with specific consideration paid to speed of vehicles. If we conclude all the observation for Poland experience we can say that: The turbo-roundabouts which are being built in Poland make an opportunity to move forward the activity execution and street security in basic focuses of the street arrange. The significant differences of arrangements connected in these roundabouts is not as it were the result of activity circumstances, but it is additionally decided by the need of across the nation plan rules as well as of any strategy of assessing their effectiveness. There has been no wide-scope data campaign pointed at advancing these modern arrangements for convergences which, as distant as activity rules go, are a cross between a channelized crossing point and a circular crossing point. It may trigger different conduct in drivers passing through them, counting bizarre behavior. The conducted consider appears that drivers pass through roundabouts in a confident way, and the rate of

drivers abusing in a clear way the activity rules and the rationale of turbo-roundabouts is often underneath many percent. Illegal path changing happens most habitually within the exit area. The physical division of activity paths has not been found out to make an extra danger, whereas it speeds up the affinity to remain inside the assigned activity passage and can contribute to abating down at the section to a roundabout. The investigation of speed of the vehicles passing through a circuitous illustrated a speed separation within the inward and external paths, where at the passage onto the circulatory roadway higher speed is noticed within the internal path, whereas at the roadway of a indirect the vehicles moved with a negligibly higher speed within the external path. The contrast in speed in neighboring paths by the section on to a circuitous is much littler on the off chance that path dividers are actualized.

CHAPTER 4

PROJECT NETWORK

4.1 Main approach of “Ukraine” roundabout

Figure 17. *Special part of the “Ukraine “roundabout.*

The Ukraine roundabout is one of the most popular and new constructed circles in Azerbaijan, exactly in the capital- Baku (Figure 17). This roundabout called “Ukraine roundabout” , because there is a good friendship between Ukrain and Azerbaijan. That is why it is called by government. This circle is in Baku, specially in these coordinate 40.378538, 49.951814 . As an governmental issue that we have to change and modification all the elements of roundabout. One of the main assumptions of this project to realized and re-design this roundabout by using AASHTO standards. Beacuse in this project traffic safety is not eligible with standarts and there is some problematical points which is affecting to use 100% by roundabout. In this redesign project you will see many new approaches and elements which is using

specially for turbo roundabout. The Ukraine roundabout indirect could be a prevalent arrangement for activity convergences these days. The number of applications is developing ceaselessly, primarily for reasons of road security and activity stream quality. The most rule for achieving higher activity security within the Ukraine circle is the concept of Sustainable Safety, in which a triangular connection between work, utilize and plan of a street is put central. The most components of an fitting plan of single lane turbo roundabouts are explained. One of the foremost vital issues related to the security of roundabouts is section plan. Most nations, counting Azerbaijan, favor radially associated legs in arrange the approach of the circuitous and to play down driving speeds. The nearness of splitter islands is suggested. The favored measurements of different plan components are given, to empower the indirect to operate efficiently and securely. Encounters in Asian nations over the final decade appear significant diminishments in activity mischances when applying the proper plan rules. Consistency within the plan is additionally an imperative component to the street client. The adjust of these three components must ensure clarity to the street client and lead to the planning, secure street behavior. The most focal points of the roundabouts are the following:

Standards equivalency:

There are 8 lanes for roundabout. However, only 3 lane are active by using drivers. In the new approach, all the elements will be normalized by using turbo roundabout guidelines.

Road security:

The chance of mischances is (exceptionally) to begin with reason is the driving speeds of all activity drawing nearer the roundabouts and the activity inside the indirect itself. A moment reason is the number of potential clashes among street clients, which is lower than on other sorts of intersections.

