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GEOMORPHOLOGICAL CHARACTERISTICH MOTORWAY ROUTE CORRIDOR Vc KAKANJ - BILJEŠEVO

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ABSTRACT
Geomorphological analysis of sections of the highway Kakanj Bilješevo gives an overview of the area from several aspects, namely: geological settings, lithological composition and tectonics, morphogenesis, process creation and development of the relief, morphography; description of forms of relief and morphohronology; Dated forms of relief in the study area. Morphometry provides vertical articulation, energy, topography and drainage system. Geomorphological characteristics are based on the results of completed field investigations shares motorway Kakanj Bilješevo, which is hilly and mountainous area with major water courses of the Bosna River and its tributaries.
Geological structure of the study area consists of Mesozoic-Cenozoic tectonically disturbed rocks. Genetic forms of relief are broken down into morphostructures and morphosculpture, caused by exogenous and neotectonic movements and processes during the Neogene and Quaternary. Energy parameters of the relief suggest active development of geodynamic movements. Drainage system through the categorization of water streams, bifurcation index and length, number and length of flow analysis, confirming an interactive relationship in the form of relief from geodynamic processes.
Key words: geomorphological analysis, energy relief, drainage system

1. INTRODUCTION
Study area is the motorway sections Kakanj Bilješevo in Bosnia and Herzegovina, municipalities Kakanj. A complex geomorphological analysis involves the application of modern methods and procedures of quantitative and qualitative analysis of the results of field-based research.

2. GEOGRAPHICAL LOCATION AREA
Sections of the highway on the Corridor Vc Kakanj - Bilješevo, length of nine kilometers geographically belongs to the southern part of the municipality Kakanj, (40 ° 00'- 44 ° 22' 30". middle latitudes and 18 ° 00';-18 ° 15' m.l.). (*fig. 1*).

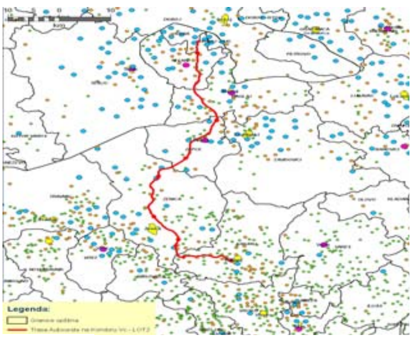


Figure 1 Corridor Vc Kakanj - Bilješevo

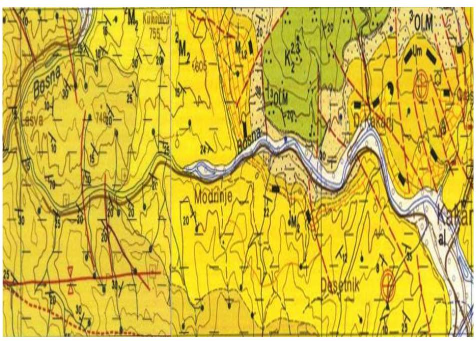


Figure 2 Geological map - the study area

3. GEOLOGICAL SETTINGS

Lithological composition of the study area consists of rocks, Upper Cretaceous, Tertiary and Quaternary (*fig. 2*). Upper Cretaceous is represented senonskim-turonian sediments ($K_2^{2,3}$), composed of calcarenite, arenaceous rocks, calcrudit, marly micrite and marl, which represents a karbonatics flysch. Tertiary is represented limnic-terrestrial sediments from two polifacially complexes and several distinct lithostratigraphic units: Oligomiocene polifacially complex is divided into three units: the basal zone, travertine limestone and mottled zone. Basal zone of limestone and travertine (^{1,2}Ol, M) consists of limestones, conglomerates and sandstones. Colourful Zone (^{3}Ol, M) is built from a conglomerate that replacement with sandstone, marl and clay. Older Miocene complex consists of four lithostratigraphic units: the main coal zones ($M_{1,2}$), povlatn limestone zone ($^{1}M_2$), transition zone ($^{2}M_2$) and lašva series ($M_{2,3}$). Quaternary alluvial deposits represented (al) developed in the areas of river valley, which is mostly river gravel containing layers of sand, less clay. (3)

