

## ANALYSIS OF THE SAFETY OF VULNERABLE ROAD USERS ON STUDENSKA STREET <sup>10</sup>

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***Abstract:** The paper presents an analysis of the safety of vulnerable road users (VRUs) along “Student’s Street” in the city of Ruse, Bulgaria. Due to the presence of several educational institutions and the intensive traffic flow, the area is characterized by a high concentration of pedestrians and cyclists. The study identifies critical shortcomings of the current transport infrastructure, such as insufficient vertical and horizontal signaling, degraded traffic-calming facilities, and irregular parking practices that reduce the level of protection for VRUs. Based on European regulations and good practices, a set of measures is proposed, including improved traffic organization, the reconstruction of intersections, the installation of effective speed-limiting devices, and the implementation of a planned bicycle lane. The findings emphasize the need to prioritize safety interventions in order to reduce the risk of road traffic accidents and to enhance the overall sustainability of urban mobility in Ruse.*

***Keywords:** vulnerable road users, traffic safety, pedestrians, cyclists, urban mobility.*

### INTRODUCTION

Pedestrians and cyclists are vulnerable forms of transport, as their participants are exposed to serious risks when interacting with motor vehicles. In European legislation, the term “Vulnerable Road Users” (VRUs) refers to groups of participants who, due to the lack of physical protection and the lower kinetic energy in a collision, are most at risk of serious consequences in road accidents. According to Regulation (EU) 2019/2144, in addition to pedestrians and cyclists, vulnerable road users also include other non-motorized, as well as some motorized participants who use individual means of transportation without a protective bodywork – for example, electric scooters or motorcycles.

Studentska Street in the city of Ruse is a typical example of an urban road artery with a high concentration of vulnerable participants, due to the location of five educational institutions along it. This circumstance implies an intense flow of children, schoolchildren and students, whose safe movement requires special attention.

The traffic congestion on the street, combined with the presence of a large number of young pedestrians, necessitates the implementation of a comprehensive approach to improving road safety.

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This analysis aims to assess the current state of the road infrastructure in the area, identify the main risk factors and propose specific measures to reduce the danger to vulnerable road users. The emphasis is placed on integrated solutions creating infrastructure improvements, signaling, speed limits and educational campaigns aimed at all road users.

## EXHIBITION

"Studentska" Street, with a length of approximately 880 meters, is a significant transport artery in the northeastern part of the city of Ruse. It is characterized by intense traffic of both motor vehicles and pedestrians, especially during peak hours of the day. The main feature of this road section is the concentration of five educational institutions along its length: Ruse University "Angel Kanchev", kindergarten "Chuchuliga", kindergarten "Slantse", Secondary School "Vazrazhdane" and Secondary School for European Languages "St. Konstantin-Kiril Philosopher" (Fig. 1).