Traffic stream quality:

Roundabouts have tall levels of benefit in terms of activity stream for all street clients, compared to a ordinary need crossing point or an crossing point with activity signals. For circumstances in which 8 lane roundabouts cannot adapt with the anticipated activity volumes, indeed with the arrangement of bypasses (physically isolated right turn paths), turbo lane roundabouts may be the arrangement. The most components for an fitting plan of such roundabouts are clarified, counting the number of passage and exit paths. One of the major security issues of multi path turbo roundabouts is the weaving and cut-off episodes that habitually happen, as well as intelligent with defenseless street clients, i.e., cyclists and people on foot. Since of the destitute execution of multi path roundabouts with regard to security and capacity, they are not connected within the Azerbaijan; instep, they have been supplanted by ‘turbo roundabouts. Turbo

roundabouts are multi path roundabouts with winding street markings and separated circulating paths. They perform much superior about capacity and security than standard multi path roundabouts, whereas they don't require any extra space.

4.2 Geometrical redesign of “Ukraine” turbo roundabout

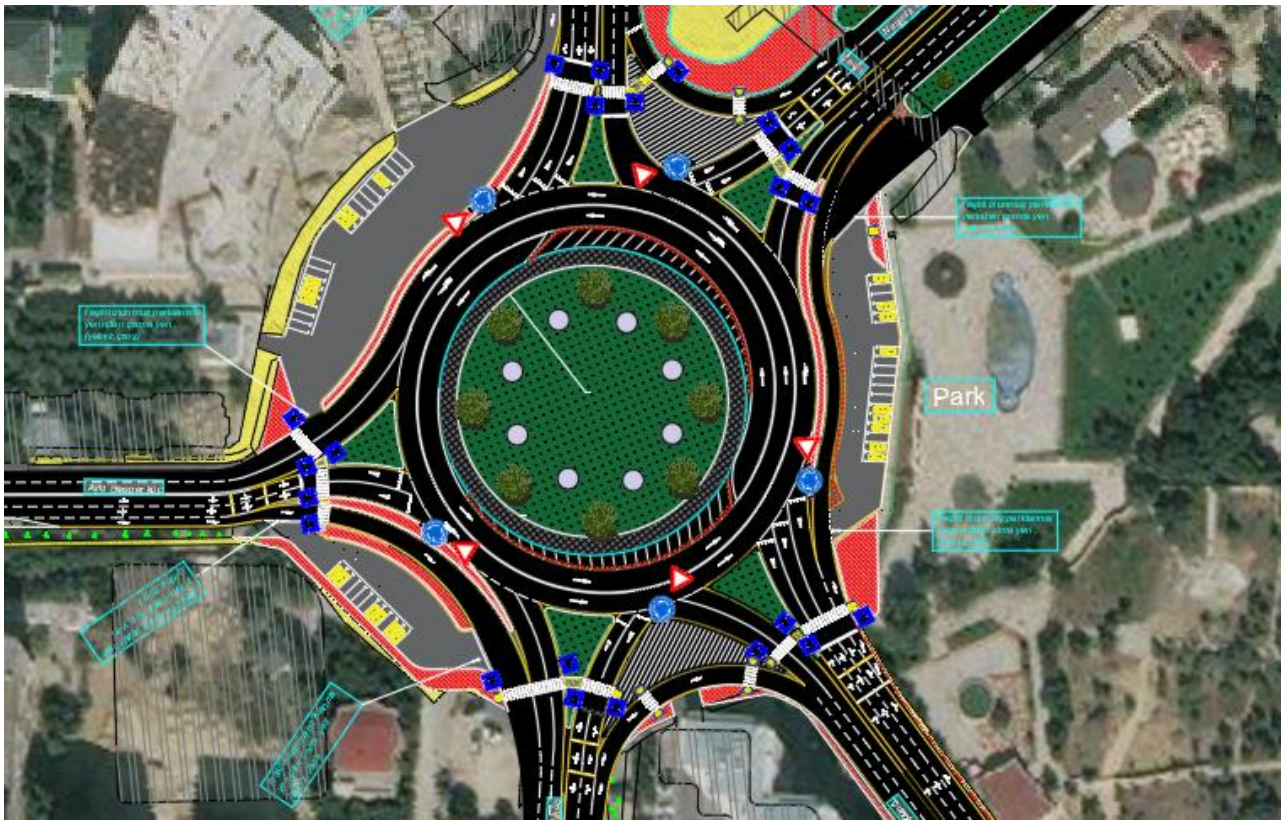


Figure 18 . *Geometrical plan view of the turbo roundabout.*

In this design the different sorts of turbo roundabouts are appeared, and their plan components clarified. There is 4 street which is connected in one intersection (Figure18). Ukraine roundabout is playing connection, todays. Neapol street is connecting from east, Ashiq Alasgar from west side, Mahammad Hadi from south and north and Vungtau from south as well. It is standard roundabout which is constructed 8

