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ANALYSIS OF THE FUNCTIONAL AND ADMINISTRATIVE CLASSIFICATION OF THE STATE ROAD NETWORK IN THE TERRITORY OF VOJVODINA

Abstract:

This paper analyzes the functional and administrative classification of the state road network in the territory of Vojvodina. The research covers all categories of state roads, with a focus on section lengths, pavement type, and compliance with minimum technical standards, primarily carriageway width. The results indicate a high level of technical adequacy of the highest road categories, while local deviations from standards were observed on Class IIa and IIb roads. Overall, the road network of Vojvodina is technically well developed and largely aligned with European practices, with a need for targeted improvements on lower-category roads.

Keywords: road classification, state road network, technical standards, Vojvodina

АНАЛИЗА ФУНКЦИОНАЛНЕ И АДМИНИСТРАТИВНЕ КЛАСИФИКАЦИЈЕ ДРЖАВНЕ ПУТНЕ МРЕЖЕ НА ТЕРИТОРИЈИ ВОЈВОДИНЕ

Сажетак:

У раду је анализирана функционална и административна класификација државне путне мреже на територији Војводине. Истраживање обухвата све категорије државних путева, са фокусом на дужину деоница, врсту коловозног застора и усаглашеност са минималним техничким стандардима, пре свега ширином коловоза. Резултати указују на висок ниво техничке уређености путева највиших категорија, док су код путева IIa и IIb реда уочена локална одступања од стандарда. У целини, путна мрежа Војводине је технички добро развијена и у великој мери усаглашена са европским праксама, уз потребу за циљаним унапређењима на путевима нижих категорија.

Кључне ријечи: класификација путева, државна путна мрежа, технички стандарди, Војводина

1. INTRODUCTION

The road network of any country represents one of the most important infrastructure systems, the development of which directly affects economic growth, regional connectivity, and social cohesion. It enables the unhindered movement of people, goods, and services, stimulates trade and investment, and connects local communities into an integrated spatial and economic system. A well-organized road network is also a prerequisite for improving road safety, ensuring efficient infrastructure maintenance, and achieving more balanced regional development.

From the perspective of spatial planning, the road network functions as the “backbone” of the spatial-economic system, providing accessibility to remote areas, promoting more balanced development of urban and rural zones, and improving the quality of life of the population. At the same time, it represents a prerequisite for the efficient functioning of other types of infrastructure - energy, utility, digital, and others.

The importance of road classification stems from the need to establish a clear hierarchical system that enables rational planning, design, construction, and maintenance of roads. Classification defines the role of each road within the system, determines the level of service it should provide, and allows for precise allocation of investments in accordance with development priorities. Proper road categorization not only contributes to traffic functionality and safety but also has an environmental dimension, as it enables better management of traffic flows, reduction of congestion, and decrease of harmful emissions. Transport infrastructure, particularly the road network, is increasingly viewed as an instrument of sustainable development and spatial equity. In this context, road classification represents the basis for establishing a balanced relationship between economic needs, safety, environmental protection, and social inclusion, in line with contemporary European standards for transport infrastructure planning [1], [2].

A particularly important role within the state road network of the Republic of Serbia (Serbia) is played by road infrastructure in the territory of the Autonomous Province of Vojvodina (Vojvodina), which is characterized by predominantly flat terrain and a favorable geostrategic position within European transport corridors.

The subject of this paper is the analysis of the functional and administrative classification of the state road network in the territory of Vojvodina, with the aim of assessing the existing classification systems and their consistency with the actual role and technical characteristics of the roads. The paper identifies sections with a high and low degree of compliance with prescribed standards, with particular emphasis on basic technical and operational parameters. The obtained results are intended to indicate potential shortcomings of the existing classification system and to serve as a basis for improving the planning, management, and prioritization of investments in road infrastructure.

2. ROAD CLASSIFICATION

Road classification represents one of the key elements in the planning and management of transport infrastructure. Its primary objective is to establish a clear hierarchy within the road network, enabling rational use of existing resources, definition of investment priorities, and provision of an adequate level of service for users [3]. Through classification, different road links are grouped according to similar functional characteristics, their importance within the network, and traffic volume levels, thereby creating a system suitable for efficient management and development [4].

From a planning perspective, classification allows development priorities to be directed toward corridors of the greatest national and regional importance. From a legal standpoint, classification serves as an instrument for defining the competencies of managing authorities and the mechanisms for financing road maintenance [4]. In technical terms, classification determines geometric and safety parameters such as design speed, curve radius, and the level of access control [5], while from an economic perspective it enables a more rational allocation of resources and optimization of maintenance costs [2]. At the international level, proper classification contributes to the integration of the national road network into European transport corridors and to creating conditions for the smooth flow of transit traffic [6].

