73
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INVESTIGATION OF THE PURPOSE OF THE TRAVEL IN THE AREA OF UNA – SANA CANTON FOR THE NEEDS OF EXPRESSWAY CONSTRUCTION

Abstract

In this paper, research data on the purpose of the trip, the origin and destination of the trip, and the occupancy of vehicles for the construction of the expressway were analyzed. All published data are given in tables with percentages, and graphical representation in a GIS environment is used. The research included nine locations in the area of the Una-Sana Canton, which are also displayed in a GIS environment. Research results showed that the preliminary expressway route should go along the Bihać - Cazin - Velika Kladuša section. This research can be useful to all subjects involved in the preparation of expressway feasibility studies, local self-government and the like.

Keywords: trafic research, traffic counting, GIS, survey

ИСТРАЖИВАЊЕ СВРХЕ ПУТОВАЊА НА ПОДРУЧЈУ УНСКО - САНСКОГ КАНТОНА ЗА ПОТРЕБЕ ИЗГРАДЊЕ БРЗЕ ЦЕСТЕ

Сажетак

У овом раду анализирани су подаци истраживања о сврси путовања, поријеклу и циљу путовања, и попуњености возила за изградњу брзе цесте. Сви подаци који су обрађени дати су у табелама са процентима, и искориштени су за графички приказ у ГИС окружењу. Истраживањем је обухваћено девет локација на простору Унско – санског кантона које су такође приказане у ГИС окружењу. Резултати истраживања су показали да би идејна траса брзе цесте требала ићи дионицом Бихаћ – Цазин – Велика Кладуша. Ово истраживање може бити од користи свим субјектима који се баве израдама студија оправданостих брзих цеста , локалној самоуправи и слично.

Кључне ријечи: саобраћајно истраживање, бројање саобраћаја, ГИС, анкета

1. INTRODUCTION

Throughout history, human lives and obligations have always been unimaginable without a quality and rationally built traffic infrastructure throughout the territory of a country as an indispensable part of a global and dynamic economic system [1]. Traffic research implies defining the problems and goals of research, determining data origins and types of research, method of data collection, data analysis and report on obtained research results. With the right approach and survey methodology, relevant and useful data with high value can be collected. One of the goals of the work is to clearly present the methodology of the survey as well as other information that affects the final research result [2]. Considering the high population density and a large number of settlements, as well as the significant traffic-geographical importance of this area, the road network is relatively well-developed (it is connected to the rest of the Federation by arterial roads, and the connectivity of the Canton centers is achieved via regional roads without the existence of higher-order highways), although there are certain issues such as the obsolescence and deterioration of certain parts of the transportation infrastructure. [3,9]. In the research part of the paper, questionnaires were used: origin and destination of the trip, average vehicle occupancy, purpose of the trip. Due to the global development of traffic and traffic demand, the existing traffic infrastructure does not meet the existing requirements. The planned expressway Bihać-Cazin-Velika Kladuša expressway route is located in the western part of Bosnia and Herzegovina, in the Una-Sana canton. It passes through the municipality of Velika Kladuša, starting from the Maljevac border crossing, then continues through the city of Cazin towards Bihać, up to the junction of the expressway route with the planned Bihać bypass, shown in Figure 2. of this paper (see Figure 2.).The Una-Sana Canton has a network of road infrastructure consisting of a network of local and regional roads, via main roads, and European road routes that connect the Una-Sana Canton with Corridor Vc and further to the south and north with the Republic of Croatia. Main connection with Corridor Vc is the European route E-761, which runs through Bihać - Bosanski Petrovac - the inter-entity demarcation line, while the connection of the southern part of the Una-Sana Canton with the Republic of Croatia is made via road E-59, which runs through Izačić-Bihać - Ripač-Užljebić. The development of the international transport axis in BiH in the northwest-southeast direction, along with the already established north-south axis of development, is a prerequisite for polycentric sustainable development at the regional level, which is a generally accepted modern approach to the country development and one of the basic principles of the country development in the EU. The implementation of the Bihać-Velika Kladuš expressway construction project would complete the strategically important project of adequate road connection of the Una-Sana Canton with other areas in Bosnia and Herzegovina and the Republic of Croatia. The construction of a new road implies a road with four traffic lanes, two lanes on both sides. The purpose of building a new road is to shorten the travel time to the destination. In addition to shortening the travel time, the construction of the new road also improves the area where it is located, thereby encouraging the investors and the development of the industrial zone. The planned expressway will reduce and relieve traffic on the existing roads, thereby achieving greater traffic safety and security for other road users [4]. The authors propose the aforementioned general statement as a hypothesis, which will be either refuted or confirmed during the preparation of planning and study documentation (traffic studies, multi-criteria analysis, and feasibility study). This documentation represents one of the input data for the financial-economic analysis of the mentioned documentation, in which the profitability of the proposed expressway will be elaborately justified. The adopted methodology for the analysis and forecast of traffic needs, relevant for traffic infrastructure development studies, will be based on the research of the mentioned needs between individual zones within the narrower and wider gravitational area of the treated roadway.