years before. Almost 2 years, the roundabout was renewed by engineers. However, there are many problematical situations. For example, not eligible with norms, more conflict area than normal roundabout, great parking area which is not safe. Once more, consistency and clarity within the plan may be a pivotal component to supply activity arrangement that empowers the street client to perform the specified, secure activity behavior. For any sort of circuitous, there are a few uncommon street clients that require consideration within the indirect plan: people on foot, open transport vehicles, crisis vehicles and additional huge vehicles. A brief area at the conclusion of this Manual covers signalized roundabouts, roundabouts that utilize activity signals to the activity stream productively and safely.

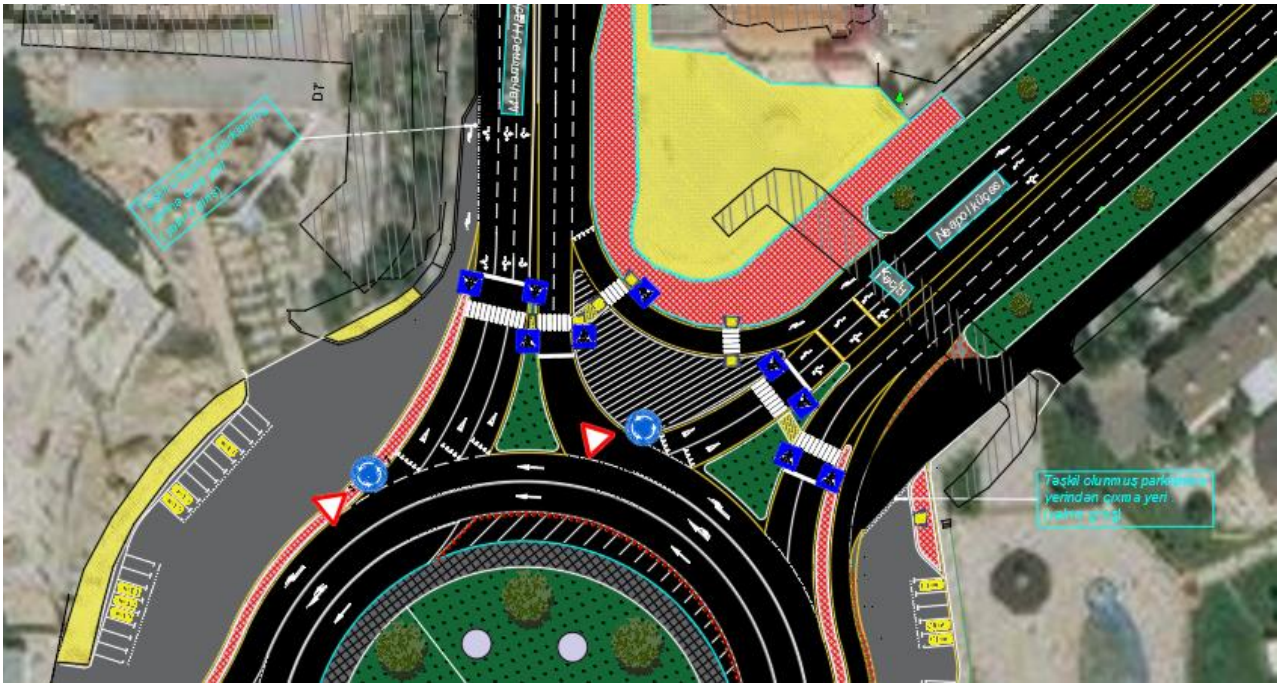


Figure 19. *Special part of the roundabout*

A form of the turbo roundabout directional arrow sign (R40.00 m) within the central island directs drivers to the proper and increments the conspicuity of the central island. Signage can too coordinate people on foot to assigned offices, drivers to their wanted lane, and communicate the nearness of raised controlling, such as a raised lane divider (in case one is utilized Figure 19). If the lane divider incorporates furrowed, finished, or brick asphalts, thought can be given to counting sign to caution street.

