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LANDSLIDES ON THE ROADS OF THE NORTHERN PART OF THE REPUBLIC OF SRPSKA AS A RESULT OF ELEMENTAL OR ANTHROPOGENIC PROCESSES

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ABSTRACT

The Republic of Srpska, which is an integral part of Bosnia and Herzegovina, was affected by intense precipitation during May 2014 and May 2015. The northern part of the Republic of Srpska is located between the plain area of the Sava River and the mountain massif of the inner Dinarides, while the eastern and western parts are confined to the rivers Drina and Una. Increased precipitation, which in 2014 was three times higher than the average, activated large number of landslides, and most of them threatened the facilities of various purposes. One year later, in the same month, this area was again hit by intense precipitation, less than in the previous year, but more significant by the size of activated landslides.

The most significant landslides were formed along the roads, and the degree of damage is different, depending on the method of construction and maintenance during exploitation.The slopes on which roads are built are in general conditionally stable, and for years have kept their stability in natural conditions. By engineering interventions during the construction of the roads, the natural state of balance was disturbed, which was manifested with delay, since the slopes were not well repaired. The open terrain profiles on the slopes created favorable conditions for water to flow into the quasi homogeneous and heterogeneous clay sediments, where their stability was disturbed.

The roads that were built of good quality as well as slope reparations during construction did not have significant damage during intense precipitation, although some of them were built several decades earlier. During the inventory of landslides on the roads, the effects of elemental and anthropogenic processes were analyzed, where 23 of the characteristic landslides were selected. The periods of construction before and after 1990 were separated, that is, the periods of earlier quality construction of facilities from today's modern one.

Key words: *precipitation, landslides, roads, slopes, reparations*

INTRODUCTION

Terrains on which the roads are built in the Republic of Srpska are mostly conditionally stable or unstable slopes. They are built of clay sediments (clayey marls, petrificated clay, clay, and alevrolites) and sandy sediments of different degrees of saturation with water from atmospheric deposits or collectors in the outback. The formation of landslides on roads is related to the elemental and anthropogenic processes. Which of the above factors will have a greater impact depends from the period of environmental disturbance. Dry periods during the year are not characteristic by elemental processes when the landslides are formed, but create the conditions for the development of landslides after the rainfall periods. High temperatures lead to the drainage of the surface area of the terrain, creating larger cracks, which after the first rainfalls absorb the water and degrade the structure of the surface sediments. This is more characteristic to the mountainous or slightly aslope terrains, which leads to disturbance of natural environmental balance and activation of rock mass, resulting in a formation of landslides of a certain scale [1,2,3,4,5,6,7,8,9].

Construction of facilities often results in a disturbance of terrain stability at all weather seasons during the year, depending from the degree of its natural stability. This phenomenon was more characteristic to the end of the 20th and the beginning of the 21st century, since the construction with time has become more frequent. Engineering activities, with respect to the influence of humans on the change of natural state of the rock mass during the construction of facilities, have given more significance to the anthropogenic processes, especially in the sphere of insufficient awareness that it is necessary to conduct the field studies of terrain first and then to start with construction. Today everything is being built rapidly, which is especially notable in linear facilities.

This period can be named as "the modern construction of facilities", whish is not organizationally, professionally and scientifically characterized, it simply imposed itself [10]. The negative results of construction of facilities in this period are visible during or after construction, especially during the heavy precipitation, which this area has encountered twice in May 2014 and in 2015.

In the first period of intense precipitation in May 2014, several thousand landslides were activated, and the largest number was related to linear facilities, primarily traffic roads. Almost all traffic roads from local to highways have suffered a certain degree of damage. All significant landslides have been recorded, primarily those ones related to the endangering of the population and facilities of interest to the social community [11]. The period of May 2015 is characterized by the appearance of a smaller number of landslides, but significantly larger than in the previous period. Mostly these are the landslides on the slopes where the balance situation was deteriorated during the heavy precipitation in May 2014, and now the process is just finished [12].

The question that arises is how far the formation of landslides in the road zones is the result of the natural elemental processes, and what is the result of engineering activities during the construction of facilities [4,5,11,12,13,14,15,16,1,7,18,19,20] The landslides on roads built before 1990 and after that period were analyzed. This delimitation was taken as a period of change of the social system, which left the consequences in the field of facility construction.

As part of one of the UNDI projects, a number of landslides in Bosnia and Herzegovina was visited, and a short overview of the surveyed landslides in the northern part of the Republic of Srpska was presented in the study.

THE REASONS FOR RESEARCH

During the May of 2014, the weather was variable with frequent and increased precipitation. Especially the period from May 14-17, when the increased precipitation caused severe floods in northern part of the Republic of Srpska, figure 1. The amount of rainfall was up to three times than the average (www.rhmzrs.com/meteorologija/mjesecne-analize), and in some places May had the highest amount of precipitation since meteorological observations were conducted in this area, figure 2. Another significant period was in May 2015, when the precipitation was significantly lower compared to May 2014, but still slightly higher than the average annual rainfall of this month.