Tectonic Study area belongs to the zone of Paleozoic and Mesozoic limestone, shale, under the represented two smaller units, the Upper Cretaceous folded complex and srajevo-zenica basin. (2,4)

4. GEOMORPHOLOGIC COMPLEX ANALYSIS

A complex geomorphological analysis includes quantitative and qualitative analysis. Quantitative geomorphological analysis defines the geological structure, morphogenesis, morphography, morphohronology and morphometric study area. Morphogenetic identified endogenous neotectonic fault types, link arm turn the valley of the Bosna River at the entrance to the city Kakanj, and exogenous, fluvio-denudation and fluvio-accumulative forms. Morphohronology are determined forms originate neotectonic movements and exogenous processes in the Neogene and Quaternary. Morphometric analysis revealed three classes of relief (*table 1*). (1)

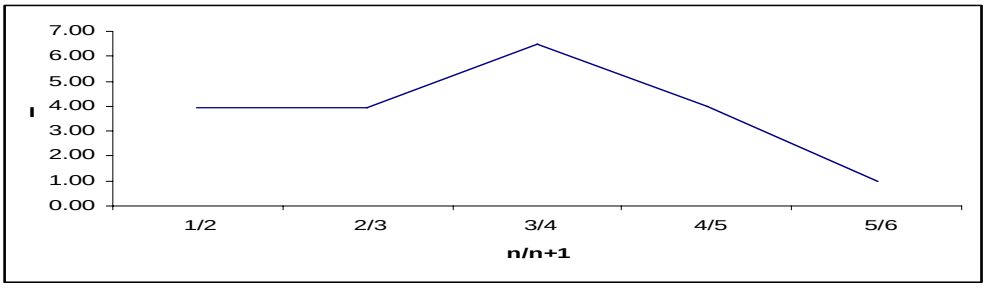
Table 1. Classes vertical separations of relief

Class relif	Vertical articulation of class	relief characteristics
1	5-30 m	poorly articulated plains
2	30-100 m	poorly articulated relief
3	100-300 m	Moderately broken relief

Analysis of energy relief is made on the 27 km^2, which corresponds to the length of the analyzed sections of the highway and 3 km width caused by the section of the field follows the course of the Bosna River. Drainage system of the Bosna River area as a major waterway with its tributaries. Categorization is determined by the flow stream position in the hierarchy of the drainage system, with six categories of streams (*table 2*).