Asphalt markings might be utilized to depict the edges of the approach and circulatory paths. At long last, given the critical part signage and asphalt markings play for all clients of turbo roundabouts, it is vital that all activity control gadgets are compliant. Because of increase safe system and to be sure that all the

vehicles will move separately in their own lane safer we will use the numbers which we have shown in the next figure. In this figure you can easily meet that how the safer system used as a maximum interface. On behalf of these and safer system we did not change traditional width of the central island. We just modified some part of roundabout. Finally, we improved easy movement, especially for heavy vehicle can move regularly, if they will move on turbo lane of the roundabout. After that we used AutoCAD Civil, which we added specially command that is useful to see behavior of the heavy vehicles specially along the movement inside the roundabout.

Circular island diameter (m)	**Entry lane width (m)**	**Entry lane width (m)**	**Turbo lane width (m)**	**Circular lane width (m)**
80.00 m	**4.00 m**	**5.00 m**	**5.50 m**	**5.50 m**

Table 3. *Base geometrical features of Ukraine turbo roundabout.*

Cutting edge roundabouts can be among the most secure attainable intersection options in a wide assortment of settings and settings – low-speed urban, high-speed country, at separated crossing points, as passage medications, and indeed at compatibility slope terminal crossing points. Significant location characteristics that can impact whether a indirect could be a feasible elective incorporate right-of- way restrictions, crossing point skew, winter support needs, adjoining activity generators or destinations that require pre-emption, and downstream bottlenecks.

4.3 Signal Control and Vehicle Implementation in Microscopic Traffic Flow Simulation

The purpose of this section is to show and calculate different types of vehicle-actuated signal control and their implementation using in PTV Vissim simulation. In the first step accumulated all the count of vehicles (Table 4a, 4b, 4c), and specified their attribution (for example: cars, buses, huge vehicles). Then, start to implement all number to the vehicles input in the simulation. In the next step following to put vehicles routes which are going through turbo roundabout and finishing their routes. Moreover, with provided data's which is how to apply our cutting-edge knowledge to other projects in a reasonable way.

Traffic Data 1 (Wednesday 5 pm-6 pm)

		1	2	3	4	sum
from:		Neapol str	M.Hadi	Ashig Alaskar str	Vungtau str	
1	Neapol str	24	54	96	69	243
2	M.Hadi	22	17	68	111	218
3	Ashig Alaskar str	82	91	16	79	268
4	Vungtau str	90	128	95	13	326
sum		218	290	275	272	

a)

Traffic Data 2 (Tuesday 8 am-9 am)

		1	2	3	4	sum
from:		Neapol str	M.Hadi	Ashig Alaskar str	Vungtau str	
1	Neapol str	27	64	106	86	283
2	M.Hadi	32	17	77	125	251
3	Ashig Alaskar str	87	95	14	89	285
4	Vungtau str	110	129	105	13	357
sum		256	305	302	313	

b)

Traffic Data 3 (Saturday 9 am-10 am)

		1	2	3	4	
from:		Neapol str	M.Hadi	Ashig Alaskar str	Vungtau str	
1	Neapol str	27	74	106	89	296
2	M.Hadi	32	27	98	131	288
3	Ashig Alaskar str	102	121	26	99	348
4	Vungtau str	130	108	122	19	379
sum		291	330	352	338	

c)

Table 4 . *Vehicles inputs of Ukraine turbo roundabout for a) Wednesday b) Tuesday c) Saturday*
(all the numbers counted for 1 hour)

We picked up the standards that are briefly explained in our introduction course "PTV Vissim – Introduction to Microscopic Traffic Flow Simulation" (TR-T0201) and extend them with further theory and practical examples. We also covered the additional functions in PTV Vissim that are essential for professional traffic modelling. In order to configurate project as a default we modified the numbers as a week, we used new general volumes of vehicles (Table5).

