Up till now, K. Terzaghi's method [1] of slope stability analysis, which is based on the hypothesis that the sliding surface is of cylindrical shape, has been very widely applied in practice. However, this method has an important disadvantage insofar as it satisfies only one condition of equilibrium. To eliminate this disadvantage, D. Taylor [2] developed a method of slope stability analysis which also assumes a cylindrical sliding surface but which satisfies all the three conditions of equilibrium, by introducing assumptions regarding the distribution of stresses over the sliding surface.

In the method described below,* instead of an arbitrary law of stress distribution along the sliding surface, adopted by Taylor, use is made of the principle proposed by M. I. Gorbunov-Posadov and V. V. Krechmer [3], which is applicable to the stability analysis of a foundation, whereby the foundation reaction is represented as a vector. Using this principle, they developed an analytical method of computing the stability of a sand foundation subjected to a vertical loading.

The same principle was employed by D. E. Pol'shin and R. A. Tokar' [4], who developed a graphico-analytical method of foundation stability analysis for an inclined loading.

The proposed method is based on the following principal assumptions: 1) The soil in the body and foundation of the slope is homogeneous and isotropic, possessing frictional strength and cohesion (the method is inapplicable if \( \phi = 0 \)). 2) The slope is a single, finite, and rectilinear surface. 3) The soil mass being displaced is regarded as a single and monolithic body. 4) The shape of the sliding surface is cylindrical.

The diagram for the slope analysis for the above-mentioned assumptions is shown in Fig. 1, where the soil cohesion is replaced by a concentrated force \( Q \), obtained from the condition that a normal compressive stress (hydrostatic pressure) equal to the soil cohesion is uniformly distributed over the sliding surface, so that

\[
Q = \frac{c}{\tan \varphi} \cdot \frac{h}{\sin \psi}. \tag{1}
\]

Thus, acting on the soil mass being displaced are the following forces: its own weight \( G \), the resultant \( Q \) of a hydrostatic pressure equivalent to the cohesion, and the resultant \( F \) of the reactive forces acting along the sliding arc. The resultant of forces \( G \) and \( Q \) cuts the sliding arc at point \( K \).

In order that the conditions for the equilibrium of the soil mass under examination be met under the action of the above three forces, it is necessary and sufficient that their vectorial sum be zero and that their lines of action intersect at one point. This means that force \( F \) must be equal in magnitude to the resultant of forces \( G \) and \( Q \) and pass through the intersection point of the latter and point \( K \).

The values of forces \( G \) and \( F \) will be

\[
G = \frac{\gamma h^2}{4} \left[ a \left( 1 + \cot^2 \alpha \right) - \cot \alpha \left( 1 + \cot^2 \beta \right) + 2 \left( \cot \psi - \cot \beta - 2b \right) \right]; \tag{2}
\]

*The study was carried out under the supervision of A. S. Stroganov.
In order that the condition of limiting equilibrium at point K be fulfilled, it is necessary that the line of action of force F be tangential to a circle drawn about the center of the sliding arc and having the radius $r = R \sin \varphi$, i.e., the radius of the friction circle.

The condition whereby the sum of the moments of all forces about the point 0 is equal to zero is expressed by the equation

$$G a - F R \sin \varphi = 0. \quad (4)$$

The moment of force Q, which is a restoring force, is equal to zero since its line of action passes through the center of the friction circle. For the arm $a$ of force G and the radius R of the sliding arc the following expressions are obtained:

$$a = \frac{h}{3} \frac{1 + 6b (\cot \beta - \cot \alpha - 2 \delta) + 3 \cot \alpha (\cot \beta - 2 \delta) + 3 \cot \alpha (3 \cot \beta - 2 \delta)}{[\cot \beta - \cot \alpha] (1 + \cot^2 \beta + 2 (\cot \beta - 2 \delta)} \quad (5)$$

$$R = \frac{h}{2} \frac{1 + 6b (\cot \beta - \delta) + 3 \cot \alpha}{V (1 + \cot^2 \alpha) (1 + \cot^2 \beta)}. \quad (6)$$

Substituting the values of G, F, a, and R, respectively, from Eqs. (2), (3), (5), and (6) in Eq. (4) and making certain transformations, we obtain the quadratic equation

$$\cos \varphi + \frac{\tan \varphi \cot \varphi}{2(1 + \cot^2 \varphi)} \frac{1}{[\cot \beta - \cot \alpha] (1 + \cot^2 \beta + 2 (\cot \beta - 2 \delta)} \frac{1}{36 (1 + \cot^2 \alpha) (1 + \cot^2 \beta)} = 0. \quad (7)$$

Its solution leads to a formula for determining the "relative cohesion" (i.e., "stabilizing number" in Taylor's terminology):

$$\zeta = A (B - \cot \beta c),$$

where $\zeta = (c/\gamma h)$;

$$A = 112 (1 + \cot^2 \alpha) (1 + \cot^2 \beta)^{-1};$$

$$B = V (1 + \cot^2 \beta) (1 + \cot^2 \alpha) \cot^2 \beta;$$

$$C = 3 \tan \varphi (1 + \cot^2 \alpha) [\cot \beta - \cot \alpha]$$

$$\times (1 + \cot^2 \beta + 2 (\cot \beta - 2 \delta));$$

$$D = 2 (1 + 6 \delta (\cot \beta - \delta) + 3 \cot \alpha (\cot \beta - 2 \delta)$$

$$+ \cot \beta (3 \cot \beta - 2 \cot \beta)).$$

Fig. 1. Diagram for analysis. where $b = b/h$.

Fig. 2. Graph of the variation of relative cohesion $\zeta = c/\gamma h$ with the angle of slope $\beta$. 

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