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Unpredictability of Gradients during Preservation Phase of the Linear Constructions

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Abstract: *Instability of the rock and earth slopes in the Andimeshk-Khorramabad Road can cause disastrous events. The road has settled and slipped on an active landslip in the marl and gypsum layers of the Gachsaran Formation, between the Zal Bridge and the Poldokhtar, under the effect of water, lithology and erosion caused by the Seymareh River. The road is threatened by the Rockfall in the north of the Poldokhtar and the Afrineh village, by the rock slide in the northeast of the Tang-e-Malawi and by taluses accumulated on the slopes prone to Creep and Slump between the Tang-e-Malawi and the Afrineh village.*

Keywords: *Rockfall; Afrineh village; Seymareh River; Afrineh village; Zal Bridge*

1. INTRODUCTION

On the Andimeshk-Khorramabad Road, heavy and repeated rainfalls have caused damages due to instability of the rock and earth slopes, landslide and settlement. This is resulted from the lack of attention to the engineering geology issues in the maintenance phase of the road. Presence of the Seymareh large landslide in the Tang-e-Fani pass and the passage of the road through different geological formations have caused problems in the maintenance phase due to the litho logical changes, tectonic structures, weathering and weather conditions.[5]

1.1. Slope Failure Mechanism in the Unstable Areas

Stratigraphic, tectonic and geotechnical characteristics of rocks considering the groundwater conditions intensify the physical and chemical weathering (Ghobadi, 1993), which leads to the formation of areas prone to failure in the aforementioned road. The road has settled and slipped on an active landslip in the marl and gypsum layers of the Gachsaran Formation, between the Zal Bridge and the Poldokhtar in the Pol Tang (Pay Elm) village, under the effect of water, lithology and erosion caused by the Seymareh River that is intensified in the rainy seasons and causes damage. Changes in groundwater level accompanied with swelling of the colored marl and effects of the groundwater leading to dissolution of the gypsum layers along with the erosion of the mentioned landslide heel increases the road settlement every year and increases the movement of the underlying slippery mass. Heavy and repeated rainfalls have increased the pore pressure and decreased the shear strength along the failure surfaces and thus, one of the retaining walls, which has been designed and constructed without drain, has cut and failed along the slippery mass. The other retaining walls and existing drains were not able to stabilize the landslide. The mentioned road crosses several anticlines and synclines and considering the road conditions and the tectonic structure, the rock slopes are unstable. The discontinuity systems that are parallel and perpendicular to the axis of the Asmari-Shahbazan limestone anticlines cause rock fall between Poldokhtar and Babazeyd post due to the weathering progress and under the effects of atmospheric precipitation in the rainy seasons, and cause rock slide in the northeast of the Tang-e-Malawi. In 1994, the rock slides in this area were not accompanied with the mortal casualties. The accumulation of materials created by the weathering processes has formed taluses with different thicknesses on the slopes between the Tang-e-Malawi and the Afrine village.[5]

The existence of multiple discontinuous surfaces with decreased shear strength is one of the most important factors causing the slope instability. The presence of numerous discontinuous surfaces, clay soil with high index of plasticity, and increased pore water in rainy months makes the slopes prone to creep and slip (Ghobadi, 1997 and 1994).

In the village of Afrine, the existing one-sided trench in the Aghajari Formation has put the road at the risk of rock fall. Dimensions of the sandstone blocks in the marl layers and Aghajari sandstones are noticeable considering the erosion of marls and the existing fracturing systems in the sandstones and their probable fall on the road will lead to irreparable damage [5]

2. METHODS AND MATERIALS

Comprehending of the inclined-work-related risk of falls and expanding novel applied engineering controls for decreasing this risk of falls among craggy working population stays in high demand. Standing on sloped areas prepares a unique circumference for considering the biomechanics and neural qualify of standing. We also inspected the impacts of different dignities of load on these situations. We demonstrate our investigation to show the reactions between slope inconstancy activities and structural consolidation interpositions intended to decrease the difficulty in a zone. At the same time, the slope inconstancy procedures intensively developed, and regressive erosion quickly continued to the landslide threshold.