Count: 6	No	Name	Link	Volu...	VehComp(0)
1	1	M.Hadi (north)	28	400,0	1: Default
2	2	Neapol str.	21	600,0	1: Default
3	3	Vungtau str.	16	500,0	1: Default
4	4	M.Hadi (south)	12	300,0	1: Default
5	5	M.Hadi (allign-road)	13	150,0	1: Default
6	6	Ashiq Alaskar str.	1	600,0	1: Default

Table 5. *General weekly volumes of Ukraine turbo roundabout*

After that, there are more identifications which is active resources of traffic flow calculated in other following steps. Parking lots are required also which we calculated by PTV Vissim. On behalf of all information's informed to inner balance of simulation we get all the results of delays and queues (Table 6). The extensive evaluation opportunities of traffic models in PTV Vissim are emphasized in this course. Moreover, efficient processing of projects with the scenario manager tool is another focus. We also modelling of parking lots and their effects on our simulation. Making videos from the simulation and different presentation ideas of the results including various 3D models are also demonstrated.

VehDelay(All)	VehDelay(10)	PersDelay(All)	PersDelay(10)	StopDelay(All)	StopDelay(10)	Stops(All)	Stops(10)	EmissionsCO	EmissionsNOx	EmissionsVOC	FuelConsumption
32,35	32,98	32,35	32,98	11,21	11,81	2,62	2,79	373,983	72,764	86,674	5,350
24,53	22,69	24,53	22,69	7,75	6,61	2,28	2,36	331,730	64,543	76,882	4,746
28,25	23,71	28,25	23,71	8,91	6,33	2,14	1,99	326,780	63,579	75,734	4,675
0,52	0,52	0,52	0,52	0,12	0,12	0,02	0,02	36,086	7,021	8,363	0,516
28,94	27,32	28,94	27,32	11,48	10,75	2,20	2,14	237,713	46,250	55,092	3,401
57,23	54,74	57,23	54,74	23,94	23,04	4,38	4,24	251,435	48,920	58,272	3,597
62,02	63,26	62,02	63,26	27,71	28,11	4,86	5,05	353,747	68,826	81,984	5,061
47,16	44,36	47,16	44,36	19,86	18,60	3,47	3,47	243,954	47,465	56,539	3,490
26,72	28,09	26,72	28,09	11,26	11,94	2,00	2,05	231,451	45,032	53,641	3,311
24,42	23,36	24,42	23,36	10,91	10,26	1,71	1,72	5455,093	1061,363	1264,271	78,041

Table 6 . *Vehicles delays of Ukraine turbo roundabout.*

In this figure we can easily see all the extension results which are regarding with vehicle delays, persistent delays, all stop spaces and stop delays as well. CO emissions, and the fuel consumption that causes them, are very sensitive to several factors. These factors include individual driving behavior, vehicle and roadway types, and traffic conditions. Because of these factors estimates CO emissions based only on a

single variable, such as trip distance, cannot provide an accurate estimate (Table 5). Rather, a comprehensive methodology that takes advantage using PTV Vissim latest vehicle activity measurements and detailed vehicle emission factors can create a more accurate emissions inventory for different types of vehicles and different levels of traffic congestion. The total emission of CO is 5455 m^3 for service of life of the turbo roundabout.

