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MASS MOVEMENT LANDSLIDE (JUNE 10, 2005) ALONG SARAB- ARDEBIL MAIN ROAD (WEST SLOPE SAVALAN VOLCANIC MOUNTAIN)- AZERBAIJAN- IRAN

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ABSTRACT

In Azerbaijan, development of landslide hazard areas is occurring at a greater rate than in previous years. Mass movements (landslides, Mass wasting) may take place suddenly and catastrophically, resulting in debris and snow avalanches, lahars, rock falls, flows (debris, quick clay, loess and dry or wet sand and silt). The region under survey is located in a valley named "ILANJIG". Its slope is about 30 to 40 percent and the main road of Tabriz- Sarab- Ardebil is routed across this valley. This valley is a Fault Valley and residual signs of old landslides can be observed along the valley. Construction of Tabriz- Ardebil main road was started in 1991 and completed in 1997. Because of poor design of the road, and due to continuous penetration of rain and water from melted snow into the mass clay layers and its volume swelling, shear strength of clay decreased and heavy loads from upper volcanic rock blocks lead to sudden fracture and resulted in a huge landslide.

Approximate volume of main landslide was $\frac{1.6 \times 10^6}{0.2} \left[\frac{\text{m}^3}{\text{km}^2} \right]$.

Landslides are the most predictable geological hazards, among other natural hazards.

INTRODUCTION

Landslide constitute one of the major hazards causes losses in lives and property.

Landslides are one of the complex analyses, involving multitude of factors and need to be studied systematically in order to evaluate the hazard. The mechanical material properties, such as Stress-Strain behavior under dynamic condition need to be included to improve the evaluation of the slope susceptibility.

Landslides are prevalent in mountainous areas of, north, northeast and south Azerbaijan among natural hazards, Landslides present a major danger for most IRAN area, especially in areas of the Azerbaijan where the risk is increased by human settlement on 10 June 2005, a landslide struck the community of Savalan Volcanic mountain in Ardebil area - Azerbaijan or seriously damaging the along Ardebil - Sarab main road (west slope Savalan volcanic mountain). (Fig .1)

This was not the first destructive landslide to damage this area, nor is it likely to be the last. This report describes my field observations and provides a description of the Savalan (Saiin slope) area, and its landslides history, a comparison of the past years and 2003 landslides, and discussion on continuing landslide hazards in the Savalan Community. The landslide slope is about 30 to 40 percent and the main road of Tabriz - Sarab - Ardebil is routed across this valley

REGIONAL FRAMEWORK

Climate and Water Conditions

Ardebil province with 17953 Km² area that it consist of 1.09 presents of Iran is a part of Azerbaijan territory. Geographical position of this province is 37°, 45' to 39°, 4' northern latitude and 47°, 3' to 48°, 55' longitude. Sayin gorge in Nir limits in Ardebil province is a part of southern scope of Savalan igneous massif (massif Savalan Mountain).

A land sliding happened in this area in 10 June 2005. That position was 47°, 57' longitude, 38°, 2' latitude and located 1600 m higher from sea level. It has 35 Km distance to Ardebil from west and is located in the way Sarab to Ardabil.

Regional condition

There is no climatologic station in Nir city. For this reason all the statistics and information that we found were from Ardebil and Sarab stations. There were the nearest stations.

All the statistics and information's that we get were about 38 sporadic years that they are perfect for some years and for the others are not, for that we recovered these data's. Ardebil and Sarab stations details are as follow:

1- Ardebil stations details:

- Type of station	synoptic
- Height from see level	1314.4m
- Latitude	48°, 17′
- Longitude	38°, 15′

2-Sarab stations details:

- Type of station	climatology
- Height from see level	1682m
- Latitude	47°, 32′
- Longitude	37°, 56′

By noting to the information, we can find that coldest and hottest month of the year was -33.8° and 38° respectively. According to the information, temperament regime and monthly temperatures summarize as follow:

As yearly temperature variation rate (A) Conrad ratio is varies by height variation.

