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Professional paper

LANDSLIDE RISK ASSESSMENT IN A NEIGHBORHOOD IN THE VILLAGE OF PIROK NEAR TETOVE

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Abstract

Quantitative landslide risk assessment, considering the area and scale of investigation, represents a research challenge, that is reflected by need to analyse, in an analytical manner, using various complex methods. Those methods of multidisciplinary and interdisciplinary observation, engineering geological and geotechnical modelling of natural parameters and causes of terrain instability are performed for landslide hazard and risk assessment. The deterministic and probabilistic dynamics models are applied to define and determine the relevant parameters that affect the quantitative landslide risk assessment. This eliminates the possibility of errors due to the subjectivity of the researcher. "Pirok", near Tetove, is chosen as a case study. This landslide is known as a very active landslide that for a century threatens housing and infrastructure facilities, as well as the population that still lives on it. The "Pirok" landslide is active, deep, slow and complex landslide with periods of...

Keywords: Methods, landslide, probabilistic dynamics.

1. Introduction

In the framework of the activities of UNDP in cooperation with the municipality of Bogovina in relation to the reduction of risks from landslides as a result of rainfall and the infiltration of surface waters as well as floods and similar phenomena in the region of Pollog, the locality detected by the landslide is located in the village of Pirok in the municipality of Bogovina. Near this locality there are buildings of the local road infrastructure, private and social buildings, some residential houses, the village school. The activation of the last soil erosion in a part of this locality was in 2018, while the one in 1985 is also remembered. Taking into account this phenomenon and this problem that whenever there is a lot of rain in this region, then landslides are presented to us in this area-locality. For this reason, UNDP, in cooperation with the municipality of Bogovina, has prepared documentation of the idea and implementation project to take measures to stabilize the soil in this locality. Below are some photos from the field.

Figure 1. The appearance of cracks and landslides

Figure 2. Landslide in the investigated locality

2. Applied research-research methodology

Based on the situation on the ground, at the beginning, data was obtained from the field from the urban, hydrological, morphological, geological, etc... and the drilling of the soil was started. The geophysical tests were carried out with the help of 24 Swedish geophones-devices by the team of experts at the Faculty of Construction. The method of seismic refraction, ie refraction of seismic waves, has been applied. The basis of this method consists of recording the boundaries between environments with different seismic velocities. The geophysical profiles were made with different lengths in the longitudinal and transverse directions. The data were processed with adequate software and the results are presented in the appendix of this paper.
The laboratory tests were carried out by the Faculty of Construction from the Department of Geotechnics. The samples taken have been examined based on the standards that are in force and the Regulation for the sinking of objects, defining the granulometric composition of the materials present, plasticity, and hardness. This data is later used for the stabilization of the sliding soil.

Table 1: The number of holes and their depth

well / digging	SH-1	SH-2	SH-3	SH-4	SH-5
Depth	10.00	10.00	10.00	12.00	8.00
Presentation of Groundwater waters	/	/	/	/	4.00
Groundwater level	-3,50	-7.10	/	-2.50	/
SPT-	3.00	/	2.50	3.00	/

(in depth)	6.50	5.00	/	6.00	4.00
	/	9.50	7.00	/	7.00

3.Geological features of the terrain

In the wider area of the area, there are several types of rocks of different ages with different physical and mechanical characteristics . All this means that this terrain in certain parts is unstable. Based on the geological map of the RMV, the following rock types are found in this region;

Complex Granodiorot **(dgj)** , type of igneous rock on the map shown in green color are igneous rocks mainly in the upper area, while in the d1 and d5 drillings they are also presented at a depth of 8.5m.

- Diabaz, type of volcanic rock **(**bb**)**
- Deluvium dhe Proluvium the materials, 9-10 mm thick, are clay layers with variable consistency depending on the presence of moisture.

Figure 3. Segment of the geological map for the area

With the detailed map of the terrain, as well as the drilling, it has been established that in general, rock masses are present, which are mostly of low porosity. On the other hand, the dusty-sandy sediments have a more pronounced permeability, so that in the analyzed terrain in some places we have the appearance of underground waters from -2.5m and -7.5m. Their origin is from atmospheric influences and slow infiltration, especially in humid periods, but from a mechanical point of view, they certainly have an impact on reducing the hardness of clayey sediments and hydrostatic influences. In order to minimize their unfavorable impact in the sense of moisture, drainage and flow, it is necessary to take measures to remove surface water first of all with the realization of systems dimensioned according to the rules, and open channels should be provided in the constructions.

Based on the basic geological divisions of rocks-IAEG in the field we encounter the following types of rocks:

- Strongly connected semi-rocks. This group includes the upper areas and it can be assumed that in depth there may be
- Weakly bound rocks. This group includes clay-sand varieties which are in a soft to semi-hard consistent state. Low to medium plasticity.
- Weakly to uncorrelated exchanges. Here, sand dust with a more intense presence of rock fragments took part.

According to the condition, it is estimated that they are semi-solid consistent, with low plasticity, pale brown in color. Due to the local increase in the presence of the dust fraction, as well as the weak connection, they are therefore classified as a rock transition.

- In order to obtain data on the strength of the parameters, a sufficient number of analyzes have been carried out in the laboratory.

Figure 4. Samples extracted from drilling.