Table 2. Categorization flows

n (category)	**N** (No. flow)
1	400
2	102
3	26
4	4
5	1
6	1



Graphic 1. Index bifurcation

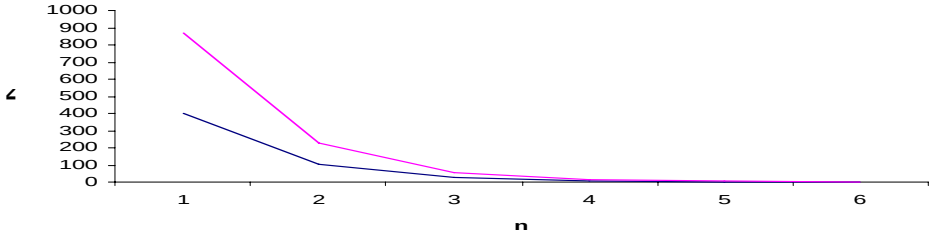
Table 3. Index length

n (Category)	$\mathbf{L_n}=\Sigma\, l_n/N_n$ (The average length of category)	$\mathbf{I_L}=L_{n+1}/L_n$ (Index length)
1	$L_1=\Sigma l_1/N_1$=614,213 cm/400 = 1,54	$I_L=L_2/L_1$=2,34/1,54 =1,52
2	$L_2=\Sigma l_2/N_2$=238,3 cm/102 = 2,34	$I_L=L_3/L_2$=8,12/2,34 =3,47
3	$L_3=\Sigma l_3/N_3$=211 cm/26 = 8,12	$I_L=L_4/L_3$=11,53/8,12 =1,42
4	$L_4=\Sigma l_4/N_4$=46,1 cm/4 =11,53	$I_L=L_5/L_4$=76,8/11,53 =6,66
5	$L_5=\Sigma l_5/N_5$=76,8 cm/1 =76,8	$I_L=L_6/L_5$=44,3/76,8 =0,58
6	$L_6=\Sigma l_6/N_6$=44,3 cm/1 =44,3	
$\mathbf{I_L}$ high =$(L_2/L_1+L_3/L_2+L_4/L_3+L_5/L_4+L_6/L_5)/5$=(1,52+3,47+1,42+6,66+0,58)/5= 13,56/5=2,73		

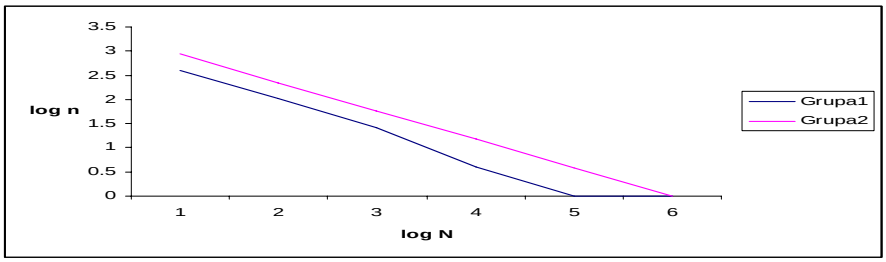
Table 4. Number of flows of real system

Real system (the actual number of flows)		
n (category)	**N** (No. flow)	**log N**
1	400	2,6
2	102	2,01
3	26	1,41
4	4	0,6
5	1	0
6	1	0

The law of flow was determined deviation of real drainage system from the ideal, theoretical, correlation of the GP of the real system with an ideal geometric progression of theoretical models. The deviation from the equilibrium state changes with the changing categories of drainage systems being developed in the area of neotectonic active, (*graphic 2, and 3*).



Graphics 2. The deviation of the real flow of the steady state



Graphics 3. Semilogarithm coordinate system-geometric progression

Analysis of the length of streams is performed on the second category of streams draining areas which results in a reflection of endogenous factors on the length of the flow.
Qualitative analysis was based geomorphological field observations and surveys conducted exploratory drilling in the construction of the bridge l = 122.40 m on the section of highway drivuša-bilješevo (fair), an +022,70 chainage km - 1 km +145.10, where he established lithological composition and thickness of alluvial cover, the geological substrate and bark decomposition (*table 5*). (5)

Table 5. Alluvial deposits

Mark well	Depth well	**Thickness of alluvial cover (al)**				
		mold	clay	silt	gravel	total thickness al
		1	2	2a	3	
B-1	8,00	1,10	1,90	-	3,20	6,20
B-2	11,0	1,00	2,00	5,50	-	8,50

5. CONCLUSION

Geological structure of the Corridor Vc, Kakanj-Bilješevo make rocks of Upper Cretaceous, Tertiary, with limničko oligomiocena-terrestrial sediments, Miocene and early Quaternary.
The relief consists of exogenous erosive and accumulative forms belonging to the endogenous forms of neotectonic fault process. According to the vertical segmentation are defined: poorly articulated plain, slightly and moderately broken down relief.
Parameters of energy relief point on the interaction and intensity of the exogenous processes and neotectonic movements. The analysis of the drainage system was established six categories of watercourses. Variable values of the index and length bifurkcije flows is a consequence of neotectonic activity. It was found deviations of real drainage system from the ideal, theoretical, that is changing and evolving, as evidenced determined length discrepancies, which flows indicate neotectonic activity in this area. Obtained by analyzing the length of the flow is a reflection of endogenous factors. Areas of shortening length of streams in the same category indicate the relative uplift of the terrain and erosion, while areas in the central parts with longer streams as a result of ground subsidence and relative point to increased accumulation.

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