This ratio is defining as follow:

$$CI = 1.7A / \sin(L + 10) - 14$$

In which:

A= yearly temperature variation

L=latitude of relevant station

CI for dried place of the world is 100 percent and for the humid and moist place is zero.

By regarding to statistics, hot, moderate, cool and cold month of the year are as follow:

- 1- Hot months: the month that the mean of daily temperature is more than 20 °C. For the considered station there was no month whit this condition.
- 2- Moderate months: the months that the mean of daily temperature is between 10 to 20 °C. From prime of May to the last of September.
- 3- Cool months: the months that the mean of daily temperature is between 5 to 10°C. May and October have this condition.
- 4- The months that the mean of daily temperature is below 5 °C. December, January, February and March have this condition.

Therefore the freezing days of the year were more than 120 days.

The mean of rainfall that was reported from 1971 to 2007 was almost 350 mm. The amount of rainfall was varies for different years and the most rainfall reported for 1971, 1972, 2006 and 2007.

Precipitation rate increases by height, and reason for this system is descending the moist weather to height .this descending will be cut it certain height. This cut line for the Albers height is 3000M, for Alp height 2500, for Zagros 2500 and for Savalan is almost 4000M.

The most seasonal rainfall in spring is 119.81mm and the least is in summer is 20.06mm.

In regard to climate categories that had represented by Emberger and Demarton this area is categorizes in cold semi dry or semi dry climate.

Geological Background of the Landslide

Savalan is 4800 m High volcano on the crest of the Azerbaijan plateau; it is shown fumarolic activity throughout historic time. This volcano from geology point of view is formed on the great Oligocene period. It is primal activity happened during Eocene time and the last activity was during end of Quaternary time.

The morphological and structural characteristics of the area suggest sub diving into two adjacent sectors, roughly corresponding to the villages of "Ilanjiq" and Nir (small town).

The landslide site is located near the confluence of two glacial and snowcapped valleys, namely the Ilanjiq and Balikhly Chay River.

In fact, the geomorphology factures of the area are due to fluvial - Glacial morphogenesis although modified by gravity deformation, slopes are usually very steep and the valleys are narrow. The Ilanjiq valley is located in the central part of the Savalan massif.

The geological unit belongs to the Pliocene - Quaternary period and it consists of a composite Eocene Eruptive rocks and Quaternary cover, locally preserved in the peripheral areas.

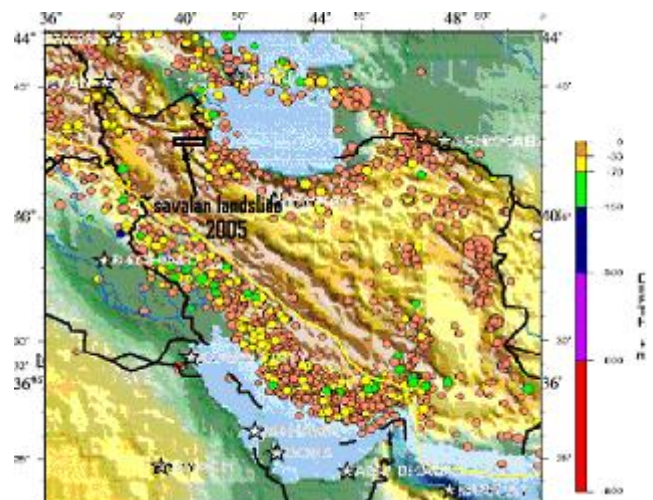


Fig. 1. Distribution of large and moderate-sized earthquakes that occurred between 1900-2005 in IRAN and their relationship with landslides

FACTORS INFLUENCING THE HAZARD ASSESSMENT FOR LARGR LANDSLIDES

Thousands of people may be killed by landslides each year and property damage may be in the tens of billions dollars, but the techniques for recognizing and coping with landslides are well developed. Landslides are generally more manageable and predictable than earthquakes, volcanic eruptions, and some storms, but only a few countries have taken advantage of this know ledge to reduce landslide Hazards.

