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ASSESSMENT OF SPECIAL PLANS AND TECHNICAL DESIGNS WITH REGARD TO TRAFFIC SAFETY

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Abstract. Traffic safety situation in Lithuania, despite the progress made in 2008, is still not good enough compared to the other European Union countries. Therefore, Lithuania implements the traffic safety improvement measures affecting all the elements of the traffic safety system "Road user–road–vehicle". In 2008 Lithuania started implementing the road safety audit procedure which substantially contributes to the improvement of safety situation on Lithuanian roads. This article gives the analysis of road safety audits of special plans and technical designs for road construction and reconstruction in Lithuania, makes the analysis of the main deficiencies of plans and designs and gives recommendations for their elimination.

Keywords: traffic safety, road traffic accidents, road safety audit.

1. Introduction

Improvement of traffic safety situation in Lithuania as well as in other European Union (EU) countries still remains a priority field of transport development. A large number of people killed and injured on the roads oblige both the specialists and the scientists to pay a special attention to solving the traffic safety problems. Road accidents cause large moral and economic losses. The analysis carried out by Elvik (2000) showed that accident losses make 1–2% of GDP. Taking into consideration this especially sore problem, the European Commission in its White Paper of 12 September 2001 *European transport policy for 2010: time to decide* pursued from 2001 to 2010 the ambitious goal of reducing the number of deaths on the road by 50%.

Lithuania, having joined the EU as a full member on 1 May 2004, has also undertaken general obligations in the field of traffic safety: to make a reach for improving the road infrastructure safety in the trans-European road network and until 2010 to reduce the number of accidents by 50%.

Based on the data of *European Transport Safety Council,* in 2008 the road accidents killed 39,000 people in the EU member-states, i.e. 15,400 people less than in 2001, and this makes 28.31%. These numbers show that the goal of the European Commission (–50%) will be difficult to achieve.

In 2008 Lithuania succeeded not only to curb the increasing number of accidents but also to significantly reduce it. Based on the data of *European Transport Safety Council,* during 2008 Lithuania (–33%), Estonia (–33%), Slovenia (–27%) and Latvia (–25%) made the largest people progress in reducing the number of killed and injured people on the roads; however, Lithuania still has the largest accident rates between the EU countries.

Such a significant reduction of the number of accidents and their victims in 2008 in our country was influenced by integrated measures, such as: more active road user control and tightened penalties for the violations of Traffic Rules, well-organized educational activities, large attention to the road infrastructure and the engineering traffic safety improvement measures, etc.

Though the main accident causes are related to a wrong behaviour of road users (speeding, driving under the influence of alcohol, using no seatbelts), in order to achieve the goals of traffic safety, it is necessary to take measures related not only to the road user but also to other elements of traffic safety system – road and vehicle.

To implement the above-mentioned goals of European Commission the European Parliament and the Council adopted a *Directive on Road Infrastructure Safety Management* (2008) which established four procedures related to the management of road infrastructure: road safety impact assessments, road safety audits, road safety inspections and determination of road safety level. According to the European Commission (2005), the implementation of the new Directive on infrastructure safety has the potential of saving 600 lives and avoiding 7000 serious injuries every year across the EU in the TEN-T network.

Road safety audit in Lithuania started to be implemented from 1 July 2008. At present it is regulated by the *Law on Road Traffic Safety of the Republic of Lithuania* and the subsequent legal acts – *Road Safety Audit Requirements* and *Procedure for the Implementation of Road Safety Audit*. Taking into consideration the fact that the mentioned national legal acts were adopted earlier

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than the *Directive* (2008), they are to be amended or supplemented according to the *Directive* requirements. This is especially related to the education of road safety auditors. Based on the *Directive*, each EU member-state shall approve the program of road safety auditors (until 19 December 2011).

The pioneers of the road safety audit are the British traffic engineers. The idea of applying audits procedure was initiated when the safety engineers realized that it is possible to prevent road accidents by checking road projects with regard to traffic safety. Adopting the principle „prevention is better than cure", the safety engineers decided to use their experience in road projects. Thus, the road safety audit, as an accident prevention measure, the British specialists started to implement in 1980. In 1990 these audits started in Australia and New Zealand. The audit geography has enlarged and in 1994 the road safety audit started in Denmark, in 1997 – in North America as a preventive measure (Belcher *et al*. 2008). At present the road safety audit has been used in many countries. The procedures, methodology and principles of such audits of different countries are very similar.