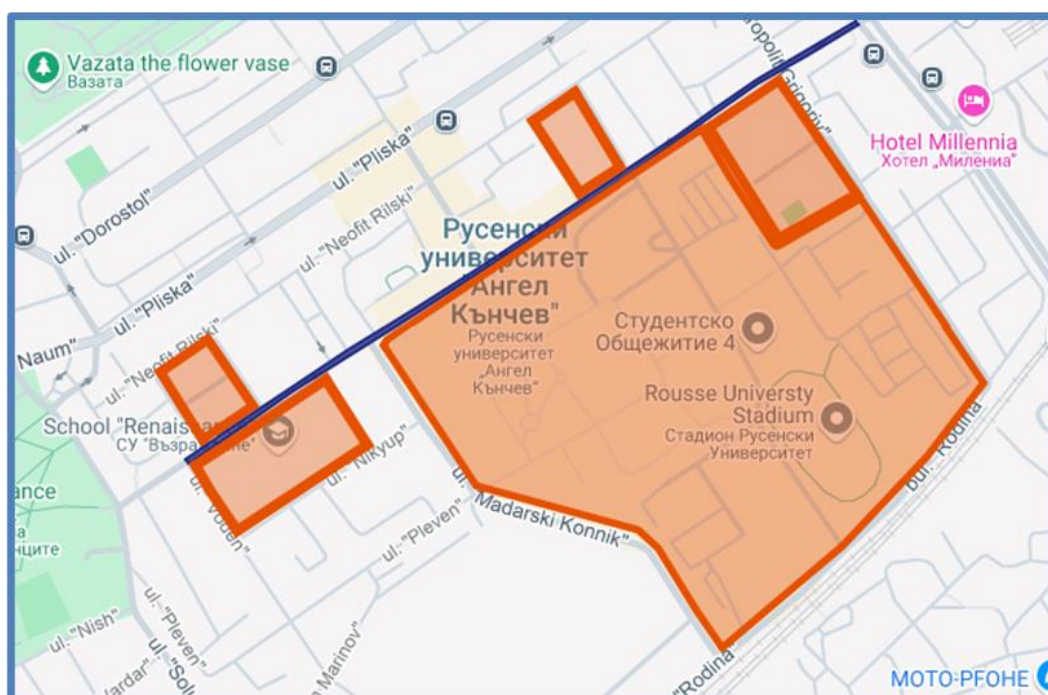


Fig. 1 Educational institutions along Studentska Street

The presence of these educational institutions determines a significant number of vulnerable road users – mainly children, schoolchildren and university students – who use the street for transportation on a daily basis. This creates prerequisites for an increased risk of road accidents, especially in the absence of adequate safety measures and adapted to the infrastructure context. Ensuring a safe environment for transportation in this section should be a priority for both local authorities and states responsible for planning and managing urban mobility.

The existing transport infrastructure along Studentska Street does not provide the necessary level of road safety for all categories of road users. A significant part of the pedestrian crossings are marked only with horizontal markings, which in many cases are partially erased or poorly contrasting with the pavement, which greatly limits its visibility – especially in adverse weather conditions or in the dark. In addition, in a number of key locations there is a lack of or insufficient vertical signage, which makes it difficult for drivers to perceive the road situation in a timely manner.

The lack of clearly defined infrastructure for all types of users – pedestrians, cyclists, drivers of personal electric vehicles (e-scooters, etc.) – leads to overlapping traffic trajectories

and increases the risk of conflict situations and traffic accidents. There is also insufficient protection of areas near educational institutions, as there are no raised pedestrian walkways, guardrails, speed limiters and other elements, many of which are intended to guide user behavior and reduce the potential for accidents.



Fig. 2 Pedestrian paths marked only with horizontal markings that are poorly visible and vertical ones in poor condition

Practices in a number of European cities show that the construction of so-called “traffic calming zones” (traffic calming zones) around schools and universities, as well as the integration of elements such as tactile pavements, illuminated pedestrian crossings, visually contrasting markings and traffic light systems with activation buttons, lead to a combined reduction in road accidents involving vulnerable users. Such measures are in line with the principle of Vision Zero – a strategy to eliminate fatal and serious road accidents, which is implemented in countries such as Sweden, the Netherlands and Germany.

Studies by the European Transport Safety Council (ETSC), according to which effective low-level infrastructure for pedestrians and cyclists, combined with increased speed control and educational campaigns, can reduce accidents by over 40% in risk zones around schools and kindergartens (ETSC, 2020). Similar good practices can and should be adapted to the context of Bulgarian cities, with a view to protecting the most vulnerable traffic users.



Fig. 3 Lack of markings and safety barriers

Zones around kindergartens and schools should be designed with increased road safety standards, taking into account the vulnerability of young children as road users. In the case of the "Luck" kindergarten, the lack of a clearly marked pedestrian crossing around and near the immediate entrance, as well as the absence of safety barriers or fences, exposes children and accompanying adults to serious risk when crossing the street.

Research in the field of transport psychology shows that young children (especially in the age range of 3–7 years) have a limited ability to judge the speed and distance of approaching vehicles (Zeuwts et al., 2017). They often act impulsively, without being observed, and cannot anticipate danger in the road environment in the same way as adults. This makes the need for physical protection – e.g. handrails, guides to a marked pedestrian crossing – absolutely mandatory.