The narrower gravitational area includes primarily populated places through which the mentioned route passes. The narrower gravitational area includes populated areas of the following municipalities/cities:

- In the City of Bihać: Bihać, Bajrići, Jankovac, Brekovica, Vrsta, Velika Gata, Donja Gata;
- In the City of Cazin: Vrelo, Mutnik, Pjanići, Ćoralići, Donja Barska, Kovačevići, Čajići, Gornja Barska, Pećigrad, Rošići, Mujakići;
- In the municipality of Velika Kladuša: Šabići, Šumatac, Mala Kladuša, Miljkovići, Glavica, Grahovo, Trn, Polje, Nepeke, Velika Kladuša, Trnovi.

The municipalities/cities through which the Bihać-Cazin-Velika Kladuša expressway section passes are taken as the wider gravitational area. The expressway route passes through the cities of Bihać and Cazin and the municipality of Velika Kladuša. As a broader area, the region of Slovenia and

Croatia can also be considered, with an emphasis on Croatia. The latter is justified by the fact that the construction of the proposed expressway would result in a shorter (higher quality) route connecting parts of the Sisak-Moslavina and Karlovac counties with the Lika-Senj County (see Figure 1.).

Figure 1. The area of the expressway
Source: Civil Engineering Institute IG

The following sections will present the methodology employed, the obtained results at the study site, as well as the objectives of this research.

2. STUDY AREA

The Una-Sana Canton consists of the cities of Bihać, Bosanska Krupa and Cazin and five other municipalities. The Una-Sana canton borders Croatia in the north, west and northeast, Republika Srpska in the east and southeast, and Canton 10 in the southwest. The city of Bihać is located in the northwestern part of BiH, belongs to the entity of the Federation of BiH and is the seat of USC. According to the population census, the city of Bihać has 61,564 inhabitants. The city has an area of 900 km², which is 21.8% of the USC territory, and it is composed of 35 local communities. Its relief is to a greater extent diverse, mainly consisting of fields, hills and mid-mountain land. The average altitude is 224.7 meters, the greater part of the area is located on terrains 600 meters above sea level, while a part is located in the mountain and hill-mountain belt and over 900 meters. The city of Cazin is also located in the northwestern part of Bosnia and Herzegovina at the intersection of the roads leading from Bihać to Velika Kladuša. Cazin has about 66,149 inhabitants distributed into 23 local communities and spreading over an area of 356 km2. The terrain is predominantly low-

lying between 200 and 400 meters above sea level. This area has a temperate-continental climate with rather harsh winters and hot summers. The municipality of Velika Kladuša is located in the far northwest of Bosnia and Herzegovina. In the south it borders the municipalities of Bužim and Cazin, while in the west, north and east it borders Croatia and the municipalities of Centingrad, Vojnić, Topusko, Glina and Dvor. The municipality has about 40,419 inhabitants, and it covers an area of 331.73 km². Velika Kladuša is one of the most densely populated places in Bosnia and Herzegovina, it is divided into 14 local communities.