2. Road safety audit in Lithuania

Based on the *Law on Road Traffic Safety of the Republic of Lithuania* and its established order for implementing road safety audits, a comprehensive technical inspection of safety characteristics of a road project shall be carried out in all the stages of project preparation and implementation, starting with a planning stage and finishing with the road maintenance works, also the assessment of the road condition with regard to traffic safety shall be carried out during road operation.

The main goals of road safety audit are:

- to reduce accident risk, the number of victims and the severity of injures;
- to assess the road project with regard to traffic safety taking into consideration all the road users (drivers, pedestrians, cyclists, etc.) and to give recommendations for the elimination of deficiencies;
- to seek that the issues of traffic safety become part of road planning and design.

Safety audit can be applied to all road projects, i.e. for a newly constructed or reconstructed road, rural road or the road crossing a built-up area.

Based on the current Lithuanian legal acts, all the road projects can be subject to auditing, however, if the road project satisfies at least one of the below criteria, the road safety audit is obligatory:

- the road is part of trans-European road network;
- the project for the construction or reconstruction of a new road;
- the project for the junction reconstruction;
- the project for the implementation of traffic safety improvement measures;
- the road section contains a black spot or it is a high-accident section;
- the road section crosses a built-up area.

The above criteria describe namely those projects which have or may have the largest influence on traffic safety. With the change in road environment and traffic organization the road user's behaviour also changes. How will the road user behave on the road after project implementation? Will the road environment be understandable to him? And is the road designer, implementing the ideas of the road owner, professional and competent enough to ensure that all of us get the expected result: safe and comfortable traffic conditions on roads and streets?

The important factor is that the specialists involved in the road safety audit are independent, i.e. they cannot serve as project managers or developers of the project audited, or otherwise participate in designing. This is aimed at ensuring a transparency of the audit procedure: unbiased identification of project deficiencies and audit proposals.

Proposals given by the auditors are of a recommendatory character and the final decisions on the implementation of alternatives given by the audit and on the approval of audit proposals are taken by the road owner.

The audits identify potential safety hazards typically under different grades of severity, for example, "problem" or "warning". The auditor or audit team report to the client's project manager, who will, when necessary, then instruct the scheme design team to respond with alternative designs (Slinn *et al*. 2005).

As mentioned above, the assessment of road construction and reconstruction projects with regard to traffic safety is a new subject in Lithuania. However, in the field of construction, especially in renovation of buildings, for a number of years already the scientists have been using certain methodologies for the assessment of indicators to identify the most effective renovation methods (Zavadskas, Antuchevičiene 2007; Ginevičius *et al.* 2008; Zavadskas *et al.* 2008a, b).

3. Results of assessing special plans and technical designs and result analysis

In Lithuania road safety audit was started on 1 July 2008. 50 road safety audits were carried out in the second half of 2008. The specialists of the Department of Roads of Vilnius Gediminas Technical University made the analysis of the reports of safety audits implemented and determined the main recurring mistakes (or deficiencies) of designers with regard to traffic safety.

3.1. Special plans and technical designs selected for the assessment

In the preparation of special plans and technical designs for the road construction or reconstruction the designers follow the current standards, various normative documents, also their experience and intuition to design the object under existing conditions that are usually limited by the implementation cost of design solutions and possibilities of land alienation. Due to those reasons the decisions taken during a design process are not always the best with regard to traffic safety.

For the analysis of road safety audits the following assessment criteria were used:

- road environment (service structures intended for road users, pedestrian-bicycle paths, road structures, plantings, other structures);
- speed limit, interval of driving speed;
- number and width of traffic lanes;
- types of junctions and distances between them, exit roads;
- horizontal alignment and longitudinal section;
- cross sections of the road;
- illumination of the road or junction;
- road signs and road markings;
- engineering traffic control measures (guardrails, fences, islands, etc.).

In order to assess the most frequent problems related to traffic safety and to present possible solutions 6 special plans and 17 technical designs of main and national roads of national significance were selected prepared by the specialists of the same group of designers.

3.2. Results of assessing special plans

When analyzing the results of safety audits of special plans, the determined deficiencies were distributed by the road user (Fig. 1).