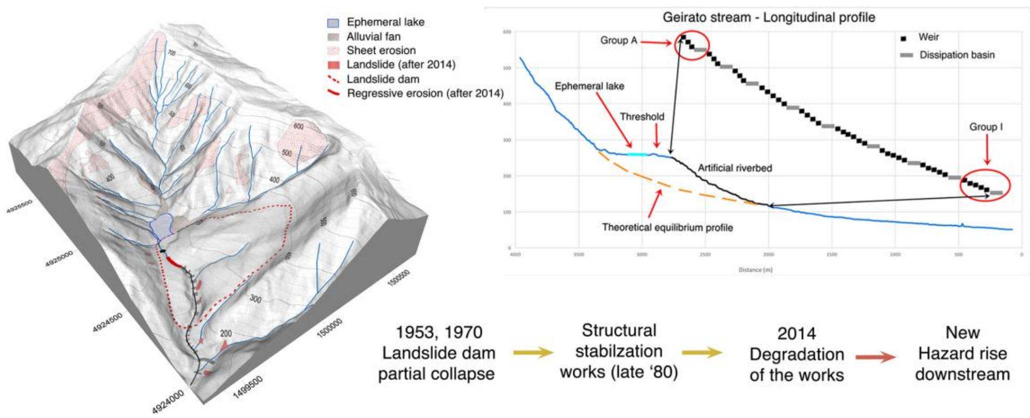

Fig1. *Geirato stream – Longitudinal profile [10]*

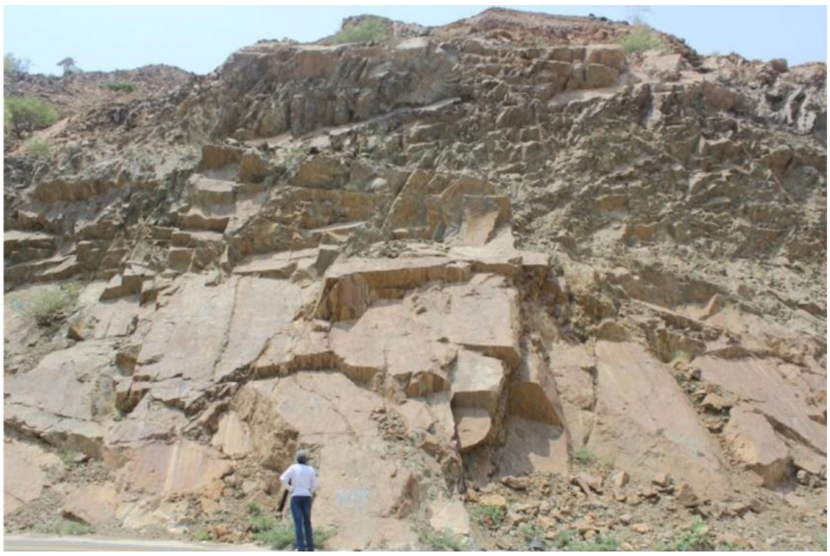

Fig2. *Example of structurally controlled failure [26]*

Fig3. *Example of non-structurally controlled failure due to highly weathering [26]*

Table1. *Rock rating system (After Bieniawski, 1989) [26]*

Row	Parameter	Range of values				
1	Strength of intact rock mineral	Point-load strength index (MPa)	>10	4-10	2-4	1-2
		UCS (MPa)	>250	100-250	50-100	25-50
	Rating		15	12	7	4
2	Drill core RQD (%)		90-100	75-90	50-75	25-50
	Rating		20	17	13	8
3	Spacing of discontinuities		>2m	0.6-2 m	200-600 mm	60-200 mm
	Rating		20	15	10	8
4	Condition of discontinuities		Very rough surfaces	Slightly rough surfaces	Slightly rough surfaces	Slickensided surfaces, or
			Not Continuous	Separation <1 mm	Separation <1 mm	Gouge < 5 mm thick, or
			No separation	Slightly weathered	Highly weathered	5 mm (continuous)
			Unweathered wall rock	Walls	Walls	
	Rating		30	25	20	10
5	Groundwater Rating	Inflow per 10 m tunnel length (L/min)	None	<10	10-25	25-125
		Ratio of joint water pressure to major principal stress	0	<0.1	0.1-0.2	0.2-0.5
		General condition	Completely dry	Damp	Wet	Dripping
	Rating		15	10	7	4

Table2. *Guideline for classification of discontinuity condition in Rock Mass rating [26]*

Discontinuity length (persistence)		Separation (aperture)		Roughness		Infilling (gouge)		Weathering	
Value (m)	Rating	Value (mm)	Rating	Description	Rating	Description	Rating	Description	Rating
<1	6	None	6	Very rough	6	None	6	Unweathered	6
1-3	4	<0.1	5	Rough	5	Hard Filling< 5 mm	4	Slightly weathered	5

3-10	2	0.1-1.0	4	Slightly rough	3	Hard Filling>5 mm	2	Moderately weathered	3
10-20	1	1-5	1	Smooth	1	Soft Filling< 5 mm	2	Highly weathered	1
>20	0	>5	0	Slickensided	0	Soft Filling> 5 mm	0	Decomposed	0

Table3. *Guidelines for classification of discontinuity in Rock Mass rating [26]*

Rating	Class	Description
100-81	I	Very good rock
80-61	II	Good rock
60-41	III	Fair rock
40-21	IV	Poor rock
<20	V	Very poor rock