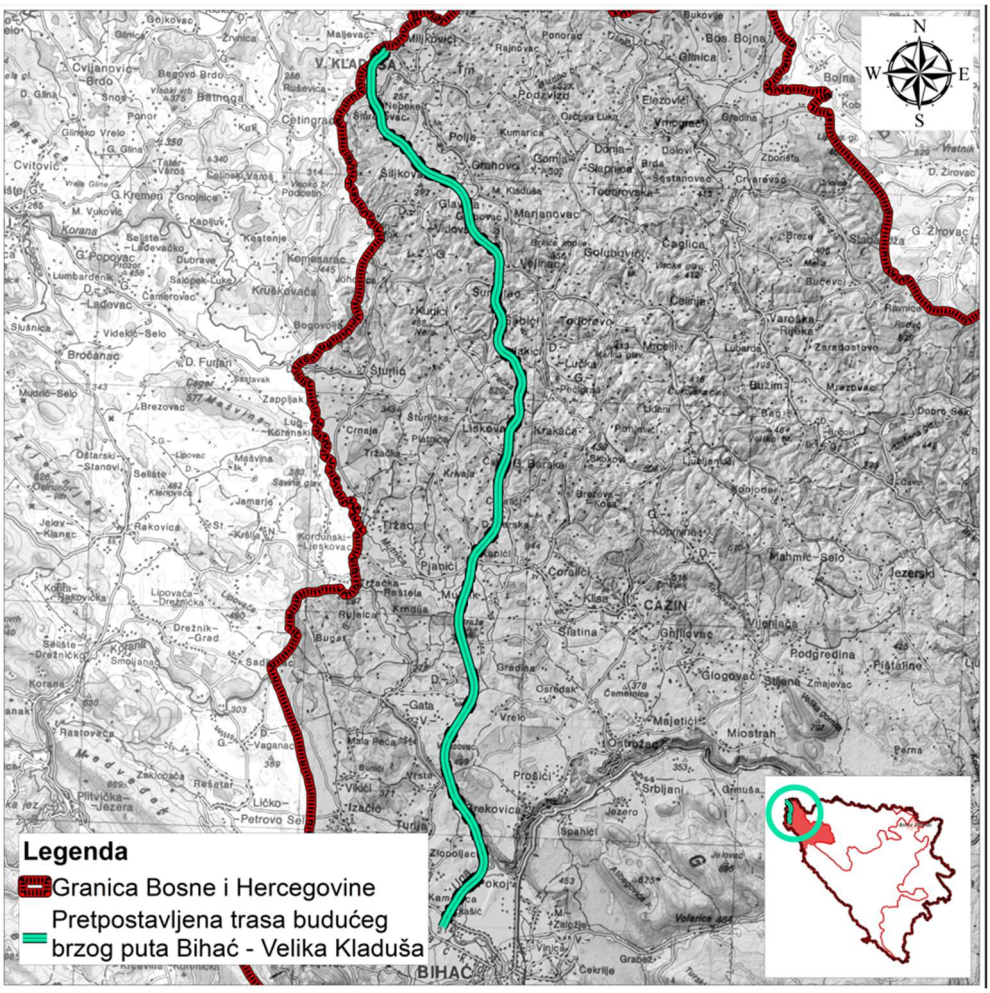

Figure 2. Figure 2. The assumed route of the expressway
Source: Civil Engineering Institute IG

3. MATERIALS AND METHODS

Given that the length data, i.e. distribution of transport infrastructure, are not sufficient to draw relevant conclusions about the transport development of the country, but essentially represent a good foundation for further research, the following parameters were also calculated.

