Coefficients of Earth Lateral Pressure

Coefficients de Pression Latérale du Sol

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SYNOPSIS The problem of defining active and passive earth pressures on walls with broken back side and the problem of bearing capacity of a structure with a deepened foundation are solved on the basis of a safe stress state theory of a loose medium suggested by V.V. Sokolovsky and S.S. Golushkevich. For convenience, the solution is obtained in an analytical form as a function of dimensionless coefficients of active and passive earth pressures and coefficients of bearing capacity of a foundation.

1. Slip surfaces for active earth pressure are shown in Fig.1. At this:

$$\theta_1 = \frac{1}{2}\left[\arccos\frac{\sin(\beta+\omega)}{\sin\varphi} - \varphi + \beta - \omega\right],$$

$$\varepsilon = \frac{1}{2}\left(\frac{\pi}{2} + \delta - \varphi - \arcsin\frac{\sin\delta}{\sin\varphi}\right);$$

$$\theta = \theta_1 - \alpha_1 - \varepsilon; \quad \theta' = \alpha_1 - \alpha_2;$$

$$\psi = \varepsilon + \varphi + \operatorname{arctg}\left[\frac{\exp(-\theta\, tg\varphi) - \cos\theta}{\sin\theta}\right];$$

$$\psi' = \varepsilon + \varphi + \operatorname{arctg}\left[\frac{\exp(-\theta' tg\varphi) - \cos\theta'}{\sin\theta'}\right].$$

To determine the pressure on the upper section of AB wall, previously developed solutions for retaining walls having plane back sides are used (Yakovlev, 1964; 1975). The resultant pressure, E_2, on low section of the wall BN can be determined graphically, by successive construction of force polygons for the regions EFDD', DD'C'C, CC'B'B, BB'M and BMN, or analytically:

$$E_2 = \gamma h_2^2 \xi_{\gamma 2} + q h_2 \xi_{q2}; \quad \overline{AF} = K h_2.$$

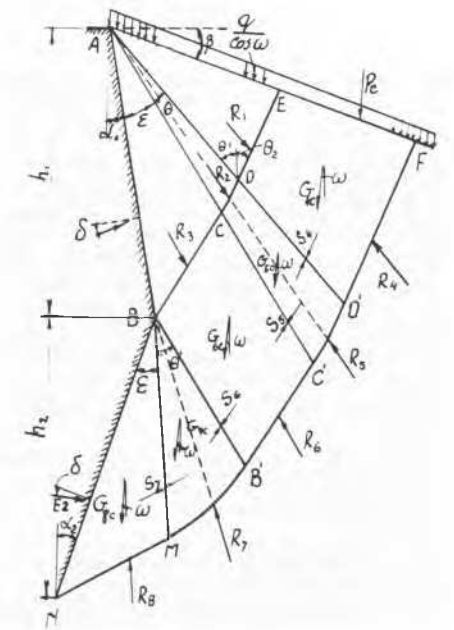

Fig.1 Slip surface of a broken back side wall in case of active earth pressure

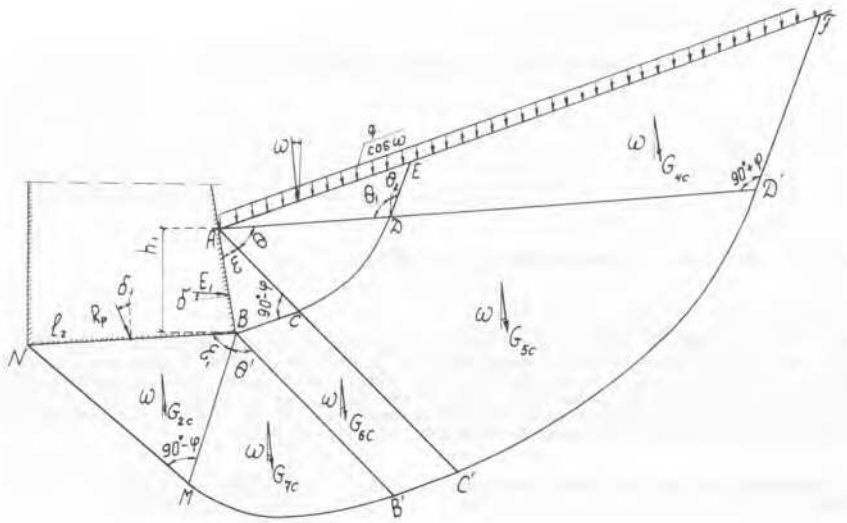

Fig.2 Slip surfaces of deeply laid structures having inclined foundation and inclined earth surface before the structure

The coefficients of active earth pressure from backfill, $E_{\gamma 2}$, from backfill surcharge E_{q2} as well as K value are functions of φ, δ, α_1, α_2, β, ω, λ. These values are obtained in a closed form, the suggestions are made as to working out the epure of earth pressure on a wall. The solution can be also applied for the case when δ (in section AB) does not equal δ_1 (in section BN). The above parameters are as follows: φ - angle of internal friction; $\omega = \operatorname{arctg} K_c$ (K_c- seismic factor); ψ - angle between side AB and direction of force R_5; ψ' - angle between side BM and direction of force R_2; $\lambda = h_1/h_2$- coefficient.

2. While determining passive earth pressure all the formulae of active earth pressure containing ω, φ, δ angles should be substituted having minus sign.

3. The problem of stability of a deeply laid structure having inclined foundation and inclined earth surface before the structure (Fig.2) is analogous to the problem of passive earth pressure in case when angle α_2 is within the range $(-70°) \div (-90°)$. The same but slightly changed formulae are used for the solution of this problem (particularly, the signs of angle δ_1 and of coefficient $\lambda = \overline{AB}/\overline{BN}$ are changed and $E_{\gamma 2}$ and E_{q2} become coefficients of bearing capacity of a foundation).

In a particular case when there are no seismic effects, $\omega = 0$ should be introduced into all formulae.

Using the derived solution, the computer program has been developed and the coefficients $E_{\gamma 2}$, E_{q2} and K are calculated for a great number of initial value patterns which enabled to quickly and accurately solve the problems connected with the determination of active and passive earth pressure upon the wall and evaluate the stability of structures subjected or not subjected to seismic effects.

Figs.1 and 2 illustrate the case of a continuous stressed state with Prandtl's zone. The author has analysed the cases of discontinuous stressed state and got continuous and discontinuous solutions for the structures with a plain side at broken earth surface contour before it.

REFERENCES

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