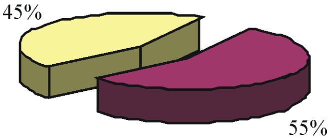

Fig. 1. Distribution of traffic safety deficiencies by the road user

Table 1 shows the distribution of traffic safety deficiencies in special plans based on the assessment criteria.

Analysis of the distribution of traffic safety deficiencies in special plans showed that almost half of the deficiencies are related to the road environment (Fig. 2). Most frequently pedestrian and cyclist safety is not ensured. Taking into consideration the fact that in Lithuania more than one third of the accidents is made by running on pedestrians, a special attention must be paid to ensure their safety. Assurance of pedestrian safety is a topical issue not only in Lithuania. This is a prevailing type of accidents in many countries. Antov *et al.* (2007) emphasized that the main task considering pedestrian safety is to lower the casualty rate for pedestrian crossing. Most of the pedestrian accidents occur in urban areas. Elderl pedestrians, drunken pedestrians and pedestrians in darkness are important target group in treatments against fatal

Table 1. Distribution of traffic safety deficiencies in special plans based on the assessment criteria

Special plan	Assessment criteria: Horizontal alignment and longitudinal section	Cross section of the road	Number and width of traffic lanes	Junctions and exits	Traffic signs, road markings	Engineering traffic control measures (guardrails, fences, islands, etc.)	Road environment (service structures aimed at road users, pedestrian-bicycle paths, stops, etc.)	Speed limit	Illumination of road or junction
1	–	1	–	–	–	–	4	–	–
2	–	–	–	–	–	1	1	1	–
3	–	1	–	–	–	1	–	–	1
4	–	–	–	–	1	–	2	1	–
5	–	1	–	–	–	1	1	–	1
6	–	–	–	–	1	–	3	1	–
Total	–	3	–	–	2	3	11	3	2

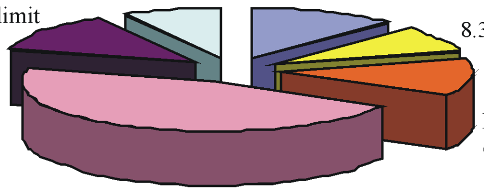

Fig. 2. Distribution of traffic safety deficiencies in special plans based on the assessment criteria

accidents. Thus, it is highly needed to introduce new modern standards in pedestrian crossing design in order to lower speeds and improve driver's visibility in the vicinity of pedestrian crossings

Also, a certain attention should be paid to a safe pedestrian and cyclist traffic within the junction zone. A designer, when designing pedestrian and cyclist traffic within the junction zone, should take into consideration not only the existing traffic volume and the intersecting roads but also attraction objects (shops, schools, etc.) surrounding the junction. Within the roundabout zone pedestrian paths are designed, on the separating islands – pedestrian passages. Project analysis showed that pedestrian crossings are withdrawn too far from roundabouts, therefore, it is likely that the pedestrians wishing to cross the road will choose the shortest way and cross the road very close to the junction where no pedestrian crossing has been designed.

Analysis of special plans also indicated that in designing roundabouts the impact of central island geometry on traffic safety is not taken into consideration. It was noticed that the designers pay insufficient attention to the need of engineering traffic control measures.

Islands on roundabouts serve a function of speed reduction, thus, make the effect on traffic safety (Fig. 3). The clearly and remotely visible central island of a roundabout is recognized as an obstacle and the driver, when approaching the junction, starts to timely reduce speed. Otherwise, when the island is flat and insufficiently marked it can happen that the driver will notice it too late and will start to sharply brake, thus, causing accident situation. It is also recommended that the central island would visually restrict the road behind the junction. Accordingly, in a dark period of the day the driver will not be blinded by the lights of oncoming vehicles and will recognize the change in a road trajectory. Thus, it is suggested to provide junctions with an elevated central island or to properly plant them.

Fig. 3. Roundabouts with the elevated central island visually restricting the road continuation

Lithuanian legal acts set no regulations for the construction of central islands at roundabouts, therefore, it is recommended to follow the foreign practice. For example, the World Road Association PIARC gives the following recommendations for the design of central islands at roundabouts.

Inside the central island:

1. In rural areas the following elements should be avoided, at least for new roundabouts:

- aggressive, rigid, compact obstacles: rock, stone or concrete sculptures, lampposts, storm drainage fixtures, trees (not bushes), etc;
- elements liable to abruptly block an out-of-control vehicle: ditches, barriers, slopes above 15%, walls, non-mountable curbs that may act as a launching pad and increase accident severity, especially for two-wheelers.

