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DETERMINATION OF PARAMETERS OF TECHNOLOGICAL PLATFORMS FOR THE SLOPES CONDUCTING CONSTRUCTION AND INSTALLATION WORK ON STEEP SLOPES

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ABSTRACT

In this paper, we consider issues of organizational-technological solutions to sustainable base structures at their building on steep slopes. In connection with the preparation of Kazakhstan for the Winter Olympic Games in 2011, in the foothills of Almaty were built unique on the importance of sports facilities.

Key words: Steep slopes, Technological platforms, Ski jumps, Olympic games.

INTRODUCTION

Complex of ski jumps for the Winter Olympic Games was built on the slope of a foothill zone of the Trans Alatau, characterized geology and tectonics, the structure of the terrain, seismic activity area, hydrogeological conditions, engineering-geological and physical-mechanical properties of rocks. In this regard, there were problems related to the sustainability of the base of the buildings and structures erected on a steep slope. The

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consolidation and sustainability of foundation soils are highly relevant in the construction of massive underground facilities (Fig. 1). A significant contribution to the solution of these problems, taking into account the technology of their construction was made by some workers[1,2-6].

Fig. 1: General view of the ski base jumps in Almaty

Modern methods and means of ensuring the stability of the base of the pan-layered structures on slopes up to 15 degrees slope is considering increasing the strength of the soil fixation. With steeper slopes apply constructive ways to ensure the sustainability of such as: strengthening piles, retaining walls, reinforcement and other activities[6-9].

The geological and lithological structure of the area are composed of Quaternary eolian deposits represented loess (sQI), Upper alluvial deposits proluvial (apQIII) presented boulder gravel, covered loam and modern sediments. Loams have thickness in the depth of upto 40 m, where to 25, 0-28, 0 m presented subsidence loess loam yellowish-brown in color, solid with the inclusion of carbonates. According to the compression test loam to a depth of 25, 0-28, 0 m are subsidence at domestic pressure. The magnitude of the drawdown was 20, 4-113, 9 sm. Soil subsidence related to the second type and the groundwater opened at a depth 32, 8 m[10,11].

On engineering and seismic survey of the construction site conditions meet the seismic zone 9-10. In accordance with the requirements of Table 4.1 SNIP RK 2.03-30-2006 soils construction site on seismic properties belong to category III[12]. The results of experimental tests of soils showed the following values of the mechanical characteristics: angle of internal friction φ = 20,5 degree; Clutch - C = 22.5 kPa.

For a constructive solution springboard for two devices bleed tracks were selected a slope 32 and 38 degrees at different elevations. Under this project, the production of works (PPR) is assumed device shelves (sites) for the construction of pile supports under construction ramp, as well as truncation of soil slope to the design level places from 1 to 7 m. (2)[10,19].

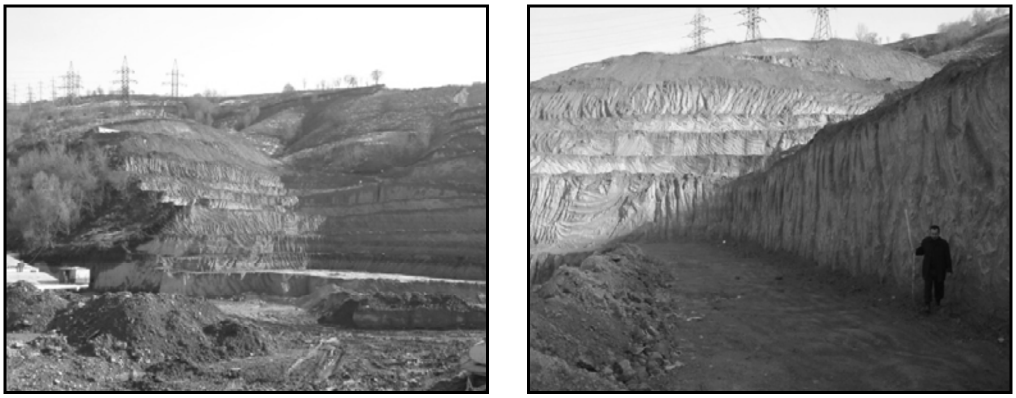


Fig. 2: Showing the truncation of soil slope to the design level places from 1 to 7 m

