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The Assessment Stability of Landslide Dangerous Slopes Existing in the Basin of River Jokhtaniskhevi

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Abstract
In the article is considered stability of the landslide dangerous slope existing on the left side of river Jokhtaniskhevi. It has been calculated critical values of slope thick ***z*** as, dry", also soil ground lay saturated with water, which overdose causes kick start of slope.
As the result of research has been determinate, that water saturation of slope decrease of critical angle approximately $10^0 \div 35^0$ (Occurring slope failures).
To accomplish this, research slope is slope existing in the marginal condition and in case of intensive rains is high possibility kick stsart of slope and suitable receive disaster results.

Keywords: ecological safety, critical, value, „dry ground", slope failures, saturated soil-ground with water

Introduction
Recently, the ecological condition in the small rivers catchment basin (more than 50 debris flow gully) surrounding of Tbilisi is catastrophic, because intensified erosion processes, landslide and debris flow phenomena, that is danger for Tbilisi population and infrastructure [1].

The main part
From the noted rivers, by ecological point of view, one important is catchment basin of Jokhtaniskhevi right tributary of Gldaniskhevi, where existing landscape-climate, structural-tectonic conditions and great contrast of relief promote high risk of natural disaster. Geologically jokhtaniskhevi river valley are not diversified. Its small part is built by fourth-order layers, by Alluvion, crushed stone, cobbles, which distributed with narrow strip in the Jokhtaniskhevi basin. The most part of territory is built by the upper and lower Paleogene Neogene clays, loam shale, rarely sandstones and some places conglomerates. South-east part, clay shales, the number of cases of high fragility and easily distinguished. The noted condition causes geomorphologic and geodynamics processes intensively, particularly, water saturation of landslide dangerous rocks cause drift away of soil and rock [2], which can lead to catastrophic results.
To accomplish this, for forecast ecological dangerous is necessary to assess stability of mountain slopes (see photo1, 2) existing in the tension condition of the catchment basin of river Jokhtaniskhevi.

Photo 1: The residents on the landslided slope adjacent to left of river Jokhtaniskhevi

Photo 2: The landslided slope adjacent to left of river Jokhtaniskhevi

In order to study stability of landslide slope of river Jokhtaniskhevi, were carried field-reconnaissance research, when has been slope in the chosen tension condition by visual terms existing in the left side of river Jokhtaniskhevi, where implemented follow works:

- From the slope has been taken soil-ground samples (see photo 3) and has been determined follow characteristics in laboratory condition: angle of internal friction φ=20^0, traction $c = 1{,}3\ tone/m^2$, Porosity $n = 0{,}5$, mineral density ρ_m =2,67 $tone/m^3$, fluid density ρ_d =1 $tone/m^3$.

Photo 3: Taking of soil-ground sample from the landslide slope

The noted data used to determine critical depth of ground lay (when start motion) on the research slope, in case ,,dry" ground [3;4] calculation implements follow methodology:

$$\frac{1}{\bar{z}} \leq \frac{c}{\rho g z} = \sin\alpha - \tan\varphi \cos a \qquad (1)$$

Where $\bar{z} = \frac{\rho g z}{c}$ - is thick of ground lay of slope, which increase cause slope kick-start; α – is inclination angle of slope, and in case of water saturated slope is:

$$\frac{1}{\bar{z}_1} \leq \frac{c}{\rho g z_1} = \left(1 - \frac{\rho_b}{\rho_\partial}\right) \cdot (\sin\alpha - \tan\varphi \cos a) + \frac{\rho_b}{\rho_\partial} \cdot \sin\alpha \cdot \frac{1}{1-n} \quad (2)$$

By taking into account our data will received follow independence:

$$\frac{1}{\bar{z}} = \sin\alpha - 0.36 \cos a \qquad (3)$$

$$\frac{1}{\bar{z}_1} = 1.374 \sin\alpha - 0.228 \cos a \qquad (4)$$

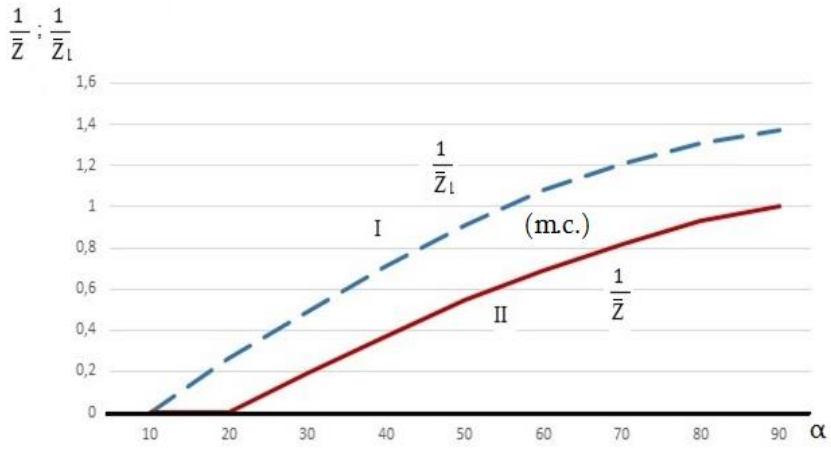
In the above independence between critical depth of slope and inclination is given in the tables 1 and 2. According them is drawn the graph #1 (see graph 1).

Table 1

	α	20^0	30^0	40^0	50^0	60^0	70^0	80^0	90^0
in case ,,dry" ground	$\frac{1}{\bar{z}}$	0	0,19	0,37	0,54	0,69	0,82	0,93	1,0

Table 2

	α	$9{,}4^0$	20^0	30^0	40^0	50^0	60^0	70^0	80^0	90^0
In case water saturated ground	$\frac{1}{\bar{z}_1}$	0	0,26	0,49	0,71	0,91	1,08	1,21	1,31	1,37



Graph 1: Graph between critical depth of slope and inclination

At the graph I is suitable to stable condition of slope, area between I and II is suitable to marginal condition, and II – when slope kick started.
For the „dry" ground will receive $\rho = 1.3\ \text{tone/m}^3$, then in case of $\alpha = 30^0$.

$$\frac{c}{\rho g z} \leq 0.2, \qquad (5)$$

where $z \geq 5.0m$ will start motion. For $= 40^0$ $z \geq 2.7\ m$, and for $\alpha = 50^0$ $z \geq 1.87\ m$.
For water saturated ground motion will start in case of 30^0.

$$\frac{c}{\rho_\partial \cdot (1-n) \cdot g \cdot z_1} \leq 0.49\ m. \qquad (6)$$

From where $z_1 \geq 2.0\ m$, 40^0 - $z_1 \geq 1.40\ m$, and for 50^0 $z_1 \geq 1.1\ m$.

From above calculated seem, that in case of water saturation start motion approximately half thick soil-ground of landslide slope , than in case of „dry" ground.
As seem from the graph, critical angle of slope inclination (when start motion) decrease with water saturation approximately with $10^0 \div 35^0$.

Conclusion

From the above mentioned research slope existing on the left side of the river Jokhtaniskhevi is clearly landslide danger, because in case of average 40^0 is enough 1.40 m thick ground mass, that in case of water saturation start misbalance.
So, according this is possible forecast slope stability of landslide section in the any river basin.

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