The above does not prevent some conditioning of the central island for other purposes (perceptibility, decoration): a gentle fill (less than 15%, low shrubbery, light or fragile sculptures, waterspouts, etc.).

2. In urban areas the similar principles should be applied with some variations:

- slope can be increased up to 25%;
- somewhat more aggressive obstacles may be tolerated (under specific circumstances).

If the elevated separating islands to be installed on the adjoining roads of a roundabout are analyzed, it should be noted that by safety considerations they should be longer. The main functions of these islands are to separate the entering/exiting traffic flows to/from the roundabout, to increase roundabout capacity, to facilitate the crossing of lane for pedestrians and cyclists, also, this is the place to position traffic signs (World Bank 2005). Besides, a separating island turns the driver‘s attention that he is approaching a roundabout and has to reduce speed. Depending on the length of the island and its distance to the circle, vehicle braking intensity changes. When a separating island is long, braking is softer, speed is reduced gradually. This is especially relevant to rural roads.

3.3. Results of assessing technical designs

When analyzing the assessment results of technical designs for road construction and reconstruction with regard to traffic safety, the determined deficiencies were distributed by the road user (Fig. 4).

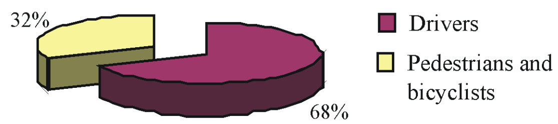

Fig. 4. Distribution of traffic safety deficiencies in technical designs by the road user

The analysis of technical designs with regard to traffic safety showed that in technical designs same as in special plans the largest part of traffic safety deficiencies are related to the road environment, especially to the assurance of pedestrian and cyclist safety (Fig. 5).

When the selection of engineering traffic safety measures was assessed it was noticed that the designers should be better familiar with the selection possibilities of safety measures and their efficiency.

Table 2. Distribution of traffic safety deficiencies in technical designs based on the assessment criteria

Technical design	Assessment criteria								
	Horizontal alignment and longitudinal section	Cross section of the road	Number and width of traffic lanes	Junctions and exits	Traffic signs, road markings	Engineering traffic control measures (guardrails, fences, islands, etc.)	Road environment (service structures aimed at road users, pedestrian-bicycle paths, stops, etc.)	Speed limit	Illumination of road or junction
1	–	–	–	-	1	1	5	1	–
2	2	–	–	2	–	–	2	–	–
3	–	–	–	1	–	–	1	–	–
4	2	1	2	1	1	1	2	1	–
5	2	–	–	1	4	1	3	–	1
6	2	–	–	2	–	4	6	2	–
7	–	1	–	1	–	–	3	–	1
8	–	1	–	1	1	–	1	–	1
9	1	–	1	–	1	-	1	–	–
10	–	–	–	5	5	1	4	1	–
11	–	1	1	–	1	–	–	–	1
12	2	1	–	–	–	–	1	–	1
13	2	–	–	1	–	–	2	–	–
14	1	–	–	1	2	2	4	1	–
15	–	1	–	–	1	–	2	–	1
16	–	–	–	3	–	1	1	–	-
17	–	–	–	1	1	1	3	–	-
Total	14	6	4	20	18	12	41	6	6

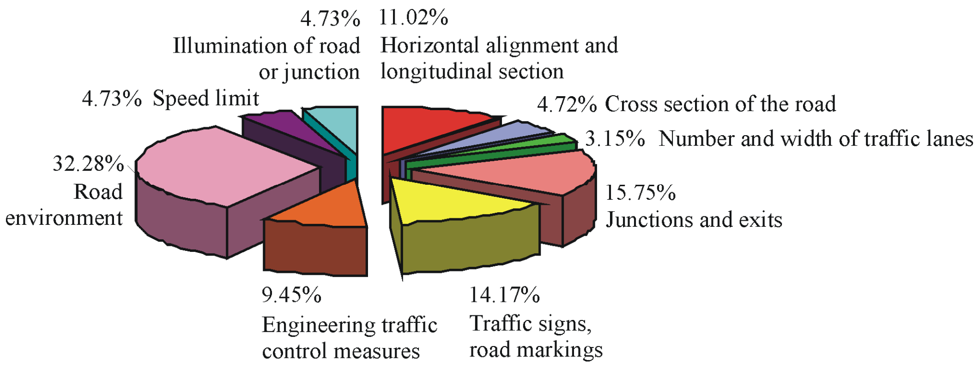

Fig. 5. Distribution of traffic safety deficiencies in technical designs based on the assessment criteria

Seeking for accurate results and objective conclusions the analyzed traffic safety deficiencies in technical designs were divided into two groups – deficiencies in junctions and deficiencies on road sections.