The landslides formed during the mentioned period left great consequences on the field, especially on linear facilities, and mostly on roads of lower categories [11,12]. Almost all roads in the northern part of the Republic of Srpska are damaged, primarily the roads of local significance more than regional and main roads. Due to the need of quick restoration of roads, putting them back in the function and establishment of normal communications, an inspection of all the landslides on every important road was carried out.

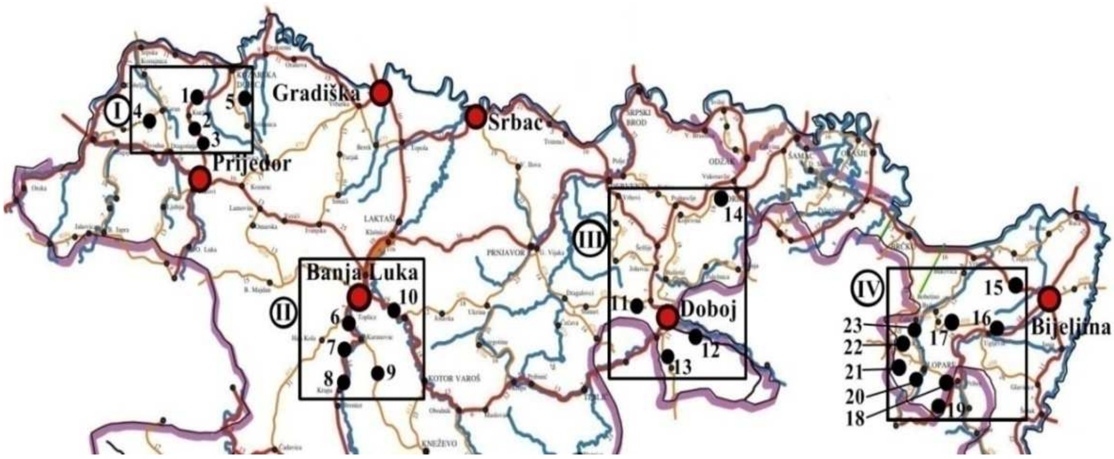

Figure 1. The area affected by increased rainfall and landslides on significant roads, during May, 2014.
I. Western part–area of Prijedor, II. Southern part –area of Banja Luka,
III. Southern part–area of Doboj, IV. Eastern part – area of Bijeljina

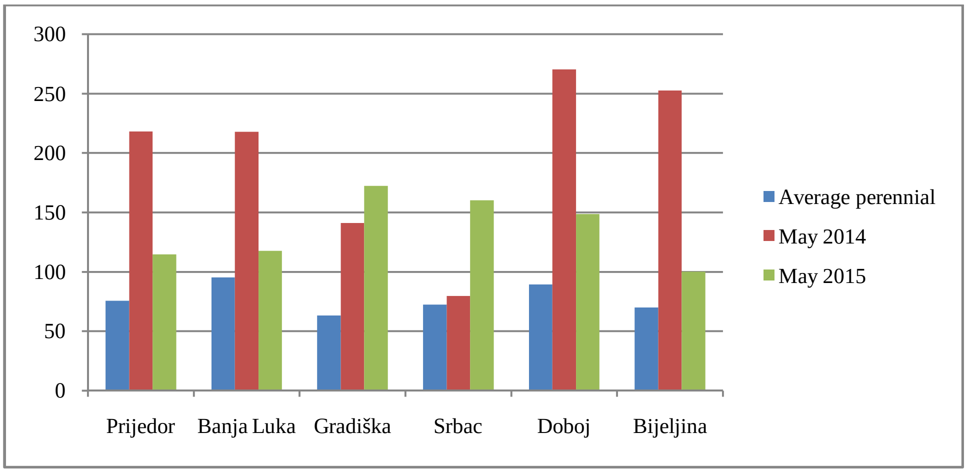

Figure 2. Precipitation in May 2014 and 2015
(source Hydro meteorological Institute of the Republic of Srpska)

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For the assessment of landslide formation, the field investigations were used, which included the period of 2014 and 2015 year. The number of landslides formed in 2015 is considerably lower, but they were larger in size, which suggests that the process of deterioration of their conditionally stable condition began in 2014, and ended in 2015. The research included:

- inventory of all the road landslides occurred after the intense precipitation in 2014, and updated with data from 2015.
- engineering-geological mapping of the landslide and the slope on which the landslide was formed
- description of landslide type from the aspect of sliding process and part of the road vulnerability (above or below the road route)
- geodetic mapping of all the elements of the landslide