Traffic network density

$$a = \frac{D \times 100}{P} \quad \text{.....(1)}$$

Where D is the length of communication, and P is the area in km^2

Table 1. Calculation of the traffic network density in a wider gravitational scope

D ***(length of main and regional roads in a wider gravitational area)*** **km**	***P (area of inhabited places through which the planned expressway route passes) km²***	***Traffic network density (a)***
326.43 km	*1,632.15 km²*	20

The traffic network density in the wider gravitational area (city of Cazin, municipality of Velika Kladuša and the city of Bihać), through which the planned route of the expressway passes, amounts to 20.

Table 2. Calculation of the traffic network density in the narrower gravitational scope

D (length of main and regional roads in a narrow gravitational area) km	***P (area of inhabited places through which the planned expressway route passes) km²***	***Traffic network density (a)***
80.8 km	258.74 *km²*	31.22

The traffic network density in the narrower gravitational area, which includes all populated places through which the expressway route passes, amounts to 31.22.

Length of communications per 10,000 inhabitants

$$a' = \frac{D \times 10000}{L} \quad (2)$$

Where D is the length of communication, and L is the number of inhabitants:

Table 3. Calculation of the length of communications per 10,000 inhabitants in the wider gravitational area

D (length of main and regional roads in the wider gravitational area) km	***L (number of inhabitants in the wider gravitational area)***	***Length of communications per 10,000 inhabitants (a')***
326.43 km	*162,829*	20.05 km

The length of communications covering the wider gravitational area per 10,000 inhabitants amounts to 20.05 km.

Table 4. Calculation of the length of communications per 10,000 inhabitants in the narrower gravitational area coverage

D (length of main and regional roads in the narrower gravitational area) km	***L (number of inhabitants in the narrower gravitational range)***	***Length of communications per 10,000 inhabitants (a')***
80.8 km	71.653	11,27 km

The length of communications per 10,000 inhabitants is 11.27 km.

Network density in relation to the area and number of inhabitants, the so-called Engel coefficient

$$A = \sqrt{\frac{D \times 100}{P} = \frac{D \times 10000}{L}} = \frac{D \times 1000}{\sqrt{P \times L}} \quad \text{.....(3)}$$

$A = \sqrt{a \times a'}$

Table 5. Calculation of the Engel coefficient in the narrower gravitational area

Traffic network density	***Length of communication per 10,000 inhabitants (a')***	***Engel coefficient***
31,22	11,27 km	18,75

Table 6. Calculation of the Engel coefficient in the wider gravitational area

Traffic network density	***Length of communication per 10,000 inhabitants (a')***	***Engel coefficient***
20	20,05	20,24

In this paper, in addition to the mentioned calculations, the survey method was also utilized. The survey method is an organized and pre-prepared examination, research, that is, the poll of views, opinions and data on a topic or phenomenon by means of a survey questionnaire as a series of questions, which are addressed to a high number of people." [3]. For the purposes of this research, a survey questionnaire was created which, among other things, investigated the trip: type of vehicle, origin – destination of trip, purpose of the trip, vehicle occupancy and average annual mileage of the vehicle. The survey was conducted in the period of May to June 2023, as shown in Figures 4 and 5 in the continuation of the paper. The applied method involves one of the research or additional research methods used in the preparation of multi-criteria analyses, traffic studies, and feasibility studies. It also constitutes one of the basic input data for analyses that involve presenting potential benefits after the construction of the planned roadway in socio-economic or multi-criteria analysis and aim to illustrate calculations of time savings, vehicle operation, travel motivations, and reducing the number of traffic accidents. This analysis serves as supplementary research to gather as precise data as possible using AADT (Average Annual Daily Traffic) to create detailed study documentation.