The absence of a pedestrian crossing not only creates legal and visual ambiguity about the crossing area, but also reduces the likelihood that drivers will anticipate and notice pedestrians. In turn, the absence of handrails increases the risk of a child suddenly stepping onto the roadway, especially during play or when searching for a parent. Such an environment configuration is considered in the scientific literature as a "non-forgiving road environment", in which a small human error can lead to a severe effect (OECD/ITF, 2016).

Good practices in a number of European countries include the mandatory construction of:

- raised pedestrian walkways with bright markings;
- guardrails that direct the flow of pedestrians to a safe crossing point;
- speed limits of 30 km/h within a radius of 100 m around childcare facilities;
- visual signs and light signals indicating the presence of children.

The lack of such measures in the area of educational authorities represents a systemic failure in the implementation of the concept of passive safety - an approach in which the environment is designed to reduce the effect of inevitable human errors. The presence of clear pedestrian routes and physical traffic limiters is a proven means of preventing serious accidents with child pedestrians.

In certain sections of Studentska Street, a speed limit of 30 km/h has been introduced, which is a positive step towards reducing safety in areas with an increased level of vulnerable participants. However, the effectiveness of this measure is limited by the lack of infrastructure elements that would reinforce its implementation by physically influencing the behavior of water. Currently, there are no typical means of so-called "traffic calming", such as transverse artificial bumps (policemen), raised pedestrian crossings, narrowing of the roadway or visual elements that signal the entry into a sensitive area.

Additionally, the existing artificial bumps are in poor technical condition – deformed and partially destroyed – and in this form do not fulfill their design function of reducing traffic speed. This compromises the overall concept of speed limit zones and creates a false sense of security for pedestrians.

A serious additional risk also arises from the unregulated use of sidewalks for parking vehicles (Fig. 3). This behavior eliminates the designated space for pedestrians and forces them to move on the roadway, in close proximity to car traffic. The risks are particularly high during hours when children are being dropped off or picked up from kindergartens and schools, as visibility is further limited for both pedestrians and the water.

The European Road Safety Charter states that pedestrian infrastructure should be physically protected and delimited, without obstacles or areas of conflict with motorized traffic (European Road Safety Charter, 2019). The disruption of this use is not only increased by road accidents, but also creates the prerequisites for lasting uncertainty in children's behavior as pedestrians - a factor that has long-term risky negative consequences in the formation of safe habits.