Count: 28	SimRun	TimeInt	Movement	QLen	QLenMax	Vehs(All)	Vehs(10)	Pers(All)	Pers(10)
1	37	0-3600	1 - 1@11....	3,97	63,53	83	72	83	72
2	37	0-3600	1 - 1@11....	3,97	63,53	0	0	0	0
3	37	0-3600	1 - 1@11....	0,00	5,40	65	65	65	65
4	37	0-3600	1 - 1@11....	3,97	63,53	78	72	78	72
5	37	0-3600	1 - 1@11....	3,97	63,53	195	174	195	174
6	37	0-3600	1 - 1@11....	3,97	63,53	177	160	177	160
7	37	0-3600	1 - 12@23...	8,71	78,65	76	69	76	69
8	37	0-3600	1 - 12@23...	8,71	78,65	144	134	144	134
9	37	0-3600	1 - 12@23...	8,71	78,65	70	63	70	63
10	37	0-3600	1 - 13@23...	0,04	6,36	158	147	158	147
11	37	0-3600	1 - 16@22...	0,03	12,12	127	119	127	119

Table 7 . *Total queue respect to the perspective queue of Ukraine turbo roundabout.*

The AM peak hour is used for VISSIM model's calibration. As can be clearly seen from Table 5, the total number of vehicles entering the traditional multilane roundabout is 2550 vehicles per 30 minute, which is a way higher than the regular capacity of a six-lane divided urban arterial in the study roundabout, however, carries 2550 vehicles per 30 minute, which corresponds to the capacity of uninterrupted flow highways in the state of Baku. That is, simply, due to the difference in driver's behavior and basic saturation flow rate between the two environments which all significantly affect roadway's capacity.

In terms of vehicle delay, it can be clearly noticed from Table 7 that there is a significant decrease in delay for vehicles traveling on minor approaches, M.Hadi St. & Ashiq Alasgar St., with a minimum decrease of 63% for NBL movement and a maximum decrease of 174% for SBR movement. We used the reduced TQP (*Total Queue Perspective*) to represent safety improvements, as seen in Table 7, before and after the application of the turbo design on the Ukraine roundabout under different radii and volumes. It is evident that adopting the turbo roundabout could improve the safety performance in most cases.For radii of 30–40 m with traffic volumes under 800 vphpe, the safety performance was enhancedby 40–60%. However, in some cases, the turbo design was not as good of a choice. Under highervolumes (>800

vphpe) with specific radii of 20–30 m, the safety improvement percentage varied within approximately 10% and even went negative. It follows that when traffic volumes in a roundabout are high, the effect of channelizing on safety is weakened. This is likely from the significantly enhanced proportion of rear-end conflicts due to the high traffic density in the road sections of entry, which limits the improvement results from decreased crossing and lane-change conflicts.

4.4 Simulation Runs

Recreation comes about gotten by VISSIM models ought to speak to the stochastic nature of field conditions. In other words, the normal of comes about gotten by different recreation runs for a VISSIM demonstrate ought to speak to the genuine normal of the show itself. The number of runs is essentially the least test estimate required to deliver substantial recreation comes about. To create beyond any doubt that the number of runs conducted by VISSIM yields comes about that are agent of the field conditions, an introductory number of ten runs with diverse seed numbers were to begin with accepted to run the reenactment show and calculate the normal and the standard deviation of activity volumes at each section and exit approach of the crossing point beneath thought. The examination uncovered that the ten reenactment runs were satisfactory and created worthy dispersions within the activity entry designs. In common, ten runs are continuously prescribed and conducted in VISSIM models to create measurably substantial and dependable comes about.

VISSIM parameter	Default value	Calibrated value
Average standstill distance	2 meters	1.1 meters
Additive part of the safety distance	2	1
Multiplicative part of the safety distance	3	2
Advanced merging	Checked	Unchecked
Front gap	0.5 seconds	0.1 seconds
Rear gap	0.5 seconds	0.1 seconds
Safety distance factor (Conflict areas)	1.5 meters	1.0 meters
Minimum gap time	3 seconds	2.5 seconds

Table 8. *VISSIM calibration parameters.*

Manual calibration of VISSIM demonstrate is performed, where it is primarily a trial and blunder method (Table 8). Each calibration parameter in VISSIM is changed exclusively, taken after by entering the recreated degree of viability (MOE) of each trial in a spreadsheet. When one parameter is being balanced, all other parameters are held steady at default values. A few trials are conducted utilizing diverse parameters of car-following show, path alter show, need rules, and strife zones until the recreation demonstrate accomplishes the calibration objective or target.