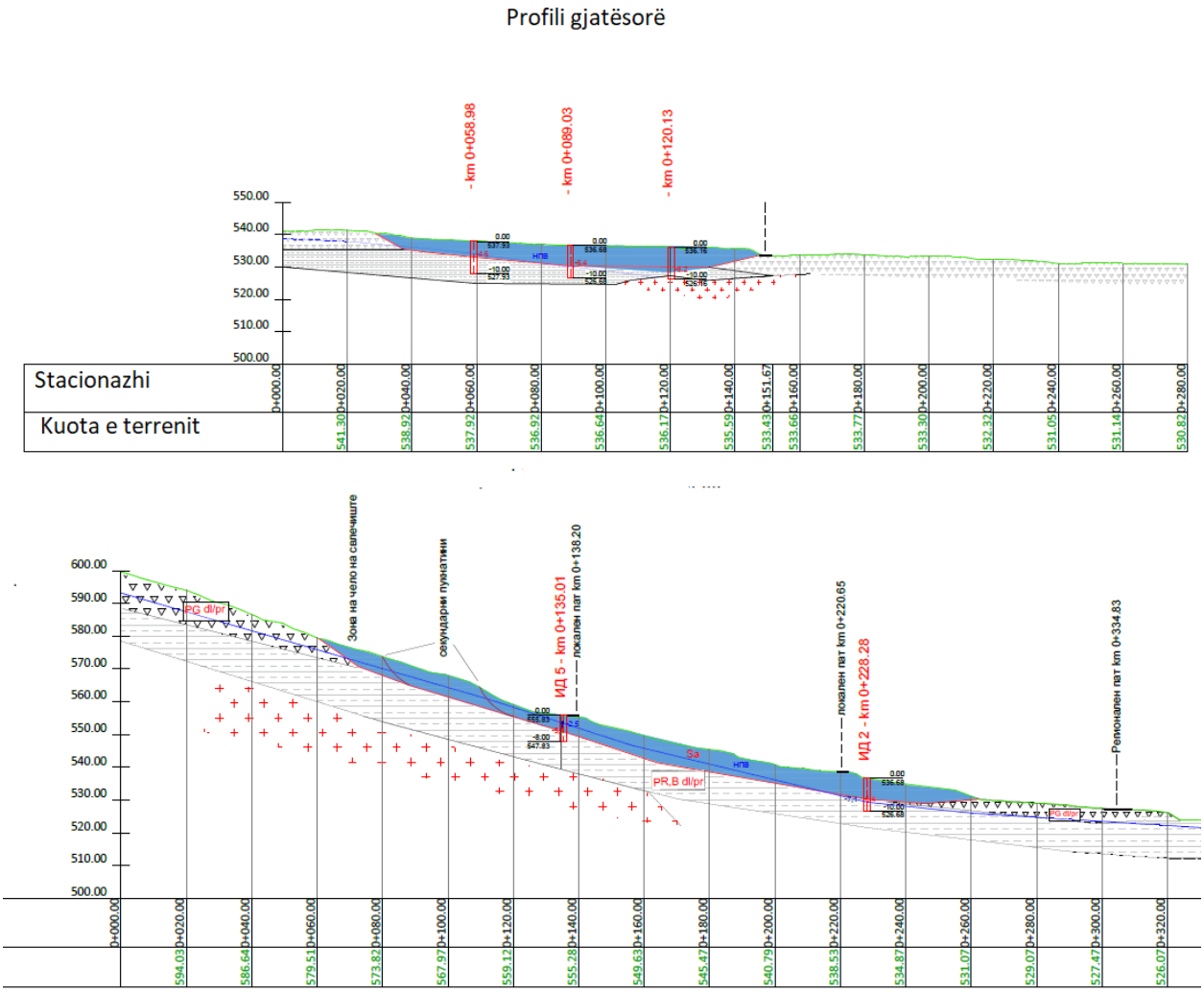

Figure 5. Longitudinal geological profiles

- On the basis of field studies, more detailed data on the needs of remediation of the slippery soil has been obtained. The landslide body includes all this rock or soil mass that has been detached from the bedrock and has slid down the slope.
- The landslide area is at a depth of 6 to 9 meters in some places even 11m and at max. up to 14m and is mainly related to the contact between clayey sediments and silty-sandy sediments due to the difference in hardness.
- In slippery soils, the characteristic is that the trees do not have a vertical shape but take different directions, the so-called "drunk forest"
- At the moment, the soil slides at extremely low speed, which does not mean that under the influence of an earthquake or water saturation, it will not be reactivated at a significantly higher speed.
- We must know that the speed of movement of the earth is not the same in all its points. The exact velocity can be obtained by systematically tracking the displacement at depth and surface where the overall values are indicated by the displacement vectors.
- Landslides differ from case to case, but we can estimate that the influence of surface and underground water is the main factor that depends on whether a terrain will go from a stable state to an unstable one.

Figure 6. Channels for removing surface water

4.Recommendations for the realization of all technical details

It is worth emphasizing that for successful implementation and longer-term securing of the land, the following measures can be implemented: Të gjithë ujrat sipërfaqsorë në pjesën e epërme të terenit dhe përeth tij të largohen dhe kanalizohen,

- It is necessary to build support-wall constructions with deep anchored foundations,
- along local roads,
- Reforestation is recommended in the future
- It is proposed that the construction of new buildings is not allowed in the body of the sliding land and the cutting of trees is prohibited,
- It should be foreseen in the project that all water released by households be eliminated without considering their capacity.
- In this case, I think that a project for the treatment of underground and surface water, as well as the construction of retaining walls, would stabilize the existing situation for a longer period.

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