In both international and domestic practice, two approaches to road classification are applied in parallel: (i) administrative classification, which is grounded in laws and secondary legislation and relates to the legal status of roads and management responsibilities, and (ii) functional classification, which is based on the actual role of a road within the network, traffic characteristics, and the level of service [7]. It is precisely through the synthesis of these two approaches that a comprehensive

system is achieved, enabling the road network to develop in line with spatial, economic, and social needs [2].

2.1. REGULATORY FRAMEWORK AND BYLAWS

The regulatory framework for administrative road classification in Serbia is based on several legal acts. The principal act is Law on Public Roads [8], which defines categories, classes, and administrative responsibilities. This law is complemented by:

- the Decree on Criteria for the Categorization of State Roads [9], which specifies primary and secondary criteria (connection of traffic nodes, traffic volume, importance for regional and international transport), and
- the Rulebook on Safety Requirements for Road Structures and Other Elements of Public Roads [10], which defines basic technical elements and requirements.

These acts ensure that administrative classification is aligned with functional requirements and that it is periodically revised in accordance with network development and traffic dynamics.

2.2. ADMINISTRATIVE CLASSIFICATION OF STATE ROADS IN SERBIA

Administrative classification represents the legal framework for categorizing public roads in Serbia. It is defined by the Law on Public Roads [8] and the Decree on Criteria for the Categorization of State Roads [9]. According to these regulations, public roads are divided into state and local roads, with state roads further classified into Class I and Class II roads. The primary objective of administrative classification is to establish a clear division of responsibilities between state and local authorities, as well as to provide a legal basis for the financing, signing, and maintenance of roads. In this way, a unified management system is created, contributing to transparency and efficiency in the operation of the road network [7].

In accordance with the Decree on Criteria for the Categorization of State Roads [9], state roads are classified into four categories (Table 1). In recent years, changes have been introduced to the system of administrative classification of state roads. Specifically, the Decree on the Categorization of State Roads [11] introduced a new category of expressways (Class IM), positioned between motorways (Class Ia) and main roads (Class Ib). This modification provides a clearer typology of Class I state roads, considering specific design standards, speed regimes, and the function of connecting major regional and national centers.

Table 1. Categories of state roads in Serbia according to administrative classification [9]

Category	Road type	Main characteristics
Ia	motorways and expressways	fully controlled access, high capacity, intensive national and international traffic
Ib	main (trunk) roads	connection of major administrative, economic, and regional centers, partially controlled access
IIa	regional roads	connection of regional centers, formation of the primary regional network
IIb	district roads	provision of local and district connections, integration into higher-level networks

This system makes it possible to establish a network hierarchy that supports coordinated management and rational allocation of financial resources. For example, the state is responsible for the construction and maintenance of motorways and main roads, while regional and district roads may be partially financed in cooperation with local self-government units. In this way, integration of national priorities with regional and local needs is ensured [5].

It is particularly important to emphasize that administrative classification also has practical significance in traffic planning and road safety. Road category designations are applied in traffic signage and official registers, enabling easier orientation for users and more transparent infrastructure management. Through this approach, a uniform management system is achieved that is aligned with European standards and the practices of neighboring countries [9].

2.3. FUNCTIONAL CLASSIFICATION OF STATE ROADS IN SERBIA

Functional road classification involves categorizing roads based on the role they play within the network and the level of service they provide to traffic. Unlike administrative classification, which is a legal instrument, functional classification is primarily of a technical and planning nature. In Serbia, the basic classification is defined according to two main criteria:

- Spatial level of function: This indicates the scale of the traffic nodes being connected. The scale refers to settlements defined by population size and the boundary conditions of daily mobility, including national (macro-regional), regional, district, and local traffic centers. Accordingly, four levels of function are defined: location, district, region (two or more regions), and state (two or more states);
- Dominant traffic function: This represents the degree to which one of the basic traffic functions is predominant.

Within the functional classification, four categories are commonly distinguished:

- Long-distance roads (LDR): These represent the highest level within the functional classification. Their primary purpose is to ensure connectivity between national, macro-regional, and international traffic centers. These roads have high capacities, the strictest level of access control, and are designed for long-distance transit traffic, both passenger and freight;
- Connector roads (CoR): These serve as links between regional and district centers, as well as connections of local networks to long-distance routes. Their role is to integrate lower-category roads into the higher-level transport system. They are characterized by a medium level of access control, with geometric parameters adapted to more intensive regional traffic;
- Collector roads (CR): Their function is to collect traffic from local and access roads and channel it toward connector or long-distance routes. They have moderate capacities and standard safety parameters, and their importance is particularly evident in densely populated agricultural areas and peri-urban zones, where they ensure daily mobility of the population;
- Local or access roads (AR): These represent the lowest level in the functional classification but are of exceptional importance for the daily life of the local population. Their primary purpose is to provide direct access to settlements, industrial zones, and agricultural land. In this category, safety is of primary importance, as different types of road users often interact, such as motor vehicles, cyclists, tractors, and pedestrians.

