

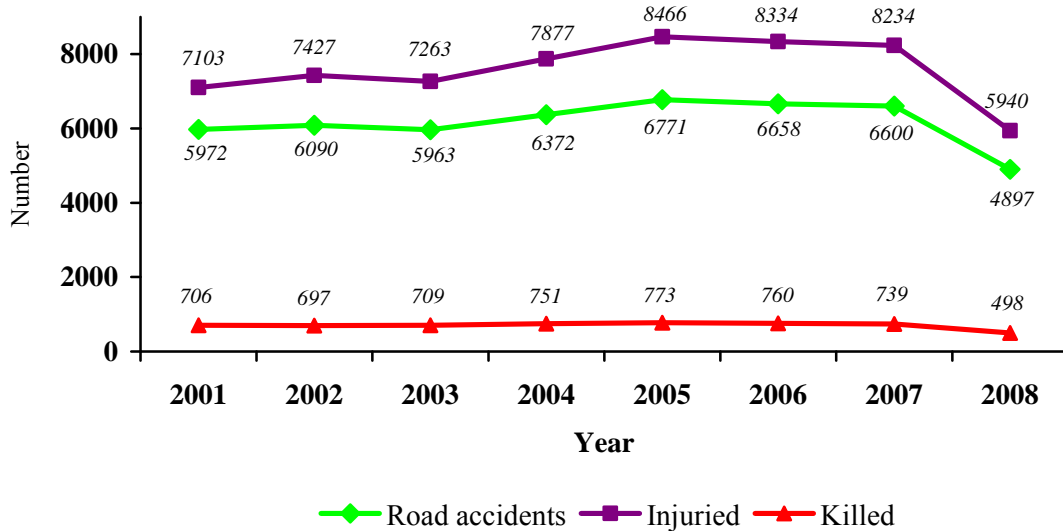
# ROAD SAFETY PROBLEMS ON THE LITHUANIAN ROAD SECTIONS WHICH CROSS BUILT-UP AREAS

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**Abstract.** Analysis of the safety situation on Lithuanian roads shows that the main indicators of road safety in our country are the worst, if compared to the other EU countries. Therefore, it is necessary to implement more effective measures for improving the road traffic safety. The Department of Roads of the Vilnius Gediminas Technical University carried out the evaluation of the efficiency of road safety improvement measures on Lithuanian roads. For this purpose, data on the effects of road safety measures was collected and analyzed for the road sections where the measures had been implemented. The article presents road safety problems on the Lithuanian road sections which cross built-up areas. Authors give some solutions for improving road safety situation, invoke particular computer programs for road planning and design.

## Introduction

At present assurance of road traffic safety is one of the most important tasks of the transport sector in Lithuania and the whole EU. In 2000 the Transport Ministers of EU states committed to reduce the number of people killed in road accidents by 50 % from 2001 until 2010. The participating countries one after another approved these commitments on a national level. Such countries as Portugal, Sweden, Netherlands, Denmark, Germany and partly Italy are on the right way in achieving their goal. However, in Lithuania the safety situation was not changing until the year 2008 (Fig 1).



**Fig 1.** Dynamics in the number of fatal and injury accidents, people killed and injured, 2001 - 2008

Figure 2 gives the change in the number of people killed on Lithuanian roads during road accidents since 2001. If the number of people killed year by year is compared to that in the year 2001 only in 2008 this number was successfully reduced up to 30%. Though it is still far from the goal to reduce the number of people killed in road accidents by 50 % Lithuania is already on the right way. Safety situation on Lithuanian roads has significantly improved for a number of reasons: increased responsibility for the infringements of Traffic Rules; social actions (safety bells, effects of alcohol, use of reflectors, etc.); speed restriction measures; managements of high-risk accident zones; speed control; separation of traffic lanes; education of traffic users; traffic safety audit and others.