4.5 "Ukraine" standard roundabout type

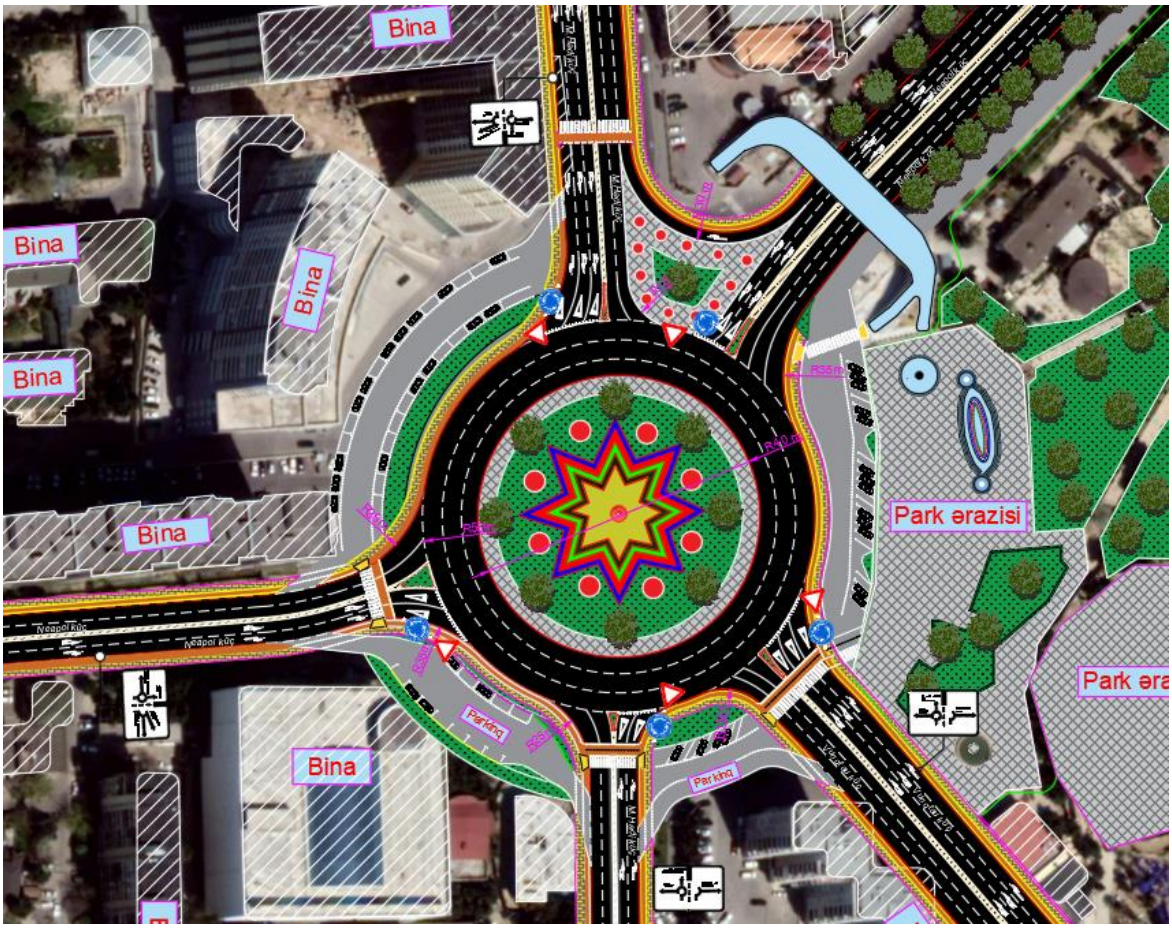


Figure 20 . *Geometrical plan view of the standard roundabout.*

This section describes the fundamental design principles of standard roundabouts for the redesign project "Ukraine" roundabout. Guidelines for the design of each geometric element are provided in the following section. However, standard roundabout project will not appropriate one for the Ukraine redesign layout.