One of the engineering and technological challenges of building a springboard is to determine the optimal size of the shelf (width and height) to provide the general slope stability during construction and installation work. Given geotechnical conditions of the construction site, taken measures to strengthen the slope by constructing piles to a depth below the slip plane, and the lower layer of soil subsidence. Calculation of the slope and design solutions to ensure their stability with printed concrete piles designed by the Kazakh Scientific Research Institute of Earthquake Engineering and Architecture[1,7]. Technological cycle of the device printed and CFA piles on a steep slope includes drilling on the slope, installation of the reinforcement cage into it, filling the hole with concrete or hardening solution, followed by crimping. To reinforce the slope, as well as support structures springboard were applied bored piles diameter of 600 ...1200 mm, depth of 30 meters or more, able to perceive high shear and concentrated load[10,19].

The technological process of the device inclined anchors, piles and supporting structures spring board provides management of construction and installation work on the steeply dipping slope. Building on these slopes using conventional earth-moving machines (excavators, bulldozers, graders, etc.) It is not possible for the process conditions, even using anchor rope-way to ensure safety of works (Fig. 3)[2,5].

Fig. 3: Showing process of the inclined anchors, piles and supporting structures

We have developed a recommendation on technology devices operating shelves for conducting construction and installation work on steep slopes. A consistent development work platforms (shelves) with the definition of the geometric dimensions using the program for calculating the stability of excavation slopes for circular cylindrical slip surfaces, designed to calculate the stability of excavation slopes of arbitrary configuration, taking into account the effect on him of seismic forces and foreign Surcharging (weight construction and installation of machinery and mechanisms, materials, designs, etc.). This comprehensive work is inextricably linked to the definition of a permanent laboratory physical - mechanical, elastic, plastic and strength characteristics of soil samples to monitor the stability of the slope of each work site, as well as the overall stability of the slope as a whole in the process of construction of buildings[13-15]. The results of experimental tests of soils showed the following values of the mechanical characteristics (Fig. 4): angle of internal friction φ = 20, 5 degrees, clutch - C = 22.5 kPa[10,11,14].

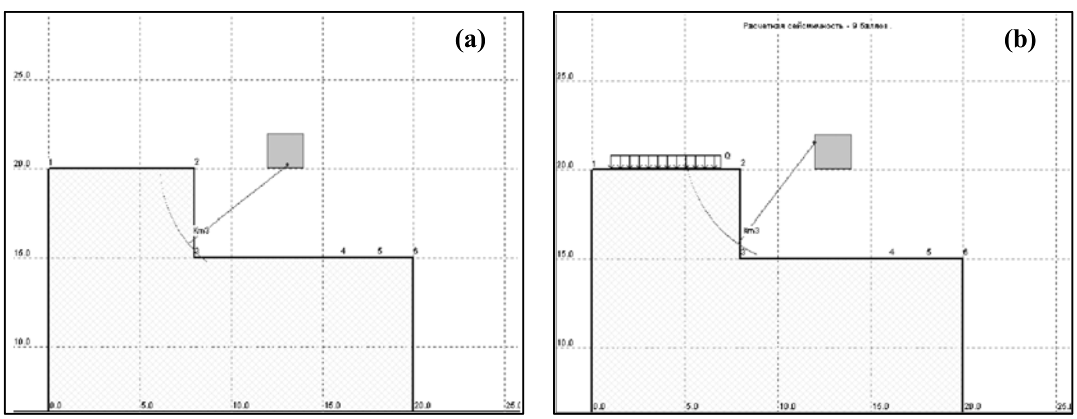


Fig. 4: Design scheme and the work site (a) without overloading; (b) with Surcharging

Assess the overall stability of slopes recesses are encouraged to implement the first limit state-bearing capacity (in terms of limiting equilibrium). Slope stability should be checked for possible shear surface (circular-cylindrical or other, including in broken surfaces) with finding the most dangerous sliding wedge, characterized by the ratio of the minimum limit of the generalized reaction forces of resistance to the active shear forces[3,16,17]. The criterion of stability of earth arrays is to comply with the inequality for the most dangerous sliding wedge:

$$\gamma_{fc} \cdot T \leq \frac{\gamma_c}{\gamma_n} \cdot R \qquad \ldots(1)$$

Where γ_{fc} - factor load combinations, taking into account the decrease in the probability of simultaneous occurrence of the design loads;

T - Estimated value of the generalized active shear force;

γ_c - Coefficient of working conditions;

γ_n - Reliability coefficient diversion structures (importance factor structures);

R - Estimated value of the generalized force limiting shear resistance determined taking into account the safety factor on the ground γ_g.