- making an exploratory cut on the lateral side of the landslide in a stable part of the slope
- mapping the open profile of the exploratory cut and taking samples for laboratory tests of shear resistance parameters

Expected results of the conducted research are to provide answers to the following:

- reasons for the occurrence of landslides
    - due to the elemental processes or engineering activities
    - due to the method of road constructions through a different period of time
- degree of traffic road vulnerability
- to select the characteristic landslides for which priority reconstruction is needed

Geological characteristics of terrain

The complexity of geomorphological characteristics and geological composition of terrain has had a different impact on the occurrence of landslides on the roads. The northern part of the explored region is plain area and borders with the Sava River which divides Bosnia and Herzegovina from Croatia. The western, southern and eastern part of the terrain is mountainous, and road routes extend along the bottom of the slope, along the slope and along the tops of the slope, actually along the boundary of the watershed. The altitude differences range from 100 - 500 m.a.s.l.

The landslides occurred on all parts of the slope. The smallest number occurred along the bottom of the slope because the slopes of the terrain area and the relief forms were milder. Larger numbers of roads are characterized by the direction of the road route along the slope with different inclinationall the way to the topographic watershed and again on the other side of the slope to its base. On the routes of these roads there are geomorphological forms, from mild to steep slopes, permanent and occasional streams to steep ravines. The slopes are characterized by a different degree of stability in natural conditions, and with the construction of the route of the roads in some of its parts, it comes to the deterioration of stability conditions. To what extent this conditional stability or created instability during the construction is successfully reconstructed, the time will show after the construction of the road and its exploitation over the time [21,22,23,24,25].

CONDUCTED RESULTS OF RESEARCH

The identification of landslides is performed visually from the moment of its occurrence to the gradual stabilization. On some sites, the processes took place very quickly or almost instantly, and some gradually during the three days of intense precipitation and after their cessation.

Of the registered several hundred road landslides, the characteristic ones and important landslides were analyzed. Selected landslides are recorded by engineering-geological and geodetic methods, and a recommendation is given on the scope and types of research in order to determine the mechanism for the occurrence of landslide, their size and method of reconstruction [11,13,15,26,27,28,29,30,31,32].

Surveyed landslides are mapped by engineering-geological method that included a wider area from the aspect of studying the slope character. Geodetic methods have determined the contours and dimensions of the landslide with significant affected area and the volume of moved ground mass. The area of the landslide can be accepted as the correct value at the time of measurement, while the volume of the moved ground mass is determined based on the estimated depth of the sliding levelby certain profiles, table 1.

The inclination angle of the slope is determined for each location by GIS program and represents a natural inclination before the sliding process [28]. On the area affected by sliding, the morphology of the landslide is different and changes the natural inclination of the slope. All the elements of the landslide were recorded in detail.

Table 1. Basic geometric characteristics of the landslide

Landslide group	Number of landslides	Area (m^2)	Volume $(m)^3$	Length (m)	Width (m)	Inclination of slope (^{o})
I	1	2630	12123	123	27	26,6
	2	1911	5693	39	61	17,2
	3	3562	11543	51	79	22,1
	4	1621	5727	37	55	18,5
	5	3127	2511	53	72	9,2
II	6	1981	2123	32	86	27,2
	7	1857	5838	32	71	16,7
	8	2962	8756	43	78	12,1
	9	712	1202	25	34	27,6
	10	6720	4396	67	120	12,8
III	11	3792	5761	62	76	23,6
	12	1721	3391	47	52	12,1
	13	13290	43458	93	17,9	21,3
	14	9653	16671	88	123	17,6
IV	15	1095	3688	25	48	11,2
	16	2127	11606	42	87	28,4
	17	2131	5431	29	79	27,5
	18	10211	32235	217	53	17,2
	19	12859	44862	157	77	28,7
	20	63217	237723	327	219	13,3
	21	10413	28123	179	112	26,3
	22	19197	45327	137	156	17,2
	23	3297	12163	57	63	25,1

23 characteristic landslides were analyzed and classified into four groups according to their area of origin. Each landslide is marked with a number from 1 - 23, and their spatial position is shown in figure 1. Surveyed by the selected groups from I - IV, the slope inclinations on which the landslides formed values from 9,2 - 28,4^0, table 1. Selected landslides are divided into three categories, where it can be seen that the landslides are more present on slopes with higher inclinations. They classify to the second and third category with inclinations from 15 -25^0 and > 25^0, figure 3.