3.3.1. The most frequent traffic safety deficiencies in junctions

The most frequent and recurring deficiencies in the technical designs of junctions with regard to traffic safety are as follows: 1) diameters of roundabouts; 2) cross-section of the central island; 3) junction visibility in a dark period of the day; 4) pedestrian-bicycle paths in a roundabout, and 5) influence of deceleration lanes on traffic safety in a three-branch junction.

The driving conditions in a roundabout or its approaches are regulated by the properly selected junction diameters: width of entrances and exits, turning radius R, right angle of adjoining roads, etc.

Roundabouts can contribute to increase road safety in the following ways (Elvik, Vaa 2004):

- by theoretically reducing the number of conflict points between the traffic flows passing through an intersection from 32 to 20 at crossroads and 9 to 8 at T-junctions;
- road users entering a roundabout are required to give way to road users already in the roundabout, no matter which road they are coming from, and thus are forced to observe traffic at the roundabout more carefully;

- all traffic comes from one direction. Road users therefore do not have to observe traffic from several directions at the same time in order to find a gap to enter the roundabout;
- roundabouts with offside priority eliminate left-turns in front of oncoming traffic;
- roundabouts are built so that road users cannot drive a straight path through the junction but must drive round a traffic island located in the middle of the junction and this reduces speed.

In accordance with Brabander and Vereeck (2007), in general, roundabouts are found to reduce the number of injury accidents by 39%, severe injury accidents by 17% and light injury accidents by 38%. But the safety impact differs significantly depending on the speed limit regime and the pre-roundabout signalization situation as well as the road user type. Roundabouts are most effective at intersections with high speed limits on the main and adjacent road.

The excessively wide roundabout exits that were noticed in the studied projects accommodate two vehicles, therefore, it is likely that there will be drivers wishing to overturn a slower vehicle and this gives a possibility to cross the roundabout in a too smooth trajectory, thus, the speed in the roundabout and on the exits will be too high.

To solve this problem two solutions are suggested:

- to narrow the entrances and exits of a roundabout;
- the entrances and exits of a roundabout should have as right angles as possible.

Problems related to the cross-section of the central island in the technical designs remain the same as in special plans and the same earlier described proposals for the traffic safety improvement are valid.

Assurance of junction visibility in a dark period of the day is a very important factor in respect of road safety. On Lithuanian roads in a dark period 35.26% of drivers are killed and even 67.82% – of pedestrians. The drivers travelling in darkness can notice the junction too late and enter it at high speed or ahead of the other vehicles. Analysis of the designs showed that in order to ensure junction visibility in darkness the only measures used are reflecting traffic signs and plastic pylons with reflecting strips. From the traffic safety point of view it is suggested to provide junction zone with illumination. It is especially important for the junctions with a high volume of vehicles and pedestrians.

Due to a large number of pedestrian-involved accidents a special attention should be paid to a safe traffic of pedestrians and cyclists in the junction. Analysis of the road safety audits showed that the intersection of pedestrian-cycle path and the road is designed too far from the junction. Having exited the junction the vehicle will start to gather speed, thus, it will pass the intersection of pedestrian-cycle path and the road at a higher speed than at the junction. It is suggested that the intersection of pedestrian-cycle path and the road is designed more close to the roundabout (at about 5.00 m distance from a circular traffic lane) where the speeds are lower.

The effect of deceleration lanes on traffic safety in a three-branch junction. Deceleration lane widens the junction zone and encourages the drivers to move at a higher speed. Vehicles on a deceleration lane reduce a visibility distance for the drivers on the minor road since they obstruct vehicles on the main traffic lane (Fig. 6), therefore, vehicles on the main road can get no priority. Taking this into consideration it is suggested not to design the right-turn deceleration lanes.

