However, in our opinion, in order to achieve greater safety at construction sites, it is necessary to strengthen monitoring and inspection by third-party organizations of the work of managers and coordinators at all stages of construction.

References

1. NPAOP 45.2-7.03-17. Minimum labour protection requirements on temporary or mobile construction sites. [Electronic resource] – Mode of access to the resource: https://zakon.rada.gov.ua/laws/show/z1111-17#Text

2. Labour Protection on Construction Sites. Journal «Labor protection and fire safety». [Electronic resource] – Mode of access to the resource: https://oppb.com.ua/news/ohorona-praci-na-budivelnyh-maydanchykah

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ACCOUNTING FOR PARTIAL LATERAL SOIL EXPANSION IN CALCULATIONS SETTLEMENTS OF FOUNDATIONS ON WEAK BASES

Let us briefly consider the process of resistance of the soil base when loading with the foundation by the characteristic phases of their interaction.

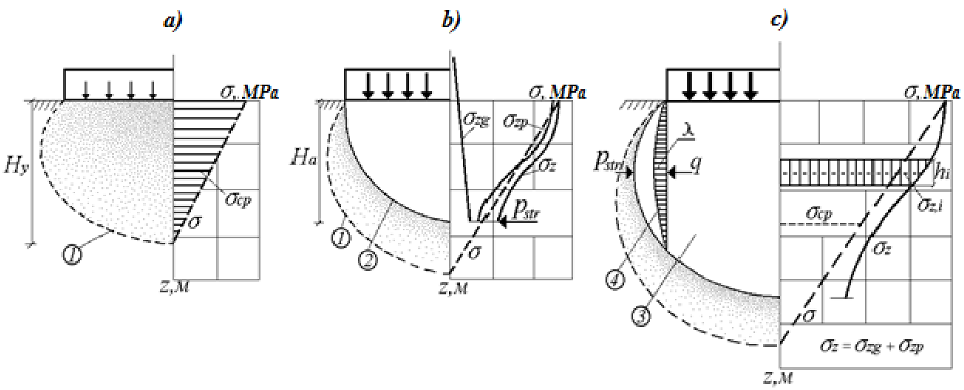

Fig. 1 – Schemes of sequential development of deformations in soils of foundations bases: limits of elastic (1) and residual (2) deformation zones; compressed volume of soil (3); diagram of transverse deformations λ (4).

Phase I (Fig. 1, a) is the initial or elastic stage of the dependence graph s = f (p), where the completely linear relationship between load pressure and settlement is preserved.. The phase limit ends with the value of the load, which is numerically equal to the structural strength of the natural soil of the base. Only elastic settlement is present in the soil of the base, and residual deformations of soil compaction are absent at all. Numerous experimental studies show that the elastic part of the settlement does not exceed a few millimeters and such a small value may not be taken into account.

Phase II (Fig. 1, b) is the second segment of the graph ***s = f (p)***, where the dependence acquires a curvilinear shape and is characterized by exceeding the increase in the amount of settlement compared to the increase in load. In this case, the pressure under the base of the foundation exceeds the structural strength of the natural soil. In the soil under the foundation base, residual deformations of the soil compaction under the foundation contour begin to develop due to a decrease in the pore volume (s_n). The boundary of this phase ends with a pressure value equal to p_q .

$$p_q = p_{str} / \xi \qquad (1)$$

where p_q is the pressure on the foundation base, with the excess of which in the soil of the base begin to develop transverse deformations;

ξ – coefficient of lateral pressure, the value of which functionally depends on both the type of soil and its condition.

At the boundary of the deformation zone, the stress is balanced by the structural strength of the natural soil. When $q < p_{str}$ transverse deformations are not observed, i.e. at the base of the foundation, residual deformations of the seal increase. Precipitation in this phase can be conditionally described by the expression:

$$p_{str} \leq p \leq p_q \rightarrow s_{II} = s_y + s_n \qquad (2)$$

where s_{II} – the amount of settlement in the second phase of the dependence s = f (p);

s_n – the proportion of settlement by reducing the pore volume.

Settlement is calculated taking into account elastic and residual deformations according to the formula:

$$s_{II} = \sigma_{cp} \cdot H_y / E_y + \Sigma\, \sigma_{z,i} \cdot h_i / E_n; \qquad (3)$$

where E_n – the compaction modulus, which is determined from the results of laboratory or field studies, it reflects the compressibility of the soil caused by a decrease in the total pore volume and is equal to $E_n = p_{cp} / (1 - \rho_d / \rho_{d,com})$,

$p_{cp} = (p + p_{str}) / 2$,

h_i – the thickness of the elementary layer of soil.

<u>Phase III (Fig. 1, c)</u> – transverse deformations ($\boldsymbol{s_v}$) begin to develop outside the foundation contour. The resistance of the base soil under the sole is exhausted; the volume of the deformation zone is formed in the natural base soil. The third section of the graph is characterized by an "avalanche" increase in settlement compared to the load increment, which can be described by the following expression:

$$p > p_q \rightarrow s_{III} = s_y + s_n + s_v \qquad (4)$$

where s_{III} – the amount of precipitation in the third phase of the dependence ***s=f(p)***;

s_v – proportion of the settlement value due to the lateral expansion of the soil.

The calculation of the foundation settlement in a multilayer basis is carried out according to the formula:

$$s_{III} = \sigma_{cp}.\, H_y / E_y + \Sigma\, \sigma_{z,i,cp}\; h_i \;/ (1\text{-}2v)\, E_n; \qquad (5)$$

where $\sigma_{z,i,cp}$ – design stress, taken as the sum of normal $(\sigma_{zp,i})$ and household ($\sigma_{zg,i}$) for each layer ($\sigma_{z,i,cp.} = \sigma_{zp,i,cp.} + \sigma_{zg,i,cp.}$);

v – the average value of the transverse expansion coefficient is determined from the experimental graph of the dependence of the transverse expansion coefficient of the soil on the foundation area.

The use of deformation properties ($E_n; v; p_{str}$) of the foundation allows determining the settlement of the foundation, taking into account the lateral expansion of the soil by the method of elementary layer-by-layer summation. In this case: a) settlement consists of the sum of the deformations of the seal and the transverse expansion of the base soil within the compressed thickness; b) the boundary of the compressed stratum is limited by the value of the structural strength of natural soil, which in the vertical and horizontal directions has equal values; the calculated stress ($\sigma_{z,i}$) is taken as the sum of additional (σ_{zpi}) and household ($\sigma_{zg,i}$); c) the compaction modulus used in the calculation is a function of the skeletal density of the natural and compacted soil base; d) the coefficient of transverse expansion of the soil functionally depends on the stress, structural strength of the natural soil, and the area of the foundation.