When looking for the most dangerous sliding wedge for stability criterion can be adopted to evaluate the dependence of the stability factor Ks in the following form:

$$K_s = \frac{R}{T} \geq \frac{\gamma_n \cdot \gamma_{fc}}{\gamma_c} \qquad \ldots(2)$$

The calculated values of the coefficient of stability, with an appropriate combination of loads, must not exceed the value $\gamma_n \cdot \gamma_{fc} / \gamma_c$ more than 10%, and its numerical value should not be less than 1.05.

The safety factor of the slope is determined by the following three methods of calculation:

(i) Method D. Cray.

(ii) Terzaghi method.

(iii) Method "Weighted pressure" (RR Chugaeva method).

SNIP RK 2.03-30-2006 suggests to calculate slope stability, taking into account the seismic effects, based on the design of the entire structure as a whole (the dam, channel, etc.), by analyzing the structure of the natural oscillations and given more than 10 forms of these vibrations[10,12].

The magnitude of the seismic force causing weight compartment being considered according to local building codes, is given by:

$$S_к = G_к * K_c * (1 + 0.5 * Y_к / Y_0) \quad …(3)$$

Where, $G_к$ - Net weight of the elementary K-th compartment;

$Y_к$ - Distance from the base of buildings to the center of gravity of the corresponding elementary compartment;

Y_0 - Distance from the base of buildings to the center of gravity of the entire structure;

K_c - Seismicity rate (Table 1).

Table 1: Values of the coefficients of seismicity

Seismicity in points	6	7	8	9
seismic coefficient	0	0.025	0.05	0.1

The program not only knows the distance from the bottom of the construction until its center of gravity. This value (in arbitrary units) is specified by the designer.

Thus, in order to allow the seismic force, a program must be entered:

(i) Seismicity in points - Ks.

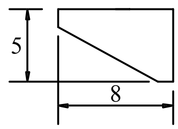
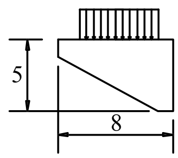
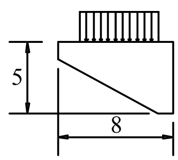
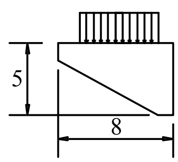
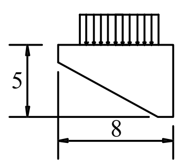
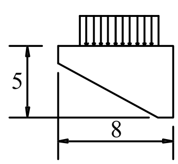
(ii) Full height of the slope - H.

(iii) The relative magnitude of the center of gravity structures (slope).

The results of the calculation of the stability of earth slope on slip surfaces are shown in Table 2.

According to the calculation results for the organization of production and execution of piling soil cutting slope to the design level, there is provided apparatus transverse flange height of the slope with the geometrical dimensions: width b = 8m, height h = 5m[18,19]. Data set calculating the optimal parameters ensures reliability and stability in the maintenance cycle of construction and installation works on a steep slope.

Table 2: The results of the calculation of the stability of earth slope

Uniformly distributed load	View ledge	The sustainability	The sustainability taking into account the seismic (9 points)
q = 0		k = 1.06-1.48	k = 0.95-1.40
q = 0.5		k = 1.03-1.43	k = 0.92-1.35
q = 1		k = 1.00-1.39	k = 0.89-1.29
q = 2		k = 0.94-1.32	k = 0.84-1.2
q = 3		k = 0.89-1.24	k = 0.79-1.12
q = 5		k = 0.81-1.12	k = 0.71-1.02

CONCLUSIONS

The developed technology devices working surfaces provides durability and stability in the maintenance cycle of construction and installation works on a steep slope. The optimal parameters for each step or slope shelves, used for providing construction and installation work is determined by calculation, with account-that the real properties of the soil at different combinations of loads, including seismic. The technological process of construction and installation work must be accompanied by continuous monitoring of physical - mechanical, elastic, plastic and strength characteristics of soil samples the slope and other changes to the terms of the construction site.

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