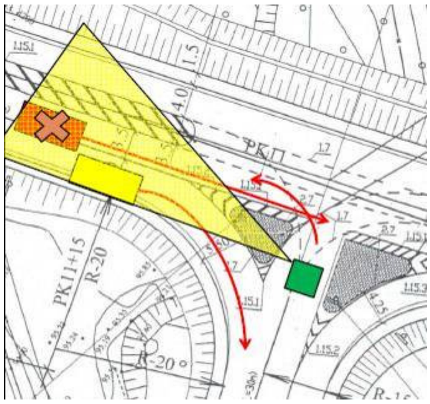

Fig. 6. Visibility distance of a driver on the minor road

Layout of diverting islands in a three-branch junction has a large influence on traffic safety. Fig. 7 shows the potential conflict points. Number 1 represents the point of possible vehicle collisions since the carriageway between the islands is narrow, and the stop line on the minor road is not clear. Therefore, the entering and exiting vehicles here block the driving trajectories of each other. Due to that collisions with the vehicles of the main road are possible since the blocked vehicle will stand on the main traffic lane. Number 2 also indicates the point of possible vehicle collisions since the traffic organization scheme can cause a complicated priority situation.

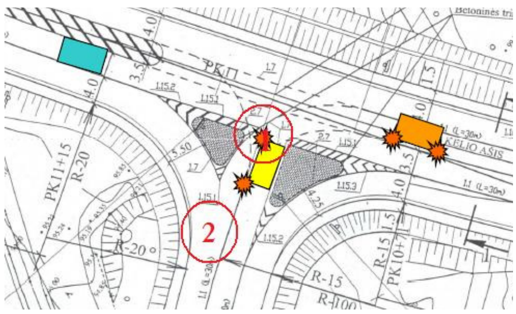

Fig. 7. Influence of diverting islands on traffic safety in a three-branch junction

In order to solve this problem, it is suggested instead of diverting islands to design one separating island which would separate oncoming flows (Fig. 8).

The four-branch junctions are distinguished for a considerably large number of conflict points and the comparatively high speeds. Besides, in our analyzed designs the selected junction schemes are also distinguished for a wide carriageway – large number of traffic lanes causing a complicated and obscure traffic situation. In a junction where several traffic lanes shall be crossed, the

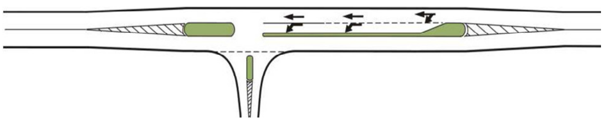

Fig. 8. The recommended scheme of a three-branch junction

traffic conditions become very dangerous, since it is necessary to cross a wide carriageway and the driving trajectories become complicated. Therefore, many accidents take place where the vehicles of the minor road do not give right of way to the vehicles of the main road. In order to prevent these traffic safety problems, it is recommended to modify a four-branch junction into the roundabout or two three-branch junctions. If there is no possibility to modify the type of junction, it is suggested to provide a four-branch junction with separate left-turn traffic lanes on the main road and to duplicate the straight-on trajectories with the right-turn trajectories. Also, to install the elevated separating islands on the main and minor roads (Fig. 9).

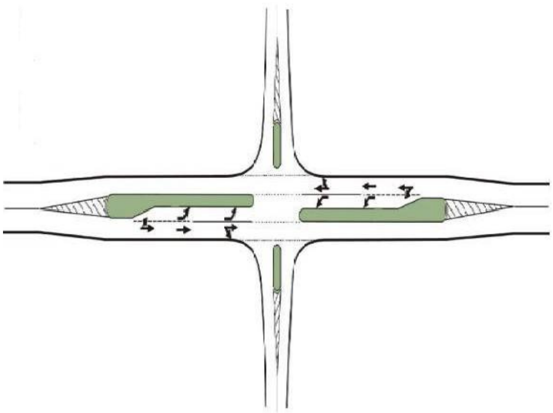

Fig. 9. The recommended scheme of a four-branch junction

3.3.2. The most frequent traffic safety deficiencies on road sections

Analysis of technical designs indicated that the most frequent traffic safety deficiencies related to the engineering speed reduction measures are as follows:

- improperly selected slope gradients of the speed humps allowing the drivers to pass them at a higher speed than the speed limit;
- too large distances between the speed humps allowing the drivers to gather speed and to pass the road section between the humps at too high speed.