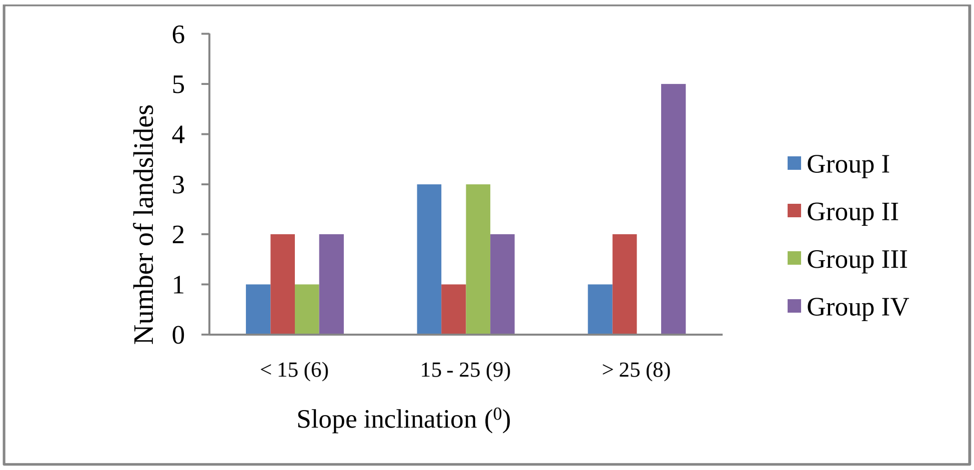

Figure 3.Landslide chart according to inclination of slopes by selected groups I - IV

Similar slope inclinations are characteristic to the largest part of recorded landslides in Bosnia and Herzegovina during that period [11,12]. Also in domestic and foreign literature there are data indicating the occurrence of landslides on these slope inclinations. The domestic researchers

[33,34,35], accept the classification of authors from the former Yugoslavia, of which the most significant are [36,37], which according to the slope inclination select four categories of which the most common landslides are in the category from 15 - 30^0. In the literature of foreign authors [6,2838,39,40]), we find that during their researches they registered over 60% of landslides in the inclination category from 10 - 30^0.

So far there were no any detailed studies along the road routes on the territory of Bosnia and Herzegovina, so these results are preliminary to be analyzed in the forthcoming period. Similar slope inclinations are characteristic to the occurrence of landslides in other parts of terrain as well, where there are no infrastructure objects, which points to the fact that in the category from 10 - 30^0 the most widespread landslides are those ones on terrains up to 500 m.a.s.l.

The landslides have occurred at surface covering composed of poorly bound clay and clayey sandy dusty stones. Below them are marls that make up the substrate of the terrain. Occasional smaller sand bands are often present, they have no much strength, but have the properties of permeable rocks. In natural conditions, a balance is maintained between the complex of rocks on surface covering and substrate, which can last for years, but also to deteriorate instantly by engineering activities or the sudden inflow of water into the permeable rocks [41,42,43,44,45,46,47,48].

The formation of landslides on the roads is different from the fact that they occurred above the road, below the road, and one section of landslide cut the road completely because they were formed above and below the road, figure 4. By examining the above mentioned landslides, it was found that there was insufficient level of terrain exploration along the road route, especially in the part of conditionally stable or unstable zones.

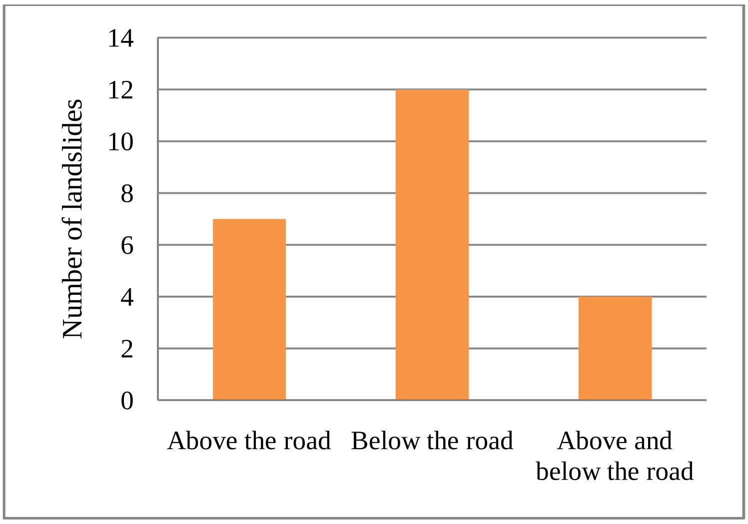

Figure 4.Spatial position of landslides on the roads

23 of characteristic selected landslides show that the majority of landslides belong to modern landslides, a total of 21. The result is the disruption of natural conditional terrain stability during the construction or improvement of road quality and poor maintenance during the exploitation period. They occurred during or after precipitation for several days in May of 2014 and 2015.

By the inspection of the periods of engineering activities on the roads, two periods were selected, until 1990 and after 1990 figure 5, which coincides with the period of change in the social system in this region.

