OBSERVATIONS OF THE SETTLEMENTS OF
A STEELMAKING PLANT ON SITU-CAST PILES

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Observations of the settlements of the steelmaking plant, which are being carried out in collaboration with the Zaporozh’e Construction Trust, began in 1966 during the construction period (after construction of the grillage) and are continuing at present.

The plant building, designed by the Zaporozh’e department of the All-Union Trust for Construction Planning of Industrial Establishments and Structures of Ferrous and Nonferrous Metallurgy and Machinery Manufacture (Promstroiproekt), was made of precast reinforced concrete and covered with 3 × 12-m large-panel slabs (Fig. 1).

The building has three bays widthwise: furnace (BD), auxiliary (EF), and scalping (FG), which adjoins the open crane trestle with a 10-ton crane intended for intermediate storing of ingots and electrodes and their loading.

Twelve electric furnaces are installed in the furnace bay. The department is serviced by two 10-ton cranes.

In the auxiliary bay are installed two roller-hearth heat-treating furnaces with an area of 18 m² and charge weight of 30 tons. This shop is equipped with three 5-ton cranes and two 15-ton cranes.

The scalping bay has machines for machining ingots, for the transport of which the bay is equipped with 5-, 7.5-, and 10-ton cranes.

The dimensions of the second line of the plant are 60 × 120 m without the open trestle.

Fig. 1. Cross section of plant and plan of piles.

The surface of the construction site is composed of made ground from 3.2 to 5.1 m thick with an inclusion of slag, ore dust, and broken brick underlain by loessial humified loam from 1.4 to 3.1 m thick and carbonate-rich loessial macroporous loam from 5.2 to 6.4 m thick.

They are underlain by nonslumping loam of medium consistency.

The groundwater level is at a depth of 5.75-6.08 m from the surface. The nonslumping loam is used as the working layer for the situ-cast piles. With consideration of the different depth of occurrence of the surface of the working layer, the length of the piles of the plant varied from 9 to 12 m. The working layer is characterized by the following indices: natural moisture weight percentage 18.2-23%; bulk specific gravity 1.97-2.02 tons/m³; unit dry weight 1.60-1.65 tons/m³; porosity 39-42%; water content at plastic limit 18.5-21.6% and at liquid limit 29.3-41.9%; consistency 0.2-0.4; permeability coefficient 0.21 m/year.

To refine the bearing capacity of the piles, static tests by an anchor stand were carried out in 1966, as a result of which it was found to be 85 tons [2].

One mark was placed on each grillage under the column and 40 marks in all over the plant of the second line.

Figure 2 shows the settlement curves of the foundations. The average settlement is 29 mm, the maximum along row C is 63 mm, and the minimum along row G is only 5 mm.

As we see from Fig. 2, the foundation settlements are quite nonuniform.

The maximum longitudinal slope of the tracks is observed along row C and amounts to 0.002, and the transverse slope of rows C and D is only 0.0012.

Analyzing Fig. 2, we can establish that during construction the increase of settlements occurred along all axes despite the fact that the loads had still not reached the design loads. A considerable increase of the settlement of rows D and F was observed after the plant was accepted for service. Evidently this can be explained by the fact that the maximum crane load is transmitted to rows D and F.

Settlement along row C is maximum, although the crane load here is minimum. Such divergence in settlements can probably be explained by the process of constructing the situ-cast piles, as a result of which there was a different sedimentation of the slurry at the bottom of the holes.

As is known, for the preparation of high-quality mud it is recommended to use finely divided bentonite clays with a specific weight of the mud of about 1.2, viscosity 20-30, daily settling up to 5%, and quantity of sand particles not more than 10%. In drilling the holes for the steelmaking plant a mud of local loess soils, represented by sandy loams and more rarely loams, was used which did not meet completely the requirements imposed.

We determined the average theoretically possible settlement for all axes, which was 26 mm.

Calculation of the settlements over the axes was done as for conventional mass concrete, in which case the working support area of a conventional foundation was taken with respect to the perimeter of the contours of the clubfoot of the situ-cast piles.

CONCLUSION

Observations of the settlements of a steelmaking plant established the differential character of the change of settlements of situ-cast piles in time under conditions of cutting through loess soils.