Because, in this project we will evaluate also bicycle lane . But, in this area there is no any connection bicycle area. It was one of the problem for the continuous lanes of bicycle lanes. As you see in the project there is a lot of parking lots. The design of standard roundabout approximately the same modification with turbo roundabout layout. Because there is also 3 circular lane in the roundabout. All the parking lots are configured as the turbo roundabout . In a multilane standard roundabout, the vehicles in the entry are aligned toward the central island or the truck apron, the vehicle on the right is pointed toward the inside lane and tends to go in that direction, while the vehicle on the left tends to be squeezed to the right toward the vehicle on the right. Avoid a design that aligns an entering vehicle at the incorrect lane in the circulatory roadway. As a vehicle enters the circulating roadway it should be headed directly toward its respective lane within the circulating roadway. For multilane roundabouts, if inside lane is pointing at truck apron this is also considered to be path overlap. If right entry lane is pointing to left circulatory lane, then there is path overlap.

Roundabout operation performance is dependent on low, consistent vehicle speeds. Low and consistent operating speeds facilitate appropriate gap acceptance by an entering driver. Design for travel lane operating speeds between 15 mph and 25 mph . Design to have low-speed differentials (12 mph or under) between entering and circulating traffic. In this roundabout layout might have higher speeds along their respective travel lane, but generally 30 mph or less. The ideal design speed mechanism has the entry and circulating speeds being similar. This varies due to size, shape and context of the roundabout. Determine which truck percentage defaults are to be used (recognizing that truck percentages can range from 5% to 15%) so that different segments can be modeled accurately.

Provide bicyclists with similar options to negotiate roundabouts as they have at other intersections. Consider how they navigate either as motor vehicles or pedestrians depending on the size of the intersection, traffic volumes, their experience level, and other factors. Bicyclists are often comfortable riding through single-lane roundabouts in low-volume environments in the travel lane with motor vehicles, as speeds are comparable and potential conflicts are low. At larger or busier roundabouts, cyclists may be more comfortable using ramps connecting to a sidewalk around the perimeter of the roundabout as a pedestrian. Where bicycle lanes or shoulders are used on approach roadways, they should end before the geometry changes the approach to the roundabout.

Conclusion

Based on the over investigation on highlights of the turbo plan in terms of security and productivity for Ukraine turbo roundabout, investigated information and approximate numbers for actualizing a turbo plan for a five-leg (Neapol str, Ashiq Alaskar str, M.Hadi (north) and M.Hadi (south) and Vungtau str circuitous development are given as follows:

1. A turbo plan can move forward the security execution in most volume conditions. Be that as it may, when the volume is 800–1100 vphpe with a 20–30 m sweep, adjusting the turbo plan does not make a calculable distinction and can indeed cause execution debasement. For more useful security enhancements, the situation with radius of 40–50 m and activity volumes beneath 800 vphpe is prescribed for applying the turbo plan. It is critical to take off sufficient space for each vehicle to dodge rear-end clashes so that the security advantage through channelization can be maximized.
2. There may be an impediment of the turbo plan when considering transportation productivity. Huge volumes with Ashiq Alaskar and Neapol streets huge radius may result in noteworthy delays compared with plans without channelization. The delay for the most part comes about from holding up for an worthy crevice at the section.
3. Disorderly lane changes at street segments of section ought to be dodged in hone, as they may produce the underutilization of path spaces and rear-end behavior due to activity squares. It is fundamental to rules to decrease the act of changing paths over numerous channels, particularly for HGVs and buses. In rundown, this article given a security and proficiency advancement investigation for a five-leg circuitous some time recently and after a turbo plan as connected to diverse geometric and activity volume scales.

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