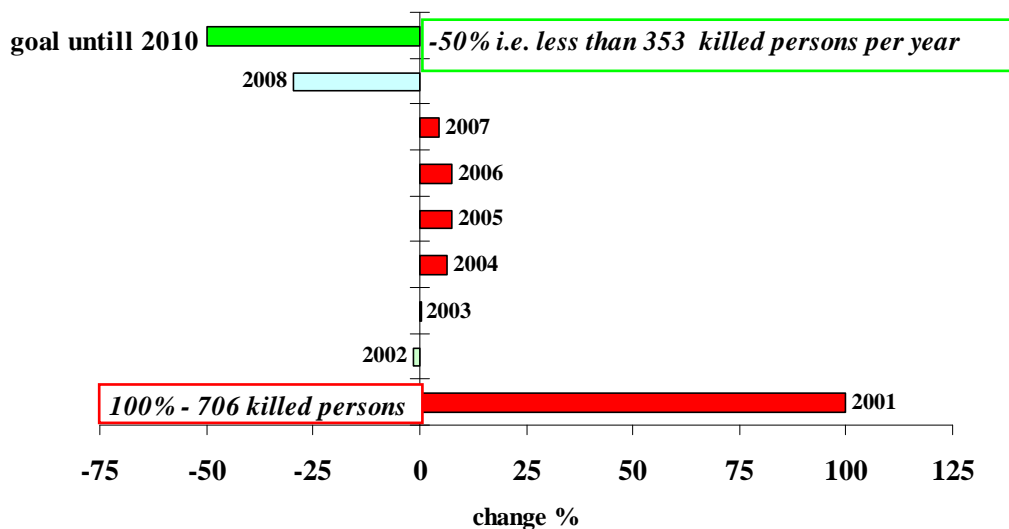


Fig. 2. Change in the number of people killed during road accidents since 2001, %

## 1. Analysis and assessment of road safety measures implemented on Lithuanian roads

The main objective of the road safety assurance actions 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. Every year various types of traffic safety measures have been implemented on the roads of the Republic of Lithuania. First and foremost, they are implemented on the road sections where the accident rate had already increased the limit values (on black spots). The following traffic safety measures are implemented on Lithuanian roads: pedestrian-bicycle tracks; safety islands; illumination of pedestrian crossings and high-accident locations; erection of guardrails; marking of carriageway; wire fences preventing from wild animals; separation of three-leg or four-leg intersections, etc.

Each road safety measure must give a certain benefit. Thus, in the assessment of suggested measures it is necessary to estimate their effects on road safety. At present Lithuania uses the adapted Lithuanian version TARVAL of the Finnish software TARVA – a tool for estimation of traffic safety effects of road improvements. This method enables to predict a reduction in the number of accidents per year based on the 4-year accident rate, traffic volume and the selected traffic safety measures.

Road Department of the Vilnius Gediminas Technical University (VGTU) carried out the analysis of the effects of the implemented road safety measures. For this purpose, accident data was collected and analyzed on the road sections where the safety measures had been implemented. A comparison was made of the accident data before the introduction of safety measures and 4 years after that.

4 stages have been analyzed to find out the effects of the implemented safety improvements. 48 high-accident road sections were selected where the safety measures were implemented in 1999, 2000, 2001 and 2002. The analysis showed that:

- from the traffic safety measures implemented on 28 road sections in 1999 they were effective on 15 sections. On the remaining 13 sections the expected results of accident reduction were not obtained. On 6 road sections no reduction in accident rate was achieved.
- from the traffic safety measures implemented on 5 road sections in 2000 they were effective on 3 sections. A real reduction in accident rate was not achieved on 1 road section.
- from the traffic safety measures implemented on 6 road sections in 2001 they were effective on 3 sections. On 3 road section the expected results of accident reduction were not obtained.
- from the traffic safety measures implemented on 9 road sections in 2002 they were effective on 3 sections. On the remaining 6 sections the expected results of accident reduction were not obtained. On 3 road sections no reduction in accident rate was achieved.

In order to make a detailed analysis of only partly-effective road safety measures, in 2007 the Research Team of the Road Department of VGTU visited the concerned high-accident road sections and made a detailed analysis of safety situation of these sections. A field inspection of only partly-effective road

safety measures pointed out that the safety measures giving no expected effect are those mostly implemented on the road sections which cross built-up areas.

