

DAMAGE CAUSED BY LANDSLIPS ON AUTOMOBILE ROADS AND WAYS OF THEIR ELIMINATION IN AZERBAIJAN REPUBLIC

Gasimova E.E.

Baku State University

Abstract

Landslips observed in Azerbaijan due to natural and anthropogenic processes, become activated in recent years, as a result of which the new areas of landslip have been emerged. In order to determine the influence of landslips and work out measures against these processes, the damage on automobile roads associated with landslips as well as the ways of elimination is complexly studied. The corresponding recommendations concerning the problem are given in the paper.

Being a movement of mass of rock from the upper part to the bottom of slope under the pressure of heavy surface cover of soil, the landslips emerge in many mountainous territories and seismic regions. This process typically takes place on slopes which consist of both water-resistant and moist rock layers which horizontally stretch over each other. Accumulation of precipitation over water-proof layers also enables favorable condition for arising of landslip. Like other processes such as abrasion, erosion and degradation, landslips may occur also because of works managed by humans without taking into consideration geological condition of the territory. Landslips are responsible for destruction and sinking of buildings, private houses, facilities of social infrastructure, engineering installations, main pipelines, energy-conducting lines as well as damages caused on the humans, and even may kill people in large number.

A number of landslips take place in mountainous and foothill territories of the Republic of Azerbaijan depending on inclination level of slopes consisting of clayey, sandy and lime rocks, influenced also by factors such as climate and humidity, extent of natural preservation of forests

and shrubs, existence and condition of grass cover, negative impact of human activity on the environment, seismicity, etc. (Babakhanov, 2013).

According to the Report of the Complex Hydrogeology and Engineering Expedition under the Ministry of Ecology and Natural Resources of Azerbaijan Republic for 2012, the landslips have been fixed at 223 areas of the country. The reasons of activity of exogenous geological processes were human-related deforestation, unmethodical and unplanned pasture, and also non-rational hydro-technical construction and transport works conducted in these territories.

Damaging highways in particular, the emergence of landslips are feature of the Greater and Lesser Caucasus, mountainous and foothill areas Talish region, Absheron peninsula, the basins of rivers of Gusarchay, Gidyachay, Garachay, Valvalachay, Atachay, Gozluchay, Chikilichay, Pirsatchay, Girdimanchay, Ganjachay, Kurakchay, Shamkirchay, Goycha, Agsuchay, Mazimchay, Shinchay and others. Landslips are observed in the territory of administrative regions of Guba, Gusar, Shabran, Siyazan, Khizi, Ismayilli, Sheki, Zagatala, Gakh, Shamakhi, Agsu, Gazakh, Tovuz, Dashkasan, Gadabay, Goygol, Kalbajar, Shahbuz, Yardimli, Lerik, Lankaran, Shusha, Ordubad and other regions. The overall territory area of the territories encompassed by landslips is over 4000 sq. km (Babakhanov, 2006).

The reasons of regular, large-scale and sudden emergence of landslips with followed by destructions in the territory of Azerbaijan are explained by the complex factors. They may be formulated as follows:

1. Inclination angle of slopes or elevations, and the existence of clayey and sandy layers in mountainous areas.
2. Mass deforestation and degradation of vegetative cover (which has the soil-fastening importance) in general as well as intensive pasture of meadows on slopes prone to landslips.
3. Partial cutting of slopes in order to construct transport facilities, buildings and communication lines.
4. The construction of multi-storey buildings on slopes with not modelling of their heaviness capacity, and without managing of corresponding engineering and geological researches at these areas (as it happened in Baku city) as well as absence of drainage and hydro-isolation system.

5. The loss or decrease of sustainability of rocks following the change of their physical, mechanical and hydrochemical peculiarities influenced by irrigation, precipitation and other factors. (Territories exposed ..., 2008).

According to the Law of Azerbaijan Republic on automobile roads, building, reconstruction and restoration works of automobile roads include fastening and enlargement of soil bed and engineering equipment in accordance with requirements of technical, economic and normative-technical documents and indicators of transportation and exploitation as well as replacement of destructed constructions and parts by effective and hard elements. The aim of rebuilding (enlargement of soil bed, regulation and security of movement, installation of road signs, etc.) and reconstruction works (such as elimination of deformation, change and reinforcing of construction, works on increase of sustainability, etc.), which are implemented on highways and other facilities of infrastructure, is elongation of duration of exploitation, increase of technical level of installations in accordance with standards.

Works on fastening of surface cover of lands must be managed effectively at highways, affected by landslips. This concerns particularly those of mountain territories where emergence of landslide has been fixed. The problem is characteristic and of great importance also for sharp turns and steep slope of highways which must be reconstructed in order to increase security. The necessary works in such places also must include addition or enlargement of motion strip, lighting of highways, provision of road signs in accordance with normative and technical documents, corresponding barriers of security, etc.