By combining the dominant traffic function and the spatial level at which it is performed, the final functional classification of roads is obtained, organized into eight types (Table 2).

Table 2. Functional classification of roads in Serbia [9]

Road type	Designation	Level of significance	Primary functions
access road (local)	AR-l	local	provides access to settlements and zones located directly along the road alignment
access road (district)	AR-d	district	connects smaller settlements and district centers with higher road categories
collector road (district)	SR-d	district	collects local traffic flows and directs them toward regional routes
collector road (regional)	CR-r	regional	consolidates traffic from several district routes and directs it toward connector and long-distance roads
connector road (regional)	CoR-r	regional	connects regional centers and integrates them into the higher-level network
connector road (interregional)	CoR-ir	interregional	provides links between multiple regions and connections to long-distance routes
long-distance road (interregional)	LDR-ir	interregional	serves transit traffic and connects the most important regional centers
long-distance road (state/international)	LDR-i	state/international	connects national centers and integrates the national network into international corridors

The functional classification of roads in Serbia provides a solid basis for planning and managing the transport system, as it clearly defines the role of each road type according to its significance and traffic volume. This categorization enables more transparent determination of investment priorities and alignment of spatial planning with transport needs. However, in practice, the system still faces challenges. One key issue is the incomplete alignment of regulatory criteria with actual conditions

on the ground, where some roads formally belong to a higher category but, in terms of technical parameters or maintenance level, do not meet the prescribed standards.

Additionally, there is insufficient integration of the functional classification with modern European models, which emphasize multimodality and the sustainability of the transport system. For this reason, it is necessary to improve existing solutions through regular revision of criteria and adaptation to practices applied in the European Union (EU). This would ensure greater efficiency and better integration of the national road network into international transport flows.

2.4. RELATIONSHIP BETWEEN ADMINISTRATIVE AND FUNCTIONAL CLASSIFICATION

The administrative and functional classifications of roads in Serbia are interconnected and together form a unified categorization system. While administrative classification defines the legal status and management responsibilities of roads, functional classification is based on the role roads play in traffic flow and spatial connectivity. The functional roles of roads (e.g. long-distance, connector, collector, and local) serve as the basis for their assignment to administrative categories (Ia, Ib, IIa, IIb). In other words, administrative classification builds upon the functional classification, translating its principles into legally recognized categories applied in practice [7].

Figure 1 illustrates the relationship between these two classifications, showing that the administrative categories of state roads correspond to functional types. This alignment allows for coordinated planning, design, and management of the road network at different spatial levels.

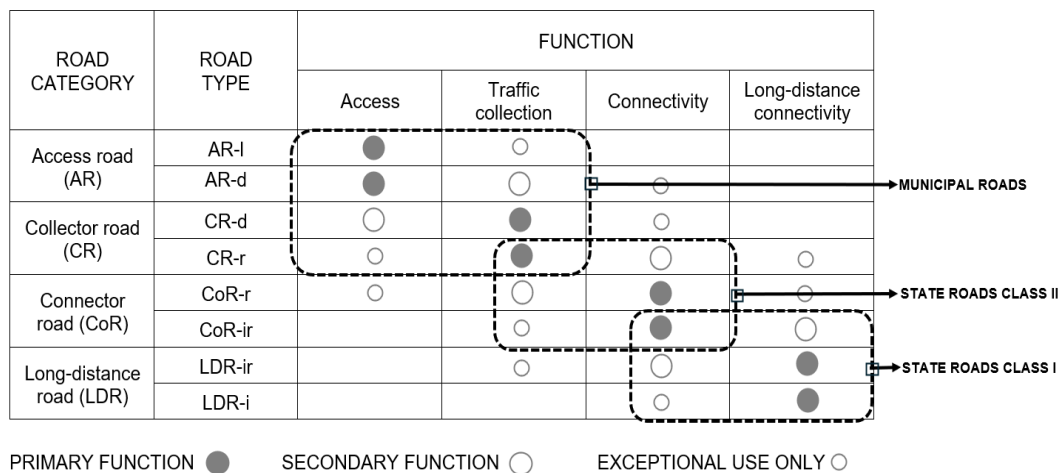


Figure 1. Relationship between road categories according to administrative and functional classification in Serbia [10].

3. METHODOLOGICAL FRAMEWORK

The study applied descriptive and comparative approaches. Descriptive analysis enabled a precise presentation of the technical parameters of the road network, such as section lengths, pavement types, and the percentage of compliance with width standards. The comparative approach was used to compare different road categories and to identify sections requiring intervention or restoration.