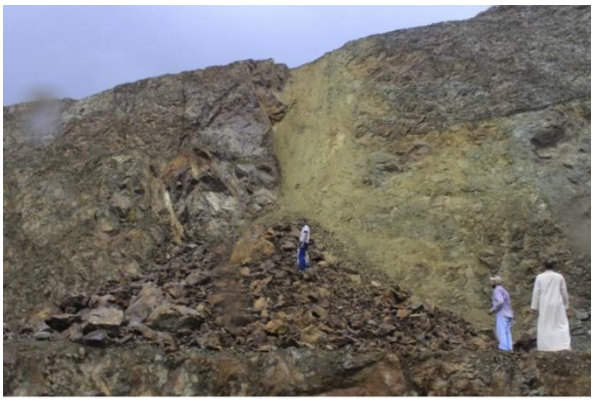

Fig4. *Wedge failure at site [26]*

Fig5. *Potential for flexural toppling failure [26]*

Fig6. *Potential for block toppling failure [26]*

The energetic temperament of a bioengineered work sets various outlines the slope design. All these various phases must be taken into the description in the work plan procedure. In this method, we suggest a coincidence of the available procedures and ways of both geotechnical operation and civil engineering plan scheme in order to nearly reverberate the content of bioengineering procedures in the classic geotechnical engineering issues. A planning methodology covering various crucial propose within the lifecycle of a gradient is suggested. Slope inconstancy shows in many shapes, ranging from constant state to punctuated motion, or sophomoric erosion to deep-seated deploying. We can apply a geographic information system (GIS) - depend on the methodology for slope inconstancy evaluations depend on geometrical correlations between topographic slopes and structural interruptions. The method concludes (a) regionalization of point perceptions of directions of structural interruptions in substances so as to produce a digital structural plan, (b) experiment the kinematical probability of special modes of slope fractures by digital elevation model (DEM)- derived slope and aspect data and (c) calculation of consistency scenarios with regard to identified slope fracture methods. The consequences of the education display improved organization of slope inconstancy in the smaller zone with esteem to recognized incidences of deep-rooted rockslides than with respect to narrow translational rockslides, suggesting that organizational control is more significant for deep-rooted rockslides than for narrow translational rockslides. The constancy of rock gradients is measured vital to public protection in roads passing through rock cuts, as well as to people and apparatus security in open pit mines.

3. RESULTS

This article evaluates the available slope inconstancy risk evaluation methods. Consequences of the scenario- based investigation display that, in slopes classified to be unbalanced, stress- induced slope variability tends to rise with the cumulative level of water saturation. The investigation shows the expediency of spatially divided information of directions of structural disruptions for medium- to the small- scale grading of slope inconstancy in earth. It displays that both quantitative and qualitative processes have some main detriments with a usual feature being the deficiency of assertion on the geology and geomorphology of gradients. Plus, the task of climatic situations (the most usual landslide triggering component) is important. It is pointed that the available risk evaluation processes depend either on only one classification of results or directly quantify the results of more than one class, which may lead to an under-approximation of the importance of an outcome classification. Finally, the compatibility and validity of the most generally applied results components are considered. The main causative and triggering components responsible for the showing of landslide phenomena, measure their interactions, obtain their weighted coefficients, and compute the inconstancy index, which denotes to the essential possible inconstancy of each natural slope of the considered zone. Large disastrous slope fractures are difficult to anticipate because the underlying instruments triggering slope quickening are hard to study under in-situ situations. For numerical risk evaluation, it is essential to describe the magnitude–frequency dispensation and a temporal model of the landslide regularity. This is often complex for great rock slope catastrophes because of the absence of considerable amounts of large rock slope catastrophes in inventories of a given similar zone or sparse data about the timing.

Rock gradients fail through structurally-controlled mechanisms, worldwide circular catastrophes, or complex instruments depending on structural designs and Rock mass harm. Gradient inconstancy and catastrophes happen because of many reasons such as contrary slope geometries, geological discontinuities, weak or weathered gradient substantial's as well as unadorned weather situations. Exterior weights like heavy precipitation and seismicity could play a important role in gradient catastrophe.

4. CONCLUSION AND RECOMMENDATION

Due to the economic importance of the Andimeshk-Khorramabad Road, more attention in the maintenance phase of the road is required. In this regard, in order to stabilize the unstable slopes, financial resources should be allocated for the understanding of the geological conditions and the development of the slopes, and soil mechanics and rock mechanics tests should be carried out at a later stage for stability analysis of the slopes (Jones et al., 1997). In the mentioned road, the use of rocket bolts and wire mesh is recommended in order to control the unstable rock slopes. In addition, mostly horizontal and trench drains and Gabion walls should be designed and implemented to stabilize the taluses. In the village of Pol Tang, changing the road direction seems a fundamental solution to solve the problem. [5]

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