

# **The Influence of Structural Setting and Lithology on Landslide Type and Pattern in Qazvin-Rasht Freeway**

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## **Extended Abstract**

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## **Introduction**

Landslides have an effective role in the destruction of freeways and railroads, which have been caused to many human and financial losses. Understanding this phenomenon and its effective factors can be important in planning for development projects and away from landslide prone areas. Based on extensive field in the Qazvin-Rasht freeway that the authors carried out in various researches in 2014-2017, it was found that the freeway was threatened by the type of instabilities due to variety of lithologies and tectonic structures exploitation phase and needs to be stabilized. The purpose of this study is to determine of the distribution of landslides in different types of lithological units of the Qazvin-Rasht freeway that shows the role of geology and differences in geotechnical characteristics and tectonic structures in the creation and distribution of landslides on the road. The role of geology on the difference in geotechnical properties and tectonic structures in the creation and distribution in the road. Geological engineering properties and appropriate stabilization methods is the other goals of this study.

## **Material and Methods**

In the study, the locations and the type of landslides are distinguished and the information were plotted on geological map. Then by the ARC GIS

10.2 program, and the use of area density method, the percentage of landslide events in each geological formation was identified. In order to study the role of lithology (type of rock, texture, mineralogy, weathering, alteration and erosion), sampling were carried out from rocks of Karaj formation, Shemshak formation, Cretaceous orbitalolina limestone and Fajan conglomerate. Geotechnical characteristics of the samples were determined by performing laboratory tests such as dry weight, porosity, uni-axial compressive strength according to ISRM standard (1979). For determining the role of tectonic structures (number of joints, dip and dip direction, length (m), spacing (cm), filling percentage, opening (mm), roughness, weathering, water, friction angle) were performed. Then, the results obtained from relative density and frequency were matched with the geological, geotechnical characteristics and tectonic structures of each formation.

### Results

In order to separate different types of landslides on various kinds of rocks, area density and frequency of landslides were determined by Eqs 1 and 2. Graph of frequency and area density are presented in Fig. 6 and Table 2, respectively. As can be seen in this figure and table, in Karaj formation, the percentage of rock fall, toppling, avalanche, scree slope and combined slip are the highest. In the rocks belonging to the Shemshak formation, the susceptibility of the debris flow and landslides has been increased. In Fajan conglomerates and limestones of the Ziarat and Cretaceous formations, the rockfalls is more formed.

- ✓ Area density of landslide

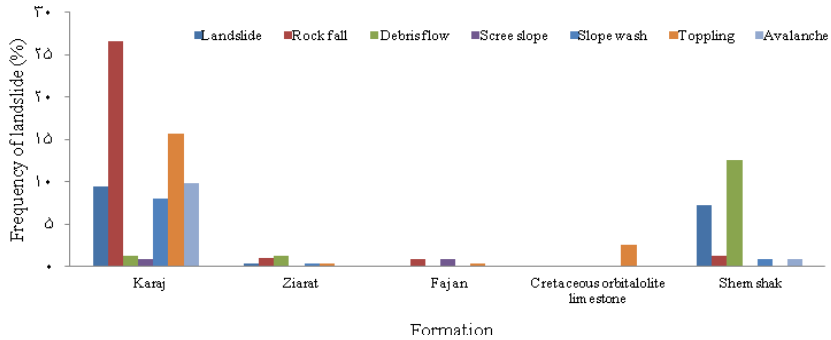
$$\% L_I = A_L / A_T \quad (1)$$

where  $L_I$ : area density,  $A_L$ : area of landslides in each lithological unit,  $A_T$ : area of landslides in total area.

- ✓ frequency of landslide

$$\% L_F = N_L / N_T \quad (2)$$

where  $L_F$ : frequency of landslide,  $N_L$ : number of landslides in each lithological unit,  $N_T$ : number of landslides in total area.



**Figure 1. Landslides frequency in each lithological unit in the Qazvin-Rasht freeway**

**Table 1. Relationships between different types of landslides with geological units**

Geological units			Area of each lithological unit (km <sup>2</sup> )	Area density of landslide (L <sub>i</sub> : %)						
				Slope wash	Toppling	Avalanche	Rock fall	Landslide	Debris flow	Scree slope
Palaeogene	Karaj	A	11.4	4	-	-	19.6	3	-	29.9
		E6v	17.7	17	13.7	6.18	12.4	10.2	-	6
		Evt	30.7	20.6	-	1.8	16	1.2	-	2.2
		Etb3	14.3	-	3	-	61	-	-	5
		Ev2	2.5	-	-	-	-	1.2	-	-
	Ziarat	Elsh	0.68	1	-	2	-	-	5	-
	Fajan	Pef	1.3	-	5	-	45	-	-	4
Cretaceous	Obitalolina limestone	K11	0.26	-	0.18	-	-	-	-	-
Jurassic	Shemshak	Js, c, s, sh	14.1	-	-	-	1.5	35.3	15	-

**Conclusion**

Result showed that despite significant heterogeneity in lithology, geotechnics, engineering geology and tectonic structures, there are similarities between the types and distribution of landslides. Four of the

identified landslides consist of rock fall, toppling, avalanche in the resistant and medium strength rocks such as andesite, trachy-andesite and basalts of Karaj formation, Cretaceous orbitalolina limestone and Fajan conglomerate with regard to the dominant direction of the joints in relation to the slope, the shear strength of the joints and their weathering, falling and scree slope in the siliceous zone and composite landslide in the argillite-alounite zone due to the high alteration and groundwater level and water retention by the presence of clay minerals, landslide in the sequence of loose and resistant rocks, debris flow and landslides in the soils of Shemshak formation due to the lepidoblastic texture of the slate and their high erosion potential due to the weather climate along the Manjil-Rudbar freeway.

**Keywords:** Qazvin-Rasht freeway, landslide, Karaj formation, Shemshak, ARC GIS.

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