It can be emphasized that elemental processes on the roads are considerably less than in naturally intact terrains. The reason for this is that the road routes were selected for more stable parts of slopes. However, during the construction of roads, the natural state of balance has been changed, especially on conditionally stable and unstable slopes. This situation had different impact on roads depending on the quality of their construction, reconstruction of the slope with the road routes go through and the quality of road maintenance during exploitation [8,22,23,24,25,49].

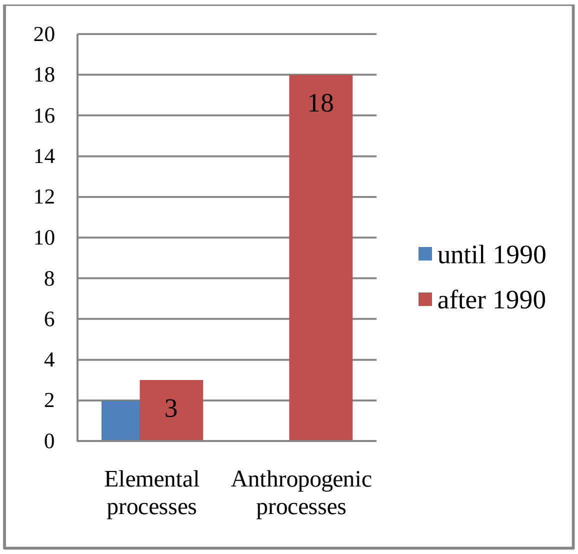

Figure 5. Overview of landslides on the roads constructed before and after 1990

Landslides according to the size [36,37] are classified into five categories, and the explored landslides are located within four categories as per area and three categories per volume. The largest number belongs to the middle sized landslides, table 2.

Table 2. Landslide overview as per size – area and volume

Type of landslide	Area (m^2)	Landslide group	(N^0)	∑	Volume (m^3)	Landslide group	(N^0)	∑
very small	< 100	-	-	-	<100	-	-	-
small	≈ 1000	II	1	1	≈ 5000	I II III IV	1 3 1 1	6
middle	≈ 10 000	I II III IV	5 4 3 4	15	≈ 100 000	I II III IV	4 2 3 7	16
large	≈ 50 000	III IV	1 4	6	≈ 1000 000	IV	1	1
very large	>50 000	IV	1	1	>1000 000	-	-	-

Selected landslides are observed in order to separate the extent to which they have occurred as a result of elemental processes or engineering activities. They are mapped in detail by engineering and geological methods, with special monitoring of contouring borders, since the frontal and lateral scarring in some slopes were up to 2.0 m, clearly separating stable from the triggered part [1,13,27,39]. This explanation is conditional, given that a part of the triggered slope is related to the area of impact due to the reconstruction of the slope during the construction of the road. Beyond this impact, the slope retained the existing state.

At the same time, with the inspection of the landslide characteristics, the slope reconstruction is also considered at the time of construction, that is, the condition of the restoration facilities after the occurrence of landslide. The slopes have been repaired by means of retaining walls, drainages, rarely with piles or by combination of mentioned objects, figure 6. All types of repairments are damaged, especially retaining walls and piles. The construction of some retaining walls is not damaged, but it is moved together with the rock mass. It is evident that they were not founded deep enough in the hard formation rock, but instead they remained in the surface area. Some landslides had even earlier damages that were repaired, and now damaged again, so that various types of reconstructions can be observed at different periods of time. Usually these are retaining walls or walls and piles.

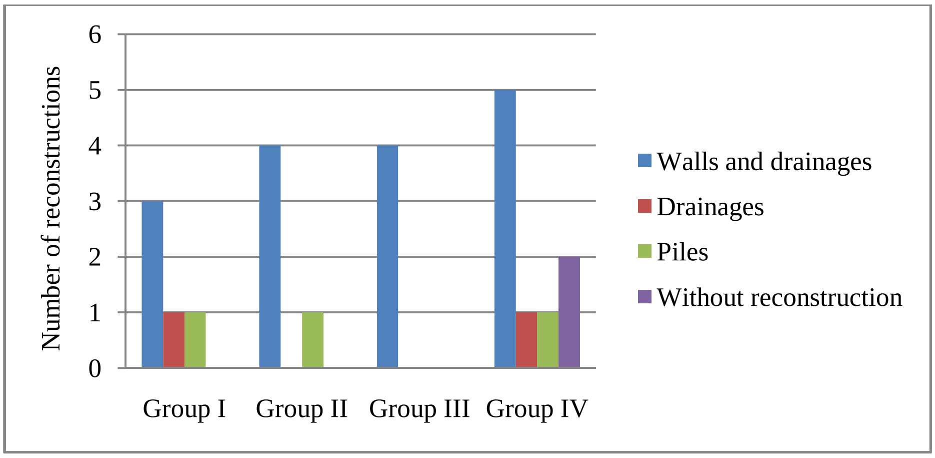

Figure 6. Overview of the types of reconstruction of slopes by selected groups I - IV

During the determination of the geometric characteristics of the landslide, along each landslide, an exploratory cut was done on its undamaged lateral side 2.0 to 3.0 m from the boundary of the landslide, depth to the substrate [3,23,50].