Data for the research were collected from relevant sources, primarily the databases of the state road manager (Public Enterprise Roads of Serbia) which include: the reference system of state roads with information on sections and junctions, data on carriageway widths and the number of traffic lanes, and information on pavement types.

Data processing was primarily conducted using the SPSS software, which allowed for quantitative analysis, generation of descriptive statistics, tabular representations, and percentage distributions. This software was used for precise analysis of technical parameters such as section lengths, pavement types, and compliance with width standards. Additionally, QGIS was used for spatial visualization and geographic analysis of the data. With QGIS, geospatial interpretation of road sections, mapping of the road network, and identification of sections with problematic carriageway widths were performed. The combination of these two programs enabled an integrated analysis of the technical and spatial characteristics of the road network, resulting in a more accurate and visually clear presentation of the findings.

4. ANALYSIS OF THE STATE ROAD NETWORK IN THE TERRITORY OF VOJVODINA

4.1. GENERAL OVERVIEW OF THE NETWORK

The road network of Vojvodina represents one of the most developed segments of transport infrastructure in Serbia, resulting from its historical role in transport development, the flat characteristics of the terrain, and the even spatial distribution of settlements. Since the mid-20th century, continuous investment in road transport has been maintained in the province, enabling the formation of a dense and well-connected network of roads of various categories. The network also reflects planned infrastructure heritage dating back to the Austro-Hungarian period. Favorable terrain and a high concentration of economic activities have contributed to the construction of modern roads and improved connectivity compared to other parts of Serbia. Vojvodina, located in the central part of the Pannonian Plain, connects Serbia with Hungary, Romania, and Croatia, giving the region a pronounced transit character. In addition to international transport corridors, the system includes a dense network of state roads of Class I and II, as well as regional and local roads, which together form the foundation for the economic and social development of the area.

This level of development is also a result of the convergence of multiple international transport routes within Vojvodina, including the Pan-European Corridors X and VII (Danube), which enable Serbia's transit connectivity with Central and Southeastern Europe. Moreover, the even distribution of settlements and the region's agricultural orientation have necessitated continuous investment in road infrastructure to ensure efficient transport of goods and raw materials to markets.

The total length of Class I and II state roads in Serbia amounts to 17,091.76 km (including both constructed and unconstructed sections) [12], of which 6,188 km are in the territory of Vojvodina, representing 15.2% of the total state road network [13]. This figure is particularly significant when compared to the mountainous regions of Serbia, where unfavorable orographic conditions limit road construction, resulting in lower network density and weaker local connectivity. In contrast, Vojvodina stands out as a region with the highest level of traffic accessibility and connectivity, which is a key prerequisite for its economic development and integration into international transport flows.

According to administrative categories, the condition of the overall public road network in Vojvodina is more favorable compared to the Serbian national average. In Vojvodina, 20.7% of roads are Class I state roads (11.8% at the national level), 31.7% are Class II state roads (23.7% nationally), while municipal roads make up 47.6% of the network (64.5% nationally). Most of the road network in the province is paved with modern surfacing (92.3%), compared to 70.6% for the entire country. Table 3 shows the distribution of state and municipal roads in Vojvodina, their level of completion, and the share of modern pavement. It is evident that state roads have a very high share of modern surfacing (99.8%), whereas municipal roads have a significantly lower share (84%). This difference reflects the functional hierarchy of the road network, as state roads generally carry higher traffic volumes and are subject to stricter technical standards, while municipal roads primarily serve local traffic with lower loading demands and often accommodate a significant share of agricultural traffic in Vojvodina.

Table 3. Structure of the road network in Vojvodina [14], [15]

Category	Constructed roads		Unconstructed roads [km]	Modern pavement	
	length [km]	share in network [%]		length [km]	share in network [%]
Total road network	6,188.21	100.0	-	5,710.00	92.3
State roads, total	3,244.09	52.4	98.99	3,237.81	99.8
Class I state roads	1,282.02	20.7	10.61	1,282.02	100.0
Class Ia	258.05	4.2	0	258.05	100.0
Class Ib	1,023.97	16.5	10.61	1,023.97	100.0
Class II state roads	1,962.08	31.7	88.37	1,955.79	99.7
Class IIa	1,642.23	26.5	7.90	1,637.46	99.7
Class IIb	319.84	5.2	80.47	318.33	99.5
Municipal roads	2,944.11	47.6	-	2,472.19	84.0

The structure of public roads (excluding streets) in Serbia, by economic significance, does not differ significantly from the situation in European countries - the share of state roads is 35.5%, and

municipal roads account for 64.5%. In Vojvodina, however, the structure differs considerably from both the Serbian and European averages. Class I and II state roads constitute 52.4% of the network, while municipal roads make up 47.6% [13]. Given that this study focuses on the state road network, the subsequent analysis is limited to these categories.

