Existing design schemes and methods for determining the bearing capacity of foundation beds are developed primarily as applies to uniform beds. Sufficiently tested solutions, which make it possible to determine the dimensionless bearing-capacity factors, exist for these schemes and methods. The limiting pressure on the soil, which corresponds to loss of the bearing capacity of a bed formed from a uniform soil, is determined by the equation

\[ P = \frac{N_q}{b'} = N_y \frac{\xi_v}{b'} \gamma_1 + N_q \frac{\xi_v}{b'} \gamma_1' + N_c \frac{\xi_c}{b'} d + N_c \frac{\xi_c}{b'} c_i. \]  

where \( b', \xi', \xi_v, \gamma_1, \xi_q, \gamma_1', d, \xi_c, c_i \) correspond to the designations adopted in the Construction Rules and Regulations [1], and \( N_q, N_v, \) and \( N_c \) are bearing-capacity factors dependent on the angle of internal friction \( \varphi \), values of which are presented in [1-3].

Let us examine the case when loads transmitted to the bed by a foundation do not have a horizontal component, and the problem is reduced to determination of \( N_v, N_q, \) and \( N_c \). Foundation beds with clearly expressed soil lamination are frequently encountered in construction practice. Few methods have been proposed for determination of the bearing capacity of two-layer, and, especially, multilayer foundation beds, and they all are rather complex. The methods proposed by Yakovlev [4] and Zhiro [3] may be considered the most highly proven methods for two-layer foundation beds. The author's problem therefore consisted in the development of an interpolation method for computing the bearing capacity of the multilayer bed, which would be based on any of the simple acknowledged and adequately tested schemes. In limiting cases of conversion from a multilayer to a uniform bed, any interpolation method of computation should also yield bearing-capacity values, like a uniform bed calculated in accordance with the "precise" method. Determination of the limiting load from bearing-capacity factors is very simple and convenient for practice, and is employed by the author later on.

The proposed engineering method of computing the bearing capacity of multilayer foundation beds* is based on simplified premises.

We used the scheme proposed by Belzetskii [2]; in this scheme, however, the angle of incline of the boundary of the overflow prism \( OA_2A_2 \) was not adopted for \( \varepsilon + \varphi \), where \( \varepsilon = \pi/4 - \varphi/2 \), but \( \varphi/2 - \beta \) (Fig. 1). The length of the overflow zone \( L = mb \) should correspond to the Prandtl scheme; hence,

\[ m = \frac{\pi}{2} \frac{\varphi}{\varphi - \varepsilon} \text{ctg} \varepsilon. \]

The angle \( \beta \) in this scheme, which is later denoted by \( \bar{\beta} \), is a function of \( m \)

\[ \bar{\beta} = \arccotg (m \text{tg} \varepsilon) = \arccotg \left( e^{\frac{\pi}{2} \frac{\varphi}{\varphi - \varepsilon}} \right). \]

Values of \( m \) and \( \bar{\beta} \) as a function of \( \varphi \) are presented in Table 1. A scheme representing the interaction between two prisms (see Fig. 1) - resistance \( A_2OA_2 \) and thrust \( A_2OA_3 \) prisms - was examined for analytical determination of the bearing-capacity factors. Both these prisms were considered rigid, and their stressed state was disregarded. The condition of equilibrium of all forces acting along the perimeters was employed to solve the stated problem. The volume of prism \( A_2OA_3 \) is considered given, and it is assumed that the bed's bearing capacity \( P \) itself is determined by any of a number of earlier approved methods. In this case, let us determine the angle \( \delta \) of incline of the force \( H \) acting on the interface \( OA_2 \) between the two zones. All active forces, including the weight of the prism, were accounted for in solving this problem. Force polygons from examination of which equations were derived for computing the bearing

*The study was conducted under the guidance of M. V. Malyshev.

Fig. 1. Proposed computational scheme for uniform foundation bed.

capacity in accordance with the adopted scheme of two intersecting planes were thenconstructed to determine $H$. Having determined the bearing-capacity factors $N_y$, $N_q$, and $N_c$ of a uniform bed as functions of the angles of incline $\delta_y$, $\delta_q$, and $\delta_c$ and knowing their values obtained from any other familiar computational scheme, for example, [1], we can determine the $\delta_y$, $\delta_q$, and $\delta_c$ values, which correspond to the latter and which enter into the computational scheme adopted. Knowing the coefficients $N_y$, $N_q$, and $N_c$ for a uniform bed, let us proceed to a two-layer, and then three-layer bed (Fig. 2). Thereafter, the author generalized the equations for the multilayer bed with an unlimited number of layers with their horizontal arrangement [5]. Average values of the bearing-capacity factors, corresponding to the soil in each layer, were calculated in this case. The protrusion prism constructed as shown in Fig. 2a, and the area of the average bearing-capacity curve should be equal to the area of the broken curve corresponding to the strength of each of the bed layers. It follows from examination of the diagram that if the number of bed layers is $i$, $b_i = h_i \tan \beta_i$; in this case, $\sum b_i/b = 1$. Thus, average values of $N_q$ and $N_c$ are obtained for a two-layer, and then a multilayer bed; here, the product $N_c c$, which enters into Eq. (1), is calculated immediately in the latter cases;

$$N_q^{av} = N_q^{(1)} \frac{b_1}{b} + N_q^{(2)} \frac{b_2}{b}, \quad i = 2,$$

$$N_q^{av} = \sum_{i=1}^{n} N_q^{(i)} \frac{b_i}{b}, \quad i = 1, \ldots, n,$$

$$N_c^{av} = c \cdot N_c^{(1)} \frac{b_1}{b} + c \cdot N_c^{(2)} \frac{b_2}{b}, \quad i = 2,$$

$$N_c^{av} = \sum_{i=1}^{n} c \cdot N_c^{(i)} \frac{b_i}{b}, \quad i = 1, \ldots, n.$$  

Equations (4) should be considered in conjunction with the expression given for $b_i$. In this case, we have

$$b_n = 1 - \sum_{i=1}^{n-1} \frac{b_i}{b} \geq 0.$$  

for the lower layer ($i = n$). It is more complicated to calculate the factor $N_c^{av}$, since the curve is triangular in this case. The familiar relation between $N_q$ and $N_q$, which follows from the computational scheme adopted, can be used to determine each of its successive segments. In this case, we can adopt the scheme in which the angle $\delta_q = 0$, i.e., the force $H$ is directed horizontally, to simplify the problem. From examination of the force polygon, it is then possible to derive the equation [5]

$$\tg \beta = \frac{N_q - 1}{2 N_y}$$

for a uniform bed. If the factors $N_y$ and $N_q$ are taken from the Construction Rules and Regulations [1], we obtain the $\beta$ values listed in Table 1.