

# ANALYSIS OF RISK FACTORS AT A TRAFFIC INTERSECTION IN THE CITY OF PANČEVO

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**Abstract:** This study analyzes traffic load and safety at the intersection of Žarka Zrenjanina and Prvomajska streets in Pančevo, one of the key points in the city's traffic network. The intersection is highly frequented due to its proximity to residential, commercial, and public facilities, contributing to significant traffic volume and an increased risk of traffic accidents. The analysis includes an assessment of traffic infrastructure, existing signage, and vehicle flow during different periods of the day. Additionally, risk factors for traffic accidents and potential safety improvement measures, such as changes in signage and the inclusion of additional safety elements, are considered. The intersection represents a point in the traffic network where conflicts arise between traffic flows coming from two or more different directions.

**Key words:** intersection, traffic accidents, traffic safety

## 1. INTRODUCTION

The intersection of Žarka Zrenjanina and Prvomajska streets in Pančevo represents one of the busiest and most important traffic points in the city, significant not only for the local but also for the regional traffic system. As a junction of two key traffic arteries, this intersection is under heavy daily load, serving both transit vehicles and local traffic flows, including public transportation, pedestrians, and cyclists. Its location is crucial for connecting the city center with other parts of Pančevo and neighboring settlements, making it vital for the city's economic and social activities. However, the high traffic frequency at this intersection leads to numerous problems, such as an increased risk of traffic accidents, congestion during peak hours, and delays in the movement of public transportation and other traffic participants. Additionally, the proximity of commercial facilities and residential zones makes this intersection challenging from a safety maintenance perspective, as it is often burdened with pedestrian flows and nearby parking. Given these challenges, the aim of this paper is to conduct an analysis of traffic load, safety, and the efficiency of existing solutions at the intersection of Žarka Zrenjanina and Prvomajska streets.

## 2. TYPOLOGY AND CHARACTERISTICS OF TRAFFIC FLOW

The main factors influencing traffic load at the intersection of Žarka Zrenjanina and Prvomajska streets in Pančevo can be divided into several key categories:

- Traffic intensity at different times of the day: Traffic loads at this intersection vary significantly depending on the time of day, peaking during morning and afternoon rush hours. During these periods, a large number of vehicles pass through the intersection, leading to increased congestion and load.
- Types of traffic participants: In addition to motor vehicles, a significant number of pedestrians and cyclists use this intersection. The presence of pedestrian crossings, as well as the intersection of bicycle and vehicle lanes, further burdens the intersection and can affect traffic flow.
- Intersection configuration and design: The design of the intersection itself, including the number of lanes, the width of traffic routes, the length and position of pedestrian crossings, and signage, affects traffic flow.
- Signage and traffic light operation: The duration and timing of green and red lights at traffic signals play a key role in managing traffic flow. Poorly adjusted traffic light operation can lead to congestion, especially during peak hours when the load is at its maximum.

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- Presence of commercial establishments and public services nearby: The proximity of stores, office buildings, and public institutions increases the frequency of pedestrians and vehicles entering or exiting the intersection. These factors contribute to higher traffic load and can slow down the flow, particularly during working hours and peak activity periods.

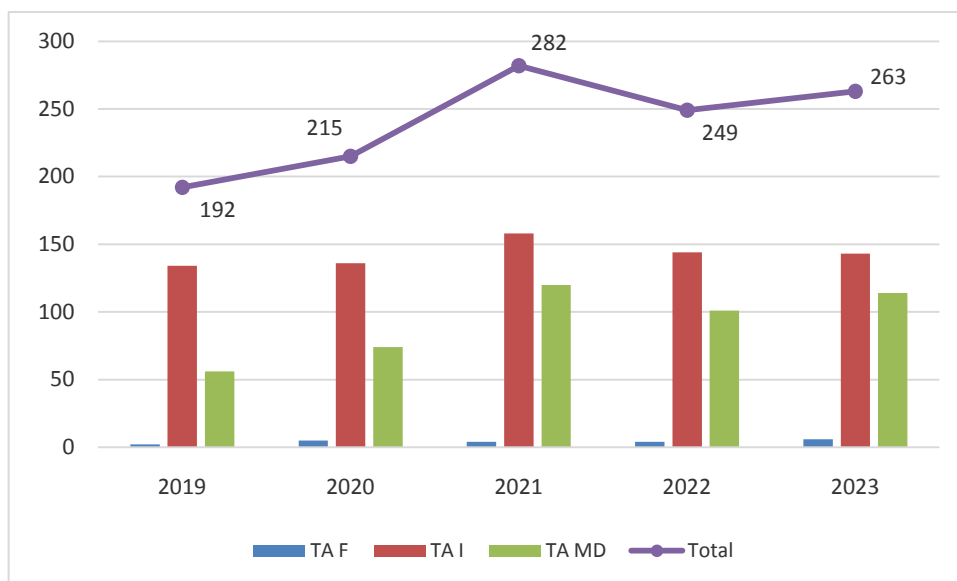


Figure 1 – Diagram of traffic accidents in Pančevo and the surrounding area during the period 2019–2023.

Figure 1 displays a diagram representing the number of traffic accidents in the city of Pančevo and its surroundings during the period from 2019 to 2023. The analyzed categories include:

- TA F (Traffic Accidents – Fatal): The category with the lowest frequency.
- TA SI (Traffic Accidents – Serious Injuries): The dominant category, with consistently high participation in the total number of incidents.
- TA MI (Traffic Accidents – Minor Injuries): A category with moderate participation, referring to incidents with moderate intensity or consequences.
- TA T (Traffic Accidents – Total): The total number of all recorded incidents, providing insight into the general trend across all analyzed categories.

