TYPES OF FOUNDATION EFFECTIVE ON PACKED SOIL BASES

P.S. Pojta, D. Eng. Sc., Prof., P.V. Shvedovskiy, Cand. Eng. Sc., Prof., T.P. Shalobyta, Cand. Eng. Sc., Ass. Prof.
Brest State Technical University, the Republic of Belarus

The construction of underground structures forms a greater part of the construction works and turns to be rather costly and time-consuming with the construction of foundations accounting for 15 per cent of underground construction costs and consuming 20 – 35 per cent of the construction time. Pile foundations account for 25 per cent of all other types of foundations used in building whereas ferro-concrete piles account for 65 per cent of all other types of piles used.

In our opinion, pile boring hasn't found wide application in our republic though this is the type which is less costly with minimum metal concentration and high bearing capacity.

Moreover, the application of pile foundations with bored piles and bored-driven piles in particular is normally practiced in complicated engineering and geological conditions with good-property soil. Theoretical analyses were carried out into the work of bored piles in firm and semi-firm soil, as the application of heavy ramming makes it possible to have foundation bases with rather high bearing capacity.

The bearing capacity of a bored pile in any settling conditions is made up of the resistance along the whole side surface and the resistance under the lower base of a pile

$$F_d = F_{dv} + F_{du} ,$$

where F_{dv} is a component of a pile's bearing capacity in the conditions of soil resistance under a pile's lower base (kH); F_{du} is a component of a pile's bearing capacity in the conditions of soil resistance along a pile's side surface , kH.

As the load carried by a pile's side surface accounts for 60 – 90 per cent in packed and loose clay soil and for more than 90 per cent in firm and semi-firm day soil and sand, only F_{du} component was calculated

$$F_{du} = f\pi dh,$$

where d is a pile's diameter (m); h is a pile's length (m); f is soil specific resistance along a pile's side surface (kPa)

$$f = (P + P')tg\varphi + C,$$

where P is horizontal pressure on a pile appearing in the process of its production (kPa), P' is additional horizontal pressure appearing in the process of applying vertical load upon a pile (kPa); φ is an angle of friction in soil (deg.); C is specific cohesion (kPa).

Applying the expression for the calculation of radial elastic deformations of a concrete column and Lashe's formula, it becomes possible to have a ratio for calculating additional horizontal pressure on soil P' appearing due to the presence of diametrical expansion of a pile in the conditions of is vertical loading.

$$P' = \frac{4NE\mu_{\sigma}}{(1+\mu)\pi d^2 E_{\sigma}},$$

where N is vertical load on a pile (kN); E is a soil deformation modules (MPa); μ_{σ} is a coefficient of diametrical soil expansion; E_{σ} is a modulus of concrete elasticity (MPa); μ is a coefficient of diametrical soil expansion; d is a pile's diameter (m).

But all these ratios are typical for common types of heavy concrete.

Straining concrete can be efficiently used in the production of bored and bored-driven piles. The self strain P_c and shape deformations of a material can be regulated by varying the composition of concrete. So,

$$f = (P + P' + P_c)tg\varphi + Q$$

As calculation show, the value of shape deformation can vary from 0,4 per cent till 1,5 per cent of a pile's diameter.

Computer modeling of the work of boring piles was done for the following conditions:

1) a hole is filled with common heavy concrete up to the upper base of a pile and the soil pressing (P) is equal to 3,42 kPa;

2) a hole is filled with straining concrete up to 3 meters from a hole's bottom and the soil pressing (P) is equal to 350 kPa with common heavy concrete placed at the top. In all these cases a pile's diameter is 400 mm and sand of average density and size is taken as a standard.

These results of the computer modeling are the following:

1) the bearing capacity of a common heavy concrete pile is 120,6 kN;

2) the bearing capacity of a straining concrete pile is 479 kN, i.e. four times higher.

The conclusion is that foundations constructed with bored and bored-driven piles are rather economical and have higher bearing capacity in comparison with foundations built with common heavy concrete piles. And more accurate consideration of straining and deformations conditions within the space round a pile in practical designing will promote a more rational use of materials.