The directives of the 24th Party Congress call for the wide use of local materials and industrial wastes (slags, ashes, etc.) in construction. Loess soils and blast-furnace slags can be such materials in the Zaporozh'e region.

Therefore, the Scientific-Research Institute of Bases and Underground Structures together with the Administration for Capital Construction of the Zaporozh'e City Executive Committee developed a new material for situ-cast piles - slag-soil cement, the components of which are blast-furnace slags of the 20-40 mm fraction, soil-loess or loesslike loam, cement of a grade not below 300, and water in appropriate weight ratios. The composition and physical and mechanical properties of optimal formulas of slag-soil cement are presented in Table 1.

The activity of the slags and loess, containing CaO and Al₂O₃, which intensify hardening of the material, was used in the slag-soil cement.

To select the optimal mixture of slag-soil cement, the physical and mechanical characteristics of the material were investigated as a function of the quantity of the components and change of the water/cement ratio on cubic specimens measuring 7 × 7 × 7 and 20 × 20 × 20 cm and on prisms and beams measuring 10 × 10 × 40 cm.

The data of Table 1 show that the cube strength of 28-day slag-soil cement is identical to the strength of heavy grade 100 concrete and after a year increased to grade 200 and higher. Thus the material gains strength with time.

Slag-soil cement as a material was tested in situ-cast piles.

During the investigations we worked out the process of manufacturing the slag-soil cement, which can be prepared both at permanent concrete plants and at construction sites with few means of mechanization (free-fall concrete mixers with a capacity to 150 liters).

<table>
<thead>
<tr>
<th>Weight composition in units</th>
<th>Cement kg/m³</th>
<th>W/C</th>
<th>Cube strength Rₜ₉₀ kg/cm²</th>
<th>Time</th>
<th>R₉₈ kg/cm²</th>
<th>R₂₈ kg/cm²</th>
<th>R₅₆ kg/cm²</th>
<th>R₉₀ kg/cm²</th>
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<tbody>
<tr>
<td></td>
<td>C</td>
<td>S1</td>
<td>So</td>
<td>S1/So</td>
<td>water</td>
<td>W/C</td>
<td>7 days</td>
<td>14 days</td>
</tr>
<tr>
<td></td>
<td>1</td>
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<td>3:1</td>
<td>0.99</td>
<td>0.90</td>
<td>1.00</td>
<td>1.04</td>
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<td>5.05</td>
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Note. C) Grade 500 cement; S1) slag; So) soil.
The slag–soil cement was prepared in the following way. Blast-furnace slag rubble, loess or loesslike loam, and cement were delivered to the drum of the concrete mixer. The dry mix was mixed for 3–5 min, and then water was added. A uniform mass was obtained after final mixing.

The technology of forming the situ-cast piles in slump-prone soils is analogous to the technology of deep compaction by soil piles. Boring and compaction of the slag–soil cement were accomplished by the same BS-1m rig without interchangeable equipment. In this case a jacket of compacted soil 0.1–0.3 m thick formed around the pile, and a soil wedge formed in the base.

A portion of the plastic slag–soil cement with a volume of 0.15–0.2 m³ was fed into the borehole and tamped by 20 blows. As a result a 0.5–0.8-m finished pile was obtained.

The upper part of the pile was reinforced with a 2-m cage (6Ø16AI). The 1.0- to 1.5-m³ pile head was made of grade 300 cast concrete on small granite rubble.

The method of construction and form of the finished piles promote close cohesion with the surrounding soil, which provides a high bearing capacity of the piles.

The bearing capacity of the slag–soil-cement piles was determined by static penetration load tests in slump-prone soils with a natural water content and in a flooded state. The tests were conducted by means of a thrust beam loaded on two sides with a load of 100 tons each created by hydraulic jacks and measured by standard pressure gauges. The deformations were measured by Aistov's deflectometers.

Before the start of the tests preparatory works were conducted at the experimental site, which included the installation of a drainage network, drain wells, pits around the piles, and surface and depth markers. The pits and drain wells were filled with small rubble to stop the flow of soil during flooding.

The water content of the soil beyond the piles throughout the entire depth of the flooded stratum, determined by control borings, was equal to 20–25%.

Testing in slump-prone soils having a natural water content was carried out on pile No. 1. On loading, the pile settled 1.5 mm. After unloading, the pile returned to the former position (see Fig. 1).

On testing pile No. 2 at a natural water content the load was brought to 100 tons. In this case the pile settled 1 mm. After accidental flooding of the soil beyond the pile, the pile, without the load removed, settled an additional 0.5 mm, and the total settlement was 1.5 mm. Flooding was continued, and the load brought to 190 tons. The total settlement of the pile at this load was 6 mm. After stabilization of settlements the pile was unloaded, and the residual deformation amounted to 0.5 mm.

Pile No. 3 was tested with preliminary flooding of the soil beyond the pile. At a load of 100 tons and water consumption of 550 m³ the settlement of the pile was 3 mm. With further flooding and 950-m³ water consumption the settlement of the pile stabilized and amounted to 5 mm. At a load of 193 tons the pile settled as much as 100 mm. Thus, settlement of the pile was brought to more than 80 mm, which was required by the Recommendations [1].