By mapping the walls of an open profile of the exploratory cut, we vertically separated quasi-homogeneous loam clayey dusty rocks (group A) from heterogeneous clayey dusty sandy ones with occasionally smaller sand bands (group B), table 3. Most landslides occurred as a result of movement in heterogeneous rocks, where it is easier to deteriorate the conditionally stable state, especially due to the increased presence of water.

Table 3. Landslide overview by the type of rock mass they occurred in

Landslide group	Type of rocks	∑ landslides	$\sum_u$	Description of rocks	∑ A + B	
					A	B
I	A	1	5	Loam clay, dusty clay	4	19
	B	4		Dusty sandy clay		
II	A	2	5	Dusty clay		
	B	3		Sandy clay, sand bands		
III	A	–	4	–		
	B	4		Sandy clay, marl clay		
IV	A	1	9	Dusty clay		
	B	8		Sandy clay, sand bands,marl clay		

A - quasi-homogeneous rocks, B – heterogeneous rocks

Values of the resistance parameters, the angle of internal friction (φ) and cohesion (c) determined in the laboratory on samples taken in exploratory cuts from different layers are given in figure 7and 8.

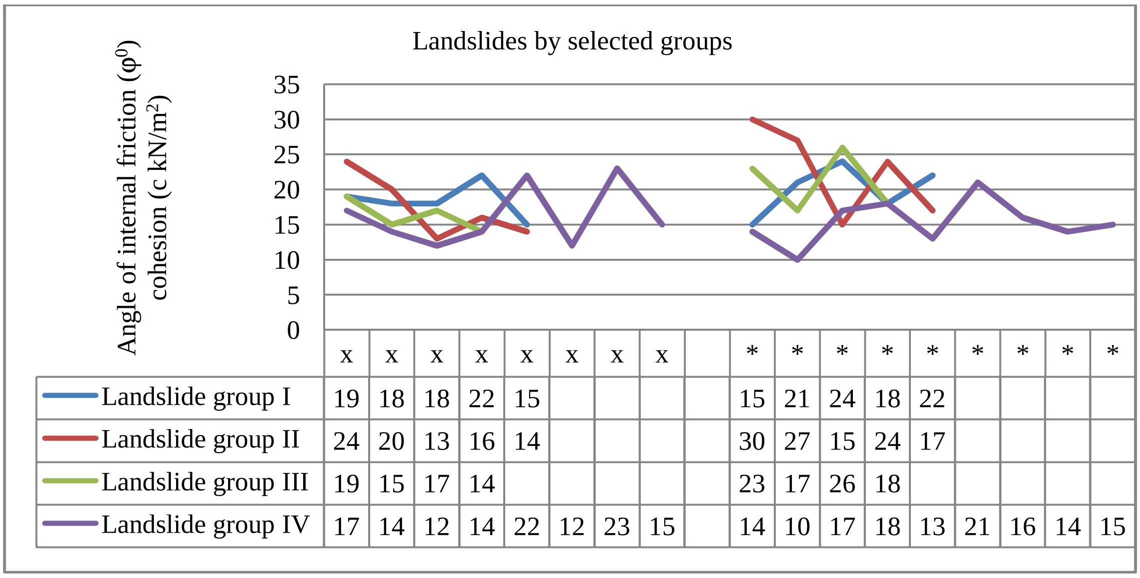

Figure 7. Values of the angle of internal friction (φ) and cohesion (c) by selected landslide groups
x. angle of internal friction, *. cohesion