The data indicate a significant increase in the total number of incidents (TA T) from 2019 to 2021, when a peak of 282 was recorded, followed by a decline in 2022 and partial recovery in 2023. Categories TA SI and TA MI show stable growth, while TA F maintains a marginal contribution to the overall values. This analysis enables experts to identify key factors influencing changes in these categories, as well as to propose measures to reduce the frequency of dominant categories, such as TA SI. Changes in the overall trend suggest possible effects of preventive measures or external influences that require further investigation. The presented data allow for a comprehensive analysis of trends across different categories of incidents over the five-year period (2019–2023). The total number of incidents (TA T) shows steady growth until 2021, reaching a peak of 282, followed by a decline in 2022 and partial recovery in 2023. The steady growth of the TA SI and TA MI categories, which together constitute the majority of total values, highlights their dominant role in defining overall trends. On the other hand, the TA F category remains marginal, with minimal participation throughout all years.

This analysis provides a foundation for deeper investigation into the factors contributing to the increase in incidents, as well as for defining strategic interventions.



Figure 2 – Traffic Accident Diagram for the Given Intersection in the Period 2019–2023.

Figure 2 represents the traffic accident diagram for the given intersection during the period 2019–2023. The data indicate significant trends and changes over the analyzed period. The year 2021 recorded the peak in the total number of incidents, while 2020 and 2022 showed a decline in the overall number of incidents. The stable participation of the TA SI (Serious Injuries) and TA MI (Minor Injuries) categories suggests their dominant role in shaping the overall trend, while TA F (Fatal Accidents) has a marginal but critical significance due to the severity of consequences.

Incidents involving material damage at this intersection remained relatively stable over the years, indicating frequent but less severe events, most commonly caused by minor traffic violations. The increase in the TA SI category highlights the need to improve safety conditions. Although rare, incidents with fatal outcomes require special attention given their seriousness.

The total number of incidents at the intersection varied over the analyzed period, with the highest increase recorded in 2021 (9 incidents) and the lowest values in 2020 and 2022 (4 incidents).

The intersection of Žarka Zrenjanina and Prvomajska Streets is one of the busiest points in Pančevo's traffic network, playing a vital role in traffic flow and the city's daily functioning. This intersection connects two important routes:

- Žarka Zrenjanina Street: One of the main traffic arteries in Pančevo, serving as a major road through the city.
- Prvomajska Street: A key route providing access to other parts of the city, including exit roads leading out of Pančevo.

A large volume of vehicles passes through the intersection, including passenger cars, freight vehicles, public transport, pedestrians, and cyclists. The intersection is regulated by traffic lights and has marked pedestrian crossings, but an analysis of its infrastructure is needed to determine whether the existing solution meets user needs.

The location of the intersection allows quick access to exits leading to Belgrade and other parts of AP Vojvodina. Additionally, this intersection plays a significant role in the city's economy, as it facilitates the transport of goods and materials. Freight vehicles and deliveries frequently pass through this route, accelerating commercial and industrial processes.

The approximate traffic flow at the observed intersection can be estimated based on general data for heavily trafficked urban intersections. The following values are general assumptions:

- Morning peak hour (07:00–09:00) and afternoon peak hour (16:00–18:00): The flow can range between 1,000–1,500 vehicles per hour.

- After the peak period (18:00–20:00): The vehicle flow usually begins to decline, and the number of vehicles is estimated to be between 800–1,000 vehicles per hour.
- At night after 20:00: The number of vehicles can drop to 150–300 vehicles per hour.



*Figure 3 – Traffic Accident Diagram for the Given Intersection in the Period 2019–2023.*

### 3. PROPOSED MEASURES FOR IMPROVING TRAFFIC SAFETY CONDITIONS

The primary measure for enhancing traffic safety for passenger car users is improving road quality, which includes regular maintenance and repair of damage, such as potholes and cracks, as well as adequate lane markings. Legislative and regulatory measures play a crucial role in improving road safety. The initial phase involves regular review and updating of traffic regulations to align with best practices and emerging technologies. This approach includes revising laws to ensure their relevance and effectiveness in the modern context.



*Figure 4: Example of a Traffic Violation at the Given Intersection*

The implementation of penalty points represents an important measure that would enable monitoring and sanctioning of traffic offenders. By introducing a penalty points system, which could lead to the temporary or permanent revocation of a driver's license, more responsible driver behavior can be promoted.

The integration of advanced technologies is one of the key elements in this process. Intelligent Transportation Systems (ITS), which integrate advanced information and communication technologies into transportation infrastructure, can significantly improve safety, traffic management, and driver information.

The application of these comprehensive measures and initiatives can significantly reduce the number and severity of traffic accidents involving two passenger vehicles and contribute to enhancing traffic safety in the Republic of Serbia.

Traffic violations at intersections often contribute to traffic accidents, such as failure to obey traffic signs. These violations, which most commonly involve driver inattention and irresponsible behavior, increase the risk of collisions at points where traffic flows merge.

The introduction of stricter controls and the use of advanced technologies at intersections can significantly reduce the number of violations and increase safety in these critical zones.

#### **4. CONCLUSION**

Intersections are points in the traffic network where conflicts between traffic flows occur, and they are typically considered critical spots on road networks. In urban and suburban areas worldwide, including in our country, various methods are applied to manage traffic efficiently at these locations. The goal is to ensure safe movement of vehicles and pedestrians, shorter travel times, lower fuel consumption, reduced environmental pollution, and other benefits.

For these reasons, during the construction or reconstruction of intersections, it is crucial to properly dimension them and define an appropriate traffic regulation type according to the needs. If this fact is overlooked, the intersection might become a bottleneck due to insufficient capacity on the observed road route. Conversely, if over-dimensioned, the intersection might be underutilized, leading to a decrease in service levels, increased operational costs, and greater environmental impact.

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