4.2. SPATIAL DISTRIBUTION AND ROAD CATEGORIES

The state road network in Vojvodina has a clearly defined spatial structure that reflects the region's geographic and economic characteristics. The flat terrain of the Pannonian Plain provides favorable conditions for road construction and maintenance compared to the mountainous areas of Serbia, resulting in a dense and well-developed network of roads.

Despite this, network density indicators reveal significant challenges. According to the road density indicator, expressed as road length per million inhabitants, Serbia records 5,864 km/million inhabitants, which is roughly half the EU-27 average and comparable to Croatia, lagging behind most regional countries. In Vojvodina, this indicator is 3,342 km/million inhabitants, considerably below the national average.

A similar situation exists when analyzing road density relative to territorial area. With 525 km per 1,000 km², Serbia is nearly three times below the EU-27 average, while Vojvodina's value (286 km per 1,000 km²) is almost half of the national level. Among the observed countries, Serbia has a higher density of roads only compared to Bulgaria, Romania, and Croatia, while in Vojvodina this indicator is the lowest in the region. These data highlight the need for systematic improvement of local and regional infrastructure to reach EU standards.

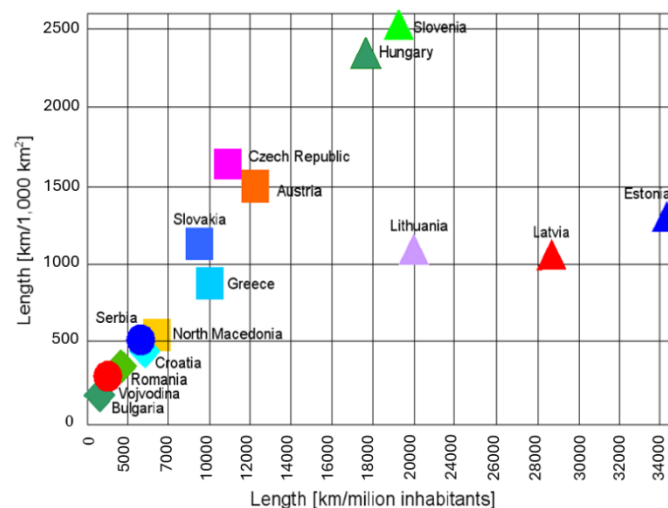


Figure 2. Comparison of road network density in Serbia and Vojvodina with European countries (created by author).

With 258 km of motorways (Class IA state roads) constructed, Vojvodina accounts for 27.9% of the total length of these roads in Serbia. This clearly highlights the significance and role of Vojvodina in the development of the national transport network. Viewed in a broader European context, both Vojvodina and Serbia rank in the middle among the analyzed countries, indicating that their motorway density is close to the European average. This means that, although they do not belong to the group of countries with the most developed motorway networks, they maintain a relatively stable position compared to their regional peers.

A particularly significant indicator is the share of motorways within the total state road network. Vojvodina, with a share of 8.0%, stands out as one of the regions with a highly developed motorway network, ranking just behind Bulgaria among the observed European countries (Figure 3). This demonstrates that Vojvodina is at the forefront in integrating modern road infrastructure into the national network, which has a direct impact on the speed and efficiency of freight and passenger transport.

In addition to the share within the total network, motorway density is also an important indicator (Figure 4). Vojvodina, together with Serbia, belongs to the group of countries with stable motorway coverage, providing relatively good accessibility and mobility within the region. Motorway density reflects not only the level of infrastructure development but also a long-term commitment to improving transport connectivity, which is crucial for economic growth and the competitiveness of the region within the framework of European integration.

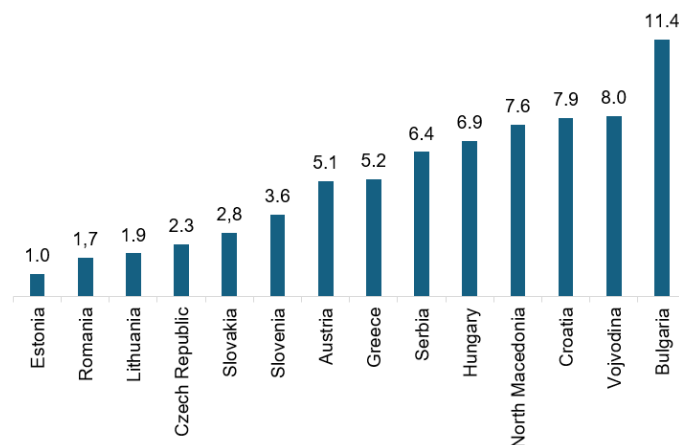


Figure 3. Share [%] of motorways in the total state road network [16].