## 2. Analysis of road safety problems on the road sections which cross built-up areas

Comparing the continuations of roads of different technical category and different traffic volume which run through the Lithuanian towns and settlements one can notice that they often have similar features. The following similar elements could be noticed on a typical Lithuanian road section which crosses a built-up area: unreasonably wide asphalt streets with gravelled shoulders, poor conditions for parking and full freedom for manoeuvring. Nearly the most important thing is that the drivers travelling by a rural area and having entered a residential area find no difference, except a white road sign which denotes the beginning of the town or settlement: the road is of the same width, the same gravelled shoulders, the same guardrails and ditches run ahead (Fig 3, 4). The only difference is that the drivers are surrounded not by fields and forests but by residential houses and intensive pedestrian and bicycle traffic. Since the road parameters and road environment has not been changing or only slightly changing many of the drivers use to insufficiently decrease speed and this becomes the main cause of accidents in a built-up area. Frequently, the road sections which cross settlements are more accommodated for the passing vehicles but not for the needs of local residents. Therefore, in order to improve road safety conditions in built-up areas it is necessary to implement the complex road safety measures and to take into consideration the needs of local residents, their safety and comfort, instead of convenience for the passing vehicles. None the less attention in a residential area must be given to the aesthetical view of road and its environment.



**Fig. 3.** The beginning of Veiveriai settlement. Having entered the settlement the road parameters do not change



**Fig. 4.** Protective guardrails erected at the pedestrian-bicycle track running through the settlement

In developed countries when planning, designing and then building the road continuations crossing towns and settlements first of all the needs of local residents, their convenience and comfort are taken into consideration. None the less attention is given to road traffic safety, the needs of pedestrians and bicyclists, environmental protection and the aesthetical view of road and environment (Fig 5).



**Fig. 5.** Examples of pedestrian and bicycle traffic separation in the settlements of foreign countries

### **3. The use of Computer-Aided Design systems in designing safe infrastructure in built-up areas**

The Computer-Aided Design (CAD) systems enable to plan and design the complex road safety improvement measures which would not only improve traffic safety in the settlements but would also be aesthetically attractive. At present creators of the computer-based systems pay a large attention to a visualization of decisions of road safety problems. Project visualization, based on the given situation and design data, makes it possible to create a spatial view of the traffic situation in the designed object, to view the project from all angles and to evaluate a variety of possible situations. All the objects can have semantic information on the basis of which the spatial situation models are generated.

Most of the CAD systems allow project visualization which helps to visually represent design solutions, simplifies their review and evaluation. In modern systems spatial models are created automatically, according to the input data and require no extensive skills of 3D modelling from an engineer. The laid out objects (roads, vehicles, pedestrians, traffic-lights, road signs, trees, buildings, water bodies, forests, bridges, guardrails, pipes, etc) are immediately represented in a three-dimensional space. Besides, it is possible in a three-dimensional space to simulate a car driving on the designed road at the indicated design speed, i.e. to simulate any type of transport or the range of driver's visibility. This enables to evaluate not only road parameters but also ergonomic parameters (for example, to identify sites of limited visibility, orientation convenience in intersections or visibility of road signs) and other design solutions. The simulated traffic situation from above could be recorded as a video into AVI (Audio Video Interleave) format file. Such project visualization helps to more visually represent project solutions, prove their advantages and check mistakes.

Road safety measures must be evaluated in a design process but not separately, as part of another process. Inability to solve road safety problems in the course of design can lead to improper decisions which later result in the appearance of black spots. And then the problems are attempted to be solved with the help of various road safety improvement measures.

In USA, based on the scientific research program, the IHSDM (Interactive Highway Safety Design Model) has been developed which is used to analyze and evaluate all the geometry alternatives of the designed road in order to ensure safe traffic. Besides, it is applied not only in highway design but also on the road sections which cross built-up areas. The IHSDM modules are adapted for the operation in any CAD environment. Therefore, the IHSDM software is used by most software manufacturers, such as Autodesk, Bentley, CAiCE, Carlson, Eagle Point and others.