Motor transport is the major type of transport in many regions of the country, and is a main source of growth in passenger- and commodity turnovers. Enterprises of this area face more damage induced by landslips particularly in mountainous territories. More than 100 settlements in Azerbaijan are also regularly or periodically affected by landslips due to natural and technogenic factors. This natural disaster creates many regional socioeconomic problems, and is responsible for disruptions in connections between villages and centers of administrative units.

The districts of Baku, such as Bayil, Yasamal, Binagadi, Zig, Ahmadli, Gunashli, are also included into territories where landslips are observed. Geological condition, i.e. existence of sand, cockleshell, limestone, clay in the composition of rock, and rarely heavy rain causes to formation of landslips in these territories. Among anthropogenic factors, responsible for emergence of landslips, overloading of slopes are notable. As a result of this process, i.e.

construction works, breaking of slopes when constructing communication lines, spills from cellars, water-piping and sewerage, landslips is observed.

Calculation of losses associated with the emergence of landslips may be disputable because it is conducted based on direct and indirect damage. Direct damage is measured in all cases whereas it is difficult to calculate indirect damage. The reason is that the related state agencies do not conduct calculation of losses due to disruptions after destruction of automobile roads and facilities of motor transport. As an example, large scale landslip, covering large territories in Bayil area of Sabail district of Baku city on March 6-7, 2000, can be shown. As a result of this landslip, a number of industrial facilities and private houses as well as engineering lines and highways saw serious damage, including the destruction of 150 m long part of highway through the Neftchiler Avenue, seen as the line within modern 'Great Silk Way' of international significance. Consequently, the traffic has been disrupted within about 40 days. In the meantime, the length of highway to Baku city and out from it, has become elongated 10 km more for 4-5 thousand cars and trucks a day. The delay of automobiles by this case was 20-20 minutes, and overuse of fuel was 1-3 liter. It was calculated that this long-term disruption resulted in loss of 50 thousand hours and expenses of 500 thousand liters of fuels additionally.

In order to eliminate the consequences of landslips, the corresponding Decree has been signed by the President of Azerbaijan Republic on March 7, 2000, according to which, the financial assistance for population and recovery of the damaged economic areas has been funded from the reserve fund of state budget. The works have been implemented in order to eliminate damages, volume of which is considered approximately at \$ 50 million, and 17 families have been moved away from the territory.

Another negative situation has been observed at Gobustan-Shamakha pass of Baku-Shamakha-Yevlakh highway in 2013. Thus, intensive rains observed here was responsible for activation of the 3 out of 18 landslip strips. In the meantime, activation of seismic processes intensified landslips more in Gobustan-Shamakha. As a result of this, some pits and sunken areas emerged at the highway, which led to impediment on traffic and increase of accidents.

In some cases, conducting of defensive measures at landslip-sensitive areas is not considered as economically beneficial. Instead of passive ways of elimination of landslips, preventive measures are needed in order to solve the problems more effectively. Non-proper evaluation and consideration of engineering- and geological condition when constructing roads, may lead to emergence of many problems at roads. Therefore, it is strongly recommended taking geological

condition into consideration when managing construction works in order to escape landslips. Activation of underground waters entails landslips in connection with moistening of soil, and change of physical and chemical properties of moist soil due to spilling of water into the ground. Moistening of soil is responsible for change of hydrogeological condition and rise of level of subsoil waters. In order to remove slipping mass of soil at roads and increase sustainability of land, it is necessary to build drainage lines, and conduct undermining works if the level of subsoil waters is more than 5 meters. In some cases, when constructing automobile roads, metal armature of 0.5-1 meter of diameter as a carcass is to be plunged diametrically into the slipping mass, if it is 15-18 meters in height. This allows prevent arising of landslips. Besides this, inclination of slopes in smaller areas should be lessened if needed. In the meantime, forestation (mixed trees and shrubs) must be conducted.

It is recommended to conduct complex preventive measures, i.e. construct water-conducting lines, install trenches in landslip-sensitive territories for collecting subsoil waters, build walls of reference, and conduct strengthening works in the territories with high risk of slip. Factors, affecting normal and securely functioning of facilities of motor transport should be determined and taken into consideration in processes of creating of new residential areas, construction of large-scale industrial enterprises and plants, and designing of automobile roads.

The following issues are seen as necessary activities in studying of territories exposed to landslips at larger scale:

- Determination of composition of slopes and level of subsoil waters must be at the center of attention;
- Surface of rocks should be studied in territories of active landslips;
- Landslips' sediments must be studied to assess their states and physical peculiarities;
- The carried studies on dynamics of landslips may allow predict their potential emergence in the future.

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