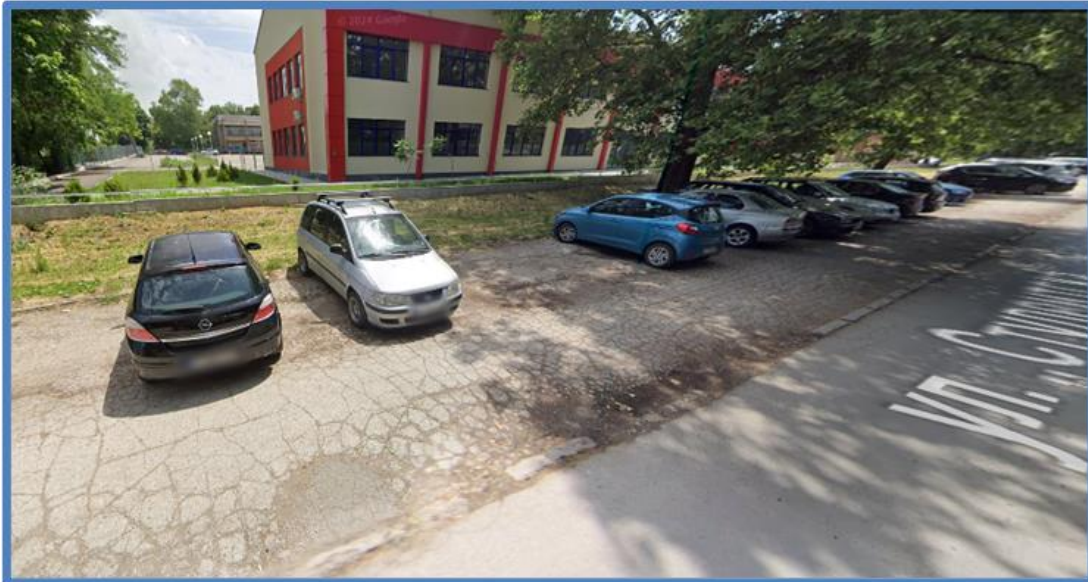


Fig. 4 Parking on Studentska Street

The railings installed near schools and kindergartens do not fully fulfill their role as protective devices, as they do not limit the sudden entry of children onto the roadway (Fig. 4). As a result of these weaknesses, the existing infrastructure and road facilities do not provide adequate conflict-free interaction between all participants in the traffic flow.



Fig. 5 Railing in front of Sofia University "Vazrazhdane"

A speed limit of 30 km/h has been introduced in certain sections of Studentska Street - a measure aimed at limiting the risk for vulnerable road users, especially in the area around the educational administration. However, its effectiveness is limited due to the lack of physical "traffic calming" measures that would force drivers to actually drive in order to comply with the better speed. At present, there are no elements such as raised pedestrian crossings, narrowing of the road or visual signs signaling entry into a zone with increased attention.

## **CONCLUSIONS**

The analysis of Studentska Street showed that the existing road infrastructure and traffic organization do not guarantee a sufficient level of safety for vulnerable users. Problems related to ineffective signaling, insufficient speed limit facilities and unregulated parking were identified, which increase the risk of accidents.

The application of national regulatory documents – Regulation No. RD-02-21-1/2024 on artificial unevenness, Regulation No. 2/2001 on horizontal marking and Regulation No. RD-02-21-1/2023 on vertical signaling – in combination with good practices for reconfiguring street space, can lead to a complete reduction in safety.

Of particular importance is the implementation of the bicycle network plan of the city of Ruse, which will provide a separate and safe environment for cyclists and promote sustainable urban mobility. The implementation of these measures will create the prerequisites for a more balanced and conflict-free interaction between all road users.

## **REFERENCES**

Ordinance No. RD-02-21-1 of 01.10.2024 on the conditions for construction or installation of artificial road humps and other traffic calming measures.

Ordinance No. 2 of 17.01.2001 on road marking signalization.

Ordinance No. RD-02-21-1 of 23.11.2023 on road traffic signs signalization.

“Plan for the Bicycle Network of the City of Ruse”, Decision No. 1064/17.07.2014 of Ruse Municipal Council.

European Transport Safety Council (ETSC). (2020). *Reducing Child Deaths on European Roads*. <https://etsc.eu>

European Commission. (2019). Regulation (EU) 2019/2144 of the European Parliament and of the Council.

OECD/ITF. (2018). *Safer City Streets: Global Benchmarking for Urban Road Safety*.

Balbuzanov T. Infrastructure solutions for sustainable development of bicycle transport, IN: Proceedings of University of Ruse - 2020, volume 59, book 4.2, RUSE, 2020, pp. 58 – 67

Balbuzanov, T., Lyubenov, D., & S., Kostadinov., 2018. Improving the safety of vulnerable road users. Proceedings of University of Ruse, Volume 57, Book 4, p. 99-104

Vision Zero Network. <https://visionzeronetwork.org>

Zeuwts, L., et al. (2017). “Children’s Crossing Behaviour in a Realistic Traffic Environment: Influence of Age and Traffic Characteristics.” *Accident Analysis & Prevention*, 106, 6–14.

OECD/ITF. (2016). *Zero Road Deaths and Serious Injuries: Leading a Paradigm Shift to a Safe System*.

European Transport Safety Council (ETSC). (2018). *Reducing Road Risk for Children and Young People in the EU*.

World Health Organization (WHO). (2015). *Ten Strategies for Keeping Children Safe on the Road*.