Fig. 6. Examples of visualization of road projects

Road design, aiming to satisfy the defined minimum design criteria, is not an effective way to ensure safety of a given road. IHSDM evaluation modules make the evaluation of the driver (e.g. aggressive, embarrassed, age, nationality, etc.), vehicles (finds the inconsistencies in a certain type of vehicles and identifies the possible problematic areas, such as large turn-over potential or insufficient length of deceleration-acceleration lane), their dynamics, accident statistical analysis data (e.g. predicts road accident probability), traffic flows and consistency of design criteria (Fig 7.).

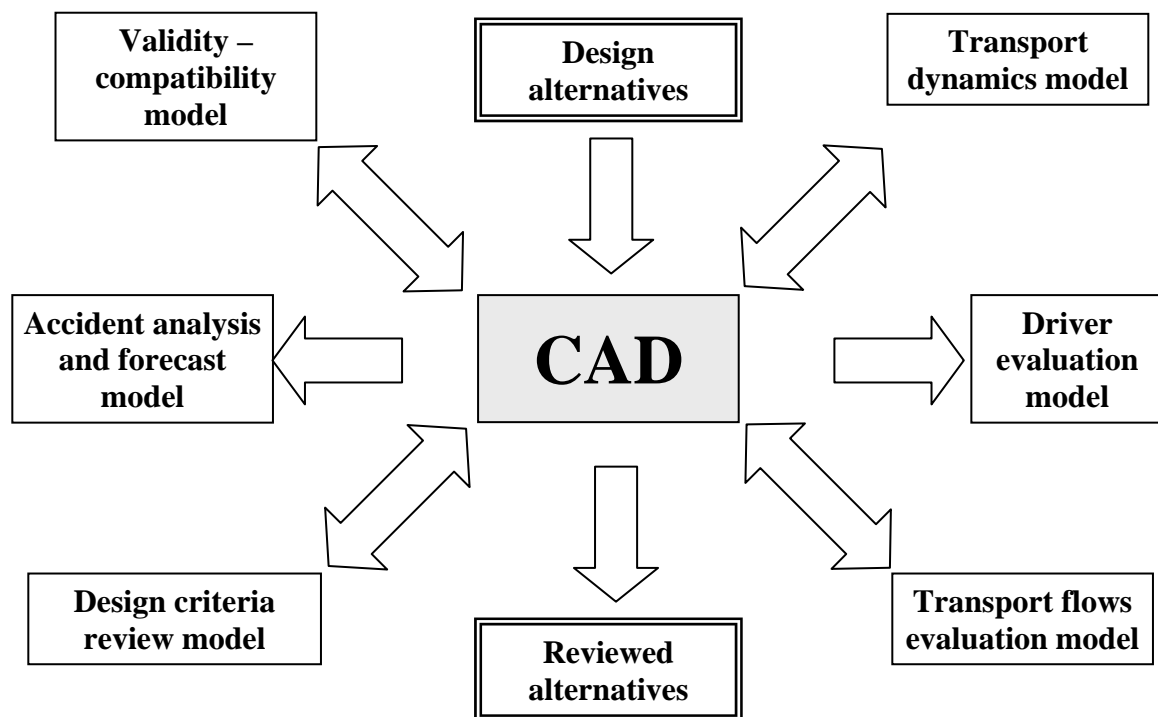


Fig. 7. IHSDM evaluation modules

#### 4. Conclusions

1. Since 2001 the Republic of Lithuania, like the other EU countries, has been solving a complicated task in the field of road safety – until 2010 to reduce the number of people killed in road accidents by 50 %. In the course of 8 years only in the year 2008 Lithuania succeeded to reduce the number of people killed in road accidents by 30%.
2. Considerable number of road accidents takes place on the road sections which cross built-up areas. Therefore, we must take every possible means to ensure road traffic safety on these sections.

3. In order to prevent the formation of black spots on the road sections crossing built-up areas, road safety problems must be solved already in a design stage.
4. CAD systems allow to model various traffic situations and to make project visualization which helps to visually represent design solutions, check mistakes and simplify their review and assessment.
5. The use of CAD and IHSDM software facilitates a design process and enables to analyze and evaluate all the geometric alternatives of the designed road in order to ensure safe traffic.

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