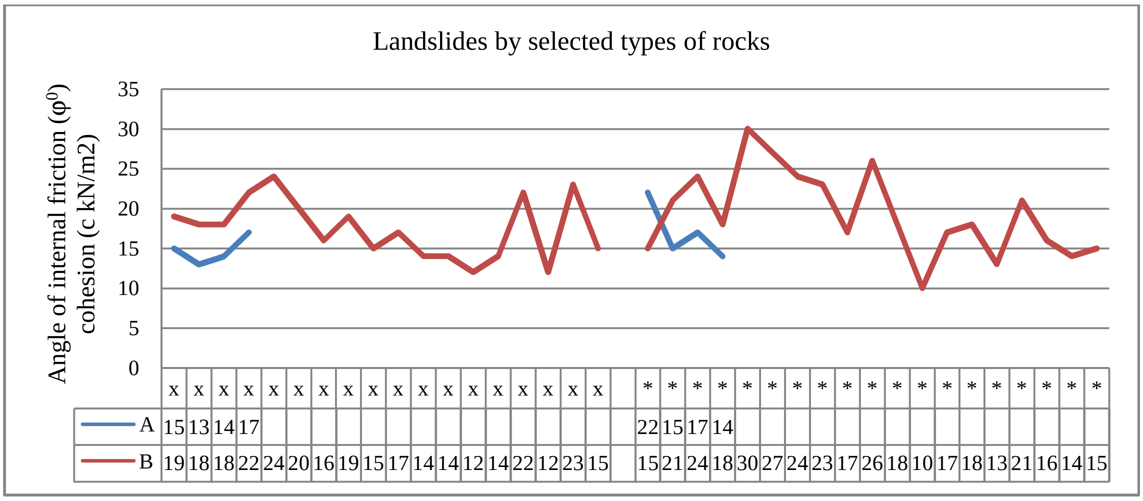

Figure 8. Values of the angle of internal friction (φ) and cohesion (c) by selected types of rocks
A. quasi-homogeneous rocks, D. heterogeneous rocks, x. angle of internal friction, *. cohesion

DISCUSSION

There are various definitions of the landslide occurrence, which basically relate to the change in the tensional state in the rock massif that forms the slope of a different inclination. Changes can be due to natural and artificial impacts, named as elemental or anthropogenic processes [1,2,3,11,27,51]. Today, the anthropogenic processes are more significant occurred because of engineering activities in the field. Elemental processes have the continuity of their development, which is often not observed if they do not take place in urban areas [9]. Intensive engineering activities in the field increasingly deteriorate the natural state of balance, which creates “modern construction landslides” that are most frequent along the road routes [9,10].

The slope inclinations at the locations of the explored landslides range from 9,2 - 28,7^{0} and they are classified into three categories, figure 3. Observed by the locations of selected landslide groups from I

- IV, the highest number of landslides occur at the slope with inclination of > 20^0 in group IV. The terrain in this area is morphologically very developed and belongs to the mountainous part. In general, the analyzed landslides are related to slope inclinations that are often found in the literature data.

Poor field research, or insufficient knowledge of its characteristics, left the slopes completely unprotected after the road construction, which was manifested by the occurrence of landslides. According to data in Figure 5, there is a clear delimitation between the roads constructed before 1990, where only 2 landslides occurred from Group IV as a result of elemental processes. On roads constructed after 1990, 21 landslides occurred, of which 18 were due to anthropogenic processes resulting from poor construction or maintenance of roads. The landslides occurred as a result of elemental processes are in a much smaller number, only 3. Under the elemental processes on the roads we implied those processes that were formed far above the road route, where the natural balance was not deteriorated during the construction, but the conditional stability of the slope was maintained up to the floods in May.

Open terrain profiles on the slope create favorable conditions for water inflow into the quasi-homogeneous and heterogeneous clay sediments, further deteriorating their stability [1,7,32,41]. In addition to the surface inflow, the underground inflow was such that the heterogeneous sediments were completely saturated and sodden. The characteristics of these sediments in such condition and conditions of the examined samples taken later vary considerably.

Analysis of field research data and laboratory testing of samples from undamaged parts of the slope shows that more realistic data are obtained in poorly bound clay sediments than in heterogeneous. Collecting the field samples and their processing in the laboratory, the samples from heterogeneous environment partially deteriorate the natural balance of situation in relation to the observed in the field, as opposed to quasi-homogeneous clay sediments where the differences are smaller. The obtained laboratory data are not sufficient because they do not apply to every lithological character, but only to the selected characteristic layer whose natural balance is deteriorated at a distance of 2.0-3.0 m during the occurrence of the landslide. Under conditions when there is no possibility of carrying out instrument tests, the data of engineering geological mapping of terrain and exploratory cut together with laboratory test data provide a sufficient basis for getting to know the basic characteristics of terrain and rock masses. The shear resistance parameters (φ and c) are categorized by the group of landslides and the type of rocks, shown in figures 7 and 8.

The common characteristic for landslides from Table 1 is as follows: from group I - III the angle of internal friction is balanced as opposed to cohesion, while for group IV both parameters have large oscillations from the landslide to landslide, figure 7. The reason is a complex geological structure due to the structural tectonic influences, which are also important for creating the surface covering of the terrain in which the landslides occurred. Majevica as a mountain where the landslides of group IV are categorized is considered to have the most complex terrain structure in this area.

More detailed observation of the parameters of resistance according to the type of rock in all groups of landslides is shown in figure 8. It refers to heterogeneous rocks, according to the larger number of samples. The oscillations of the parameters from landslide to landslide show the heterogeneity of the rocks in a wider range, which requires a higher degree of research when examining each landslide.