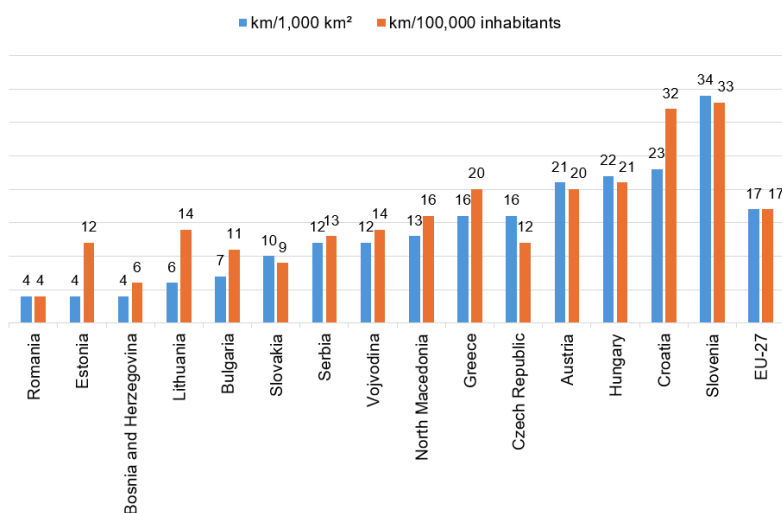


Figure 4. Motorway density [16].

Based on these indicators, it can be concluded that Vojvodina holds a significant position not only within the national context but also in the regional European framework. The high share of motorways in the total state road network, along with relatively favorable density compared to the European average, are key factors positioning Vojvodina as a transport hub and one of the most important transport regions in this part of Europe.

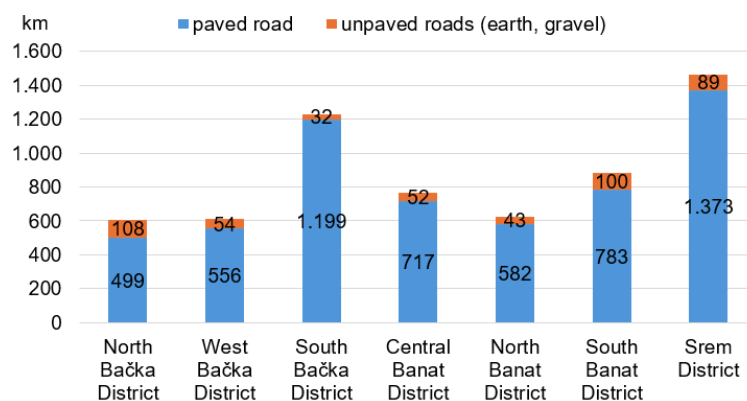


Figure 5. Regional indicators of the road network in Vojvodina (pavement type) [14], [15]

An analysis by districts of Vojvodina (Figures 5 and 6) shows that the Srem and South Bačka districts have the longest road networks. All districts in Vojvodina have a high share of roads with modern pavement, ranging from 88.7% to 97.4%, except for the North Bačka district, which has the lowest share at 82.2%. Analysis of road density by territory indicates the highest values in the Srem

and North Bačka districts, while South Banat and Central Banat districts fall below the provincial average. Road density per population is highest in Srem, North Banat, and Central Banat, while South Bačka and South Banat are below the provincial average.

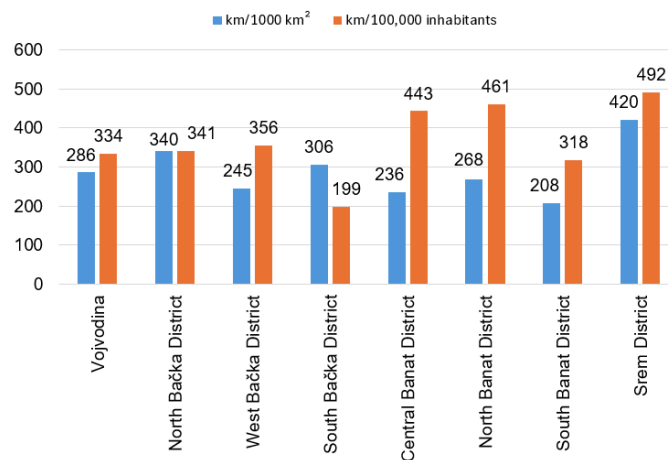


Figure 6. Regional indicators of the road network in Vojvodina (density) [14], [15]

A general characteristic of state roads in Vojvodina is their relatively good level of completion, except for certain sections and parts of routes passing through populated areas. The road network in Vojvodina is largely homogeneous, provides good regional and local connectivity, and has capacity that meets current and projected traffic needs over the medium term. The most significant achievements include the construction of motorways along Pan-European Corridor X and its branch Xb, as well as the opening of the road-railway bridge in Novi Sad in 2018.