The Balikhli Chay River and Ilanjiq valley morphology is due to fluvial - glacial modeling and to gravitational

instability of the slopes. (Fig. 2). On the right side of the Ilanjiq valley, the modeling process due to landslide deformations is evident, whereas glacial morphologies and deposit are almost absent. Along the Ilanjiq valley watershed there are trenches, sliding steps depression and spreading double - Crested ridges to deep - seated gravitational phenomena.

Right hand side of Ilanjiq valley slope whit 20 to 30 present slope covered whit alternation of red and olive green marl and sandstone whit gypsum.

This is happened undergo the mechanisms of gravitational and glacial. By overlapping and interfering phenomenon has been taken place during different periods of times. In this area the main forces extent are from north to south and it has main effect in intensifying of land slid in this place. As mentioned land sliding was happened on the left hand side of the rode and this was due to the gravitational phenomenon, severity of alternation freezing and continual precipitation cause to water penetrate inside the clay soil and consequently we had a lot of cracks and fractures. In some places the widths of these fractures were 2 to 2.5 meters.

Land sliding whit 20 m depth, 1000m length and 50m wide was happened in this areas and moved the rode 30 to 50 meters far from its first place. The total volume of land sliding was more than 9 million square meters.

We should notify that the construction of this rode began in 1991 and was ended in 1997.

Passing of heavy trucks and penetration of water inside the clay soil layers up to 30 to 40 percent as a result of steep slop and also for the rezone of heavy precipitation in 2004 to 2007 was resulted this hazards land sliding. This land sliding caused the death of more than 6 person and buried 6 to 8 cars and trucks. Damages as result of that was more than 200,000 \$.(Fig. 3)



Fig. 2. Landslide under the influence of gravity and varying degrees of saturation in west slope part of Savalan – mountain area, Azerbaijan – Iran

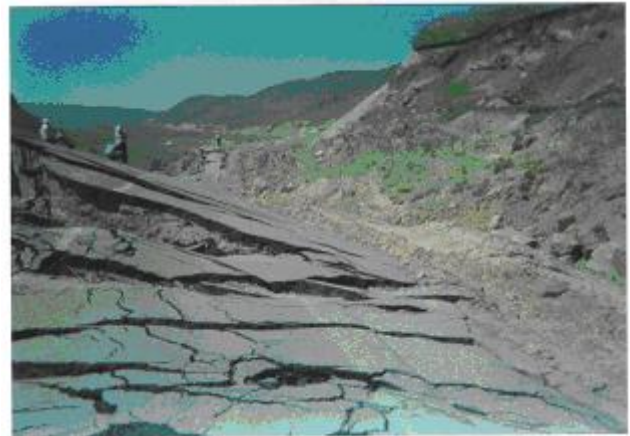


Fig. 3. Reactivation of the west Savalan landslide (Main road Sarab-Ardebil June 10, 2005)

CONCLUSIONS AND RECOMMENDATIONS

The analysis of slope stability and design of systems to warn of a possible landslide have been the topics on many books and reports.

Real - time regional landslide warning systems are rare, however, because of the complexities of landslide processes, the difficulty of determining the threshold values for triggering mechanisms, and the lack of real - time precipitation stations in landslide - prone - area.

The masking of landslide damage by earthquakes, volcanoes, and floods, and the lack of landslide damage statistics in most countries have led to widespread ignorance about the social, economic, and political consequences of landslide processes and a paucity of program for reducing the hazard, the Sarab - Ardebil main road landslide case study represents a typical situation of the difficult paradox that the populations of the Sarab to Ardebil area, have to face is they want to continue developing in their homeland, the Savalan landslide are the one major active landslides in Azerbaijan. The landslide risk has been efficiently managed for more than 25-30 years, in spite of the imaginable type of difficulties. This has represented a scientific challenge as much as a political and financial problems.

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