The values of the shear resistance parameters are favorable for the selected rocks of A and B, where in natural conditions there is no deterioration of the balance state. The balance is deteriorated at the contact of the quasi-homogeneous rocks A and the heterogeneous rocks B, which are under the influence of water and tend to move, especially in conditions of increased water quantity, their contact with water-impermeable rocks or by deterioration of the overall natural balance due to engineering activities in the field. Delimitation between quasi-homogeneous and heterogeneous rocks on some terrains is difficult to determine as clay rocks are sometimes more sandy, which makes them heterogeneous within that package.

By review of damaged reconstructions on the roads conducted at the time of their construction and available project documentation, it is noted that reconstructions have not been appropriately conducted in accordance with the projects, and projects in accordance with the geological-geomechanical characteristics of the terrain. The construction of retaining walls that were undamaged and moved by the rock mass show that they were not based in the hard rock [35,52,53,54,55,56,57,58]. They were appropriately conducted in a constructive sense, but there was no good binding with the hard rock. Drainages were not maintained over time, so that the revision shafts for collecting and draining water, as well as the drainage canals are neglected, which kept the water in the rock mass, deteriorated its structure and influenced the change in the tension condition and conditional balance.

The basic findings during the examination of the selected landslides are that the roads constructed before 1990 are less damaged, not only during the May rainfall in 2014 and 2015, but during the entire period of their exploitation. The roads constructed after 1990 are almost all damaged with different degrees of damage along the road route. The reasons are familiar. The construction of roads before 1990 was in accordance with the applicable regulations at that time that required a higher degree of research, prior to the development of project documentation. Thereby, the project documentation was harmonized with the characteristics of terrain and the obligation of slope reconstruction during the construction of the road, and monitoring of the slope behavior during the exploitation of the road.

Roads constructed after 1990 include a period of rapid construction, which we have named here as “the modern construction”. It is the construction of facilities without sufficient previous geological and engineering-geological research of the terrain, and in improving the quality of existing roads, often without project documentation, but it is all done during the phase of construction works [10]. The results of such a way of constructing are the damages of roads after heavy precipitation or winter time after snow melting. The May precipitation, which in 2014 and 2015 were the highest in that period, highest recorded since the meteorological observations in this area took place, in a few days, damaged almost all roads that were constructed on the principle of “modern construction".

CONCLUSION

The May precipitation that affected the northern part of the Republic of Srpska in Bosnia and Herzegovina by intensity was a threefold higher than in the previous period since the organized measurements exist on this area. The precipitation lasted for three days in 2014, when several thousands of landslides occurred. A year later, in the same month, an extensive precipitation again caused the new landslides, smaller in number but more significant in size. The significance of occurred landslides is different. Mainly they occurred along the road routes, which were the subject of study research after the cessation of precipitation.

During the research of road degradation and the cause of the occurrence of landslides, priority is given to roads that connect a larger number of inhabitants. The study presents 23 landslides that have occurred on the route of the main road from Bijeljina to Prijedor and the branches of roads that are connected with this route. The roads were constructed in a different time period, leaving room for an analysis of the degree of damage to roads constructed before and after 1990, or how much the elemental (natural) processes contributed to the occurrence of landslides, and what was the impact of anthropogenic processes, or engineering activities during the construction of roads.

The research found that the damages occurred as a result of poor field research, discrepancy of project documentation with the characteristics of the terrain, poorly done reconstruction works, especially with retaining walls or piles, inadequate drainage system for water collecting and drainage, and poor quality maintenance of roads during exploitation. Increased quantities of water in heterogeneous sediments reduce cohesiveness in the rocks, which is reflected in the stability of the slope.

Road safety, facilities on the road routes, reconstructed slopes damaged during the construction, as well as terrain along the road route, requires detailed geological geotechnical field research. The results of the research are a compulsory basis for the development of project documentation. The extent and type of research works and laboratory tests should be adapted to the characteristics of the terrain, the road route, type of facilities on the route, as well as the reconstruction facilities that are needed in places where the vulnerability of the slope is expected due to engineering activities.

The inventory of the road landslides in the study had limited resources, but almost all the landslides, several hundreds of them were covered, and particularly the 23 of mentioned landslides were analyzed. The study pointed to the need for a clearer state strategy for the development of a landslide cadaster and vulnerability of terrain along the route of all roads.It would include the development of guidelines for the construction and maintenance of roads that would define the raising of awareness and responsibility for the construction of facilities, the economic justification, the quality of construction, the maintenance of roads during their exploitation and the ability to act in emergency situations.

In the past year, progress has been made in the part of increasing knowledge about landslides and reducing the risk of landslides by applying appropriate reconstruction activities. For the maintenance of the existing roads, special services have been organized and trained to continuously monitor the situation on the roads during the year.

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