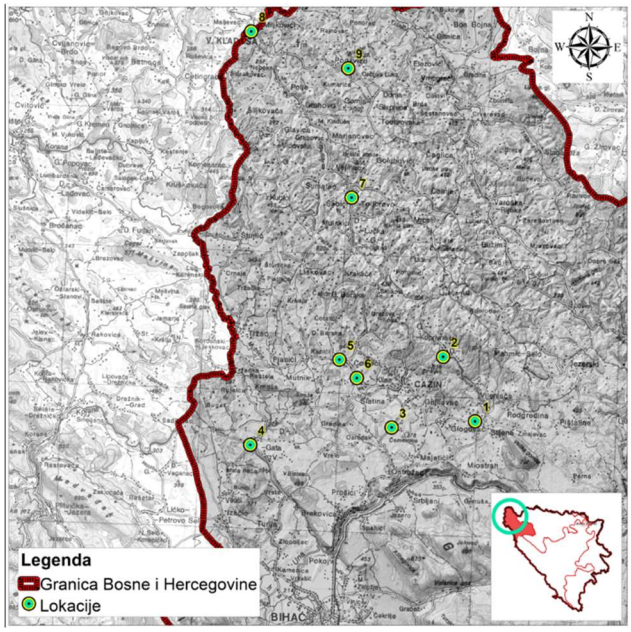

Figure 3. Locations of polling stations
Source: Civil Engineering Institute IG

4. RESULTS AND DISCUSSION

An expressway represents one of the main elements of traffic infrastructure of a country and contributes to the development of the territory where it is located. One of the solutions to increase the intensity of traffic and the density of traffic flow is precisely the realisation of the expressway.

Figure 4. Survey of road users1

Figure 5. Survey of road users 2

After processing the data obtained by surveying all nine locations shown in Figure 3, the results are shown in the following table:

Table 7. Percentage analysis of respondents by polling places

	PC	HDV + LDV	BUS
NO.	1860	838	314
% Of those surveyed	61.76	27.82	10.42

Table 8. Length of trip

Length of trip (km)				
0-10 km	**10-20 km**	**20-50 km**	**50-100 km**	**>100 km**
9	15.4	44.2	5.6	25.8
%	%	%	%	%

Table 9. Purpose of trip

PRIVATE	57.3
BUSINESS	42.7

Table 10. Type of trip

TRANSIT	21
ORIGINAL - TARGET	24,5
LOCAL	54,5

According to the results of the survey conducted among 3,012 traffic participants, the majority of vehicles, 1,860 of them, were passenger vehicles. It was also found that the most common travel distance was between 20 and 50 kilometers, accounting for 44.2% of the total number of respondents, while the least common was on routes between 50 – 100 kilometers, at 5.6% (Table No. 8). Out of the total number of respondents, 57.3% stated that they had undertaken private trips, while 54.5% were local trips (Table No. 10). Furthermore, the analysis showed that the highest percentage of respondents had local trips, accounting for 54.5%, while 21% of respondents had transit-type trips (Table No. 10).

5. CONCLUSION

Based on the results of a survey of 3,012 road users, it was determined that the largest number of passenger vehicles was 1,860. Also, the trip length was determined, where the highest number of respondents used a section of 20-50 km, then 57.3% were private trips and 54.5% local travel. The mentioned expressway is connected to the Vc corridor and road routes in the Republic of Croatia via the road infrastructure network of the Una-Sana Canton and the Federation of Bosnia and Herzegovina. The beginning of the road in question is at its junction with the planned Bihać bypass, and the end is in the area of the Maljevac border crossing. These studies are of paramount importance for identifying deficiencies in the current traffic infrastructure and determining areas that require improvement to increase efficiency and safety on roads. Data collected through travel purpose surveys and vehicle surveys provide input information necessary for the preparation of traffic studies, feasibility studies, and other analyses required for the planning and implementation of the expressway. Without accurate information about the needs and demands of road users, there is a risk of building infrastructure that does not meet the actual needs of the community. This can result in inefficient use of resources, unnecessary costs, or insufficient road capacity. Therefore, conducting in-depth research on travel purposes and vehicle surveys is crucial as an initial step in planning the expressway to ensure that the new infrastructure adequately meets traffic demands and enhances the quality of life in the community.

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