However, the main challenge remains the condition and quality of the road infrastructure. Due to years of insufficient investment in maintenance, reconstruction, and modernization, the network is not fully developed and does not fully meet European technical and operational standards. Traffic safety levels lag behind the EU average, and operational costs are significantly higher. In Vojvodina, approximately 99 km of state roads remain uncompleted, of which around 80 km belongs to the Class IIb category.

4.3. ROAD TECHNICAL CHARACTERISTICS

As shown in Figure 7, the vast majority of state road sections in Vojvodina comply with the prescribed carriageway width criteria, with compliance levels exceeding 95% across all categories. The highest share of non-compliant sections is observed on Class IIb roads (approximately 4.4%), while deviations in other categories remain marginal. Overall, the network demonstrates a high level of technical standardization, with isolated deficiencies primarily associated with lower-class roads, where widening is often constrained by settlement patterns and agricultural land use, and modernization depends on available regional funding.

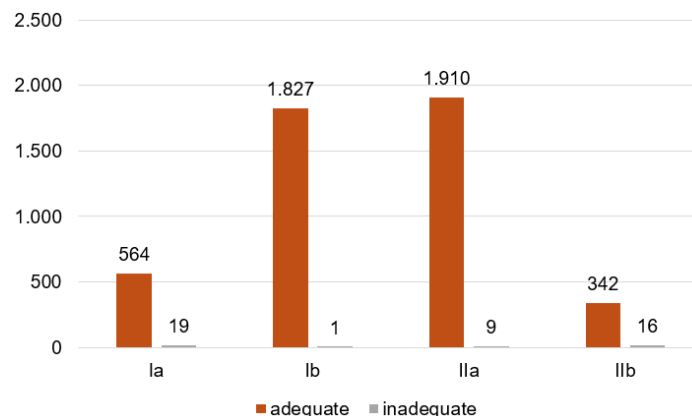


Figure 7. Lengths of roads with adequate carriageway width by road category (km) (created by author).

On the other hand, the analysis shows that the lack of carriageway width is concentrated on only a few road sections (Table 4), indicating that the prescribed standards are generally met across most

of the network. However, on the identified sections, such deviations may negatively affect traffic safety and operational capacity, depending on traffic demand, functional role, and surrounding environment.

Table 4. Degree of non-compliance with carriageway width standards

Category	Road No.	Length [km]	Compliant		Non-compliant	
			[km]	[%]	[km]	[%]
Ia	A1	391.96	384.43	98.08	7.53	1.92
	A3	190.95	179.84	94.18	11.11	5.82
Ib	10	157.17	156.36	99.48	0.81	0.52
	12	515.24	513.18	99.60	2.06	0.40
IIa	104	108.41	100.25	92.47	8.16	7.53
IIb	300	29.26	25.94	88.69	3.31	11.32
	313	36.68	24.73	67.41	11.95	32.59

The analysis of the Vojvodina road network structure by pavement type (Figure 8) indicates a high level of technical completion on state roads, with asphalt surfaces dominating across all categories. This outcome is expected, considering that Vojvodina is a region with well-developed transport infrastructure and flat terrain, which facilitates road construction and modernization. Class Ia and IM roads are fully asphalted, while Class Ib and IIa roads have a very high share of asphalted sections (97.97% and 97.91%, respectively). Concrete pavements are present only on Class IIa roads (1.53%), representing a minimal share of the total network. Class IIb roads stand out with the highest proportion of unpaved sections (classified as earth roads in this study, although the network includes a combination of earth and deteriorated gravel surfaces) at 16.05%, indicating a lower level of technical standardization compared to other state road categories and suggesting the need for progressive upgrading to ensure network consistency.

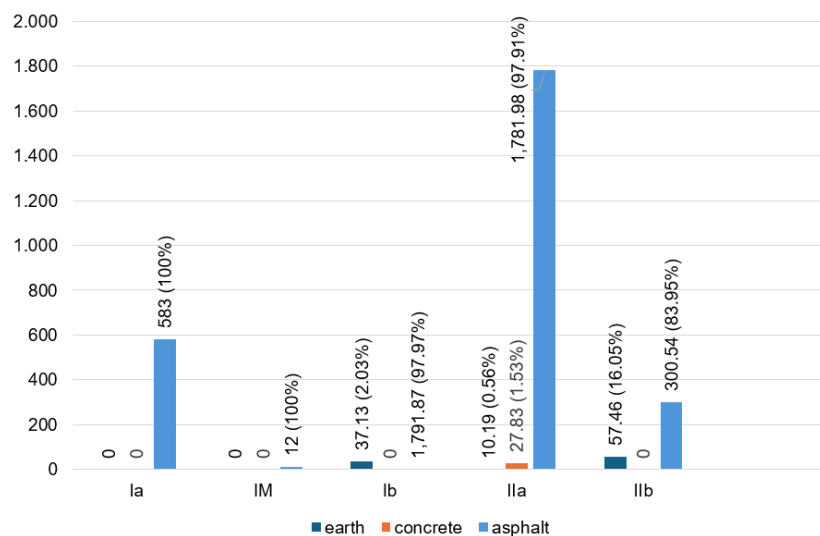


Figure 8. Road categories by pavement type (km/%) (created by author).