Seeking solution of these problems it is suggested in selecting the gradients of humps and distances between them to take into consideration the speed limit of a road section (Table 3).

In order to ensure pedestrian safety, it is recommended to install pedestrian crossings on the elevated pavement (6–12 cm). Before each pedestrian crossing or before the whole road section to erect the corresponding warning signs which would warn the drivers about the elevated pavement. The aim of this solution is:

- to reduce average speed since the elevated pavement also serves the functions of speed reduction. This will help to lower the risk for vehicle to run on pedestrian at the crossing and in case of accident due to the lowered speed the accident severity will be reduced;
- to encourage pedestrians and cyclists to cross the road at the pedestrian crossing since the crossing is conveniently joined to the shoulder.

Table 3. Dependency of the parameters of humps and distances between them on vehicle speed

Vehicle speed, km/h	Gradients of slopes of speed reduction humps	Distance between the humps, m
60	1:25	100–200
50	1:20 – 1:15	
30	1:10	50–100

Each traffic safety measure implemented must give a certain benefit to the public. Therefore, before implementing the suggested measures it is necessary to determine their impact on traffic safety. The main objective of the road safety assurance activity is to plan measures which would help to avoid painful consequences of road accidents and to reduce the cases of wrong behaviour of the road users (Ratkevičiūtė *et al*. 2007).

It should be noted that today Lithuania has no recommendations on the implementation of engineering traffic safety improvement measures to explain in which case one or another measure should be used. In view of this and taking into consideration the fact that the designers' mistakes are constantly repeated, it is worth organizing seminars or training courses for designers to make them familiar with modern safety improvement measures, possibilities of their use and their effect.

Conclusions

1. In recent years Lithuania, like many EU member-states, pays a particular attention to the issues of traffic safety. In order to ensure safe and comfortable traffic conditions within the whole Lithuanian road network and to reach general goals of the European Union, the active measures have been undertaken in the field of road user education, transport and engineering.

2. Traffic safety situation in Lithuania, despite a large progress made in 2008, is still not good enough compared to other EU countries. Therefore, on high-accident road sections more and more effective traffic safety improvement measures must be implemented.

3. Lithuanian national legal acts related to the road safety audit must be amended according to the regulations of the Directive 2008/96/EC of the European Parliament and of the Council of 19 November 2008 on Road Infrastructure Safety Management.

4. Road safety audit is not expensive but very valuable measure to ensure traffic safety on roads. This

measure helps to optimally save money, time and the most important – to save lives.

5. Traffic safety deficiencies in special plans and technical designs determined during the road safety audits are often initiated by the client's wishes and project implementation possibilities that are limited by the project implementation cost and land alienation problems.

6. Analysis of the results of safety audits of special plans and technical designs showed that traffic safety deficiencies are distributed almost evenly if the groups of road users are taken into consideration.

7. Most traffic safety deficiencies determined by analyzing the results of safety audits of special plans and technical designs, as well as suggestions for their elimination, are recurring.

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SPECIALIŲJŲ PLANŲ IR TECHNINIŲ PROJEKTŲ VERTINIMAS SAUGAUS EISMO POŽIŪRIU

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S a n t r a u k a

Eismo saugumo situacija Lietuvoje, nepaisant 2008 m. pasiektos pažangos, vis dar yra nepakankamai gera, palyginti su kitomis Europos Sąjungos šalimis. Atsižvelgiant į tai, Lietuvoje įgyvendinamos eismo saugumo gerinimo priemonės, darančios įtaką visiems eismo saugumo sistemos „Eismo dalyvis–kelias–transporto priemonė“ elementams. Lietuvoje 2008 m. buvo pradėta taikyti kelių saugumo audito procedūra, kuri prisideda prie eismo saugumo gerinimo Lietuvos automobilių keliuose.

Straipsnyje pateikta Lietuvoje atliktų specialiųjų planų ir automobilių kelių tiesimo bei rekonstrukcijos techninių projektų kelių saugumo auditų analizė, išanalizuoti pagrindiniai planų ir projektų trūkumai, pateiktos rekomendacijos jiems šalinti.

Reikšminiai žodžiai: eismo saugumas keliuose, eismo įvykiai, kelių saugumo auditas.

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