The presence of modern pavement on Class Ia and IM roads confirms that the infrastructure within these categories fully complies with technical standards for motorways and expressways, in line with their function - ensuring fast and safe traffic between major urban and regional centers and supporting international transport. Like carriageway width, insufficient pavement quality (Table 5) is concentrated on a limited number of road sections, where problems with passability may occur during rainfall or periods of high moisture.

According to EU standards for road infrastructure, the minimum lane width and requirements vary depending on the road category. For example, in Germany, the minimum lane width on federal roads (Bundesstraße) is 3.5 m, while on motorways (Autobahn) it is 3.75 m, with additional space for curbs and shoulders [17]. Furthermore, within the Trans-European Transport Network (TEN-T), which includes the main European road corridors, roads are required to have at least two lanes in each direction (four lanes total), with physical separation of traffic flows and a minimum lane width of 3.5 m [18].

Table 5. Pavement types on selected road sections

Category	Road No.	Length [km]	Earth		Concrete		Asphalt	
			[km]	[%]	[km]	[%]	[km]	[%]
Ia	A1	391.96	0.00	0.00	0.00	0.00	391.96	1000.00
	A3	190.95	0.00	0.00	0.00	0.00	190.95	1000.00
Ib	19	45.13	10.83	24.00	0.00	0.00	34.30	760.00
	21	78.31	10.96	14.00	0.00	0.00	67.35	860.00
IIa	104	108.63	9.78	9.00	17.38	16.00	81.47	750.00
IIb	307	15.11	10.27	68.00	0.00	0.00	4.84	320.00
	308	26.48	2.91	11.00	0.00	0.00	23.57	890.00
	310	74.98	26.99	36.00	0.00	0.00	47.99	640.00
	311	16.03	14.64	91.30	0.00	0.00	1.39	8.70
	314	34.55	12.68	36.70	0.00	0.00	21.87	63.30

By comparing these standards with the road infrastructure data in Vojvodina, it can be concluded that most roads comply with European standards. For instance, Class Ia and Ib roads have a high proportion of sections meeting the prescribed lane width and cross-sectional profile requirements, indicating good infrastructural quality. However, Class IIb roads show a higher proportion of sections that do not meet the standards, highlighting the need for additional investments in their modernization and widening.

Compared to EU countries, Serbia has made significant progress in aligning its road infrastructure with European standards. However, continued investment in road modernization and maintenance, particularly for lower-category roads, is necessary to ensure higher traffic safety and efficiency.

Similarly, in the EU, higher-category roads meet lane width standards on over 99% of sections, with predominantly asphalt or concrete pavements maintained regularly and periodically. In Vojvodina, conditions are roughly comparable for Class Ia and Ib roads but lag behind on local and secondary roads (IIb), where insufficient modernization and the presence of unpaved sections indicate the need for additional investments.

5. CONCLUSION

The analysis of the state of the national road network in Vojvodina shows that most of the Class I and II roads meet the prescribed technical standards, particularly regarding lane width and pavement type. Class Ia and Ib roads demonstrate an almost complete level of compliance with existing standards, while Class IIa roads generally meet the required criteria, with minor deviations on certain sections. The most significant issues were identified on Class IIb roads, where notable deviations in carriageway width on specific stretches could negatively impact traffic safety and capacity. Such conditions may warrant targeted modernization or reconstruction interventions where traffic demand and service requirements justify such measures.

At the same time, the results confirm that Vojvodina stands out as one of the most infrastructure-developed regions in Serbia, featuring a dense and well-connected system of national roads with a high proportion of modern pavement. This condition is the result of long-term investments, favorable geographic conditions, and a balanced spatial distribution of settlements, enabling the formation of a functionally well-integrated road network.

By considering both administrative and functional classifications alongside key technical parameters, it can be concluded that Vojvodina's road network is generally well adapted to the requirements of safe and efficient road traffic and plays a significant role in Serbia's transit connectivity with Central and Southeastern Europe. However, the identified weaknesses on lower-category roads indicate the need for targeted and planned future investments to ensure full compliance with prescribed standards and to maintain a high level of road safety and functionality over the long term.

The next step in analyzing Vojvodina's national road network would involve a more detailed assessment of road geometric elements and the spatial positioning of roads in relation to settlements, considering their functional role, technical requirements, and operational conditions, including roadside services. Such an approach would allow a comprehensive evaluation of the alignment between designed and actual road conditions, particularly on sections passing through or near settlements, where conflicts often arise between transit functions, traffic safety, and local needs.

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