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## **BEHAVIOR OF WORK OF PILES IN SEASONALLY FREEZING SOIL**

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**Abstract.** In this paper presented results of load and settlement variations were investigated for the construction site “Prorva”, located in the western region of Kazakhstan. Study behavior of work of piles in seasonally freezing soils ground depends on several factors negative temperature, thickness of active layer, average duration of freezing and frozen conditions, frost heaving amount. Maximum load of piles are 1639 kN, settlement is 4,43 mm in winter periods, and 6,76 mm in seasonally freezing soil respectively.

**Аннотация.** В данной статье представлены результаты нагрузки-осадки свайных фундаментов в сезоннопромерзающих грунтах на объекте «Прорва», расположенный в западном регионе Казахстана. Изучение поведения работы свайных фундаментов зависит от нескольких факторов отрицательной температуры, глубины промерзания, продолжительность промерзающих и мерзлых условий, величины морозного пучения. Максимальная нагрузка на сваю со-

ставляет 1639 кН, осадка в зимний период 4,43 мм, 6,76 мм в сезоннопромерзающий период соответственно.

**Introduction.** The climate of west Kazakhstan is continental. Strength and deformation properties of frozen soil differ from unfrozen soil. Study behavior of work of piles in seasonally freezing conditions depends on several factors negative temperature, thickness of active layer, average duration of freezing and frozen conditions, frost heaving amount.

The site “Prorva” is located close to Atyrau city (West Kazakhstan). Length of piles 27 m, 2 segment piles.

**Geological characteristics of site “Prorva”.** The studied territory is included in the zone of seaside semi-deserts with inherent soil and plant complexes. Primordial primitive soils are characteristic of the surface of accumulative sea terraces, to which the studied territory is confined in the composition of the vegetation, halophytes dominate here (saltrose, reducing, sarsazan); in some places are the curtains of the reed and tamarrisk.

In table 1 presented physical and mechanical properties of soils in site “Prorva” unfrozen soils ground conditions.

Table 1

Physical and mechanical properties

Type of soil	c, kPa	$\phi$ , deg.	$\gamma$ , kN/m <sup>3</sup>	Su, kPa	E, kPa
Fill Sand	0,7	29,4	19,4	25	2,8
Silt	0,7	29,4	19,3	15	2,75
Sand	2,7	31,5	19	–	30
Clay	20,8	24,7	19,1	80	2
Sand	2,4	31,8	20	–	40
Clay	22,7	23,8	20,6	150	4
Clay	25	24,7	20,2	150	2

### Vertical load test of piles K/3, PP/5, CC/3

The vertical load test shall be carry out by standards. Static vertical loading test should be carry out below sequences: Pile testing begin not earlier than 6 day after pile driving or re-driving: the vertical load creating with hydraulic jack DG500G250 capacity 500 tons and with hydraulic jack CLRG-2506 capacity 250 tons. Following each application of an

increment of load the load shall be held for not less than the period or until the rate of settlement is less than 0,25 mm/h and slowing down. The rate of settlement shall be calculated from the slope of the curve obtained by plotting values of settlement versus time and drawing a smooth curve through the points.

Table 2

Program of load stages of piles

Loading (maximum compression test load equals 1.25 x working load)		
Stage	Percentage	Minimum time of holding load
1	2	3
1	25	1 h
2	50	1 h
3	75	1 h
4	100	1 h
5	75	10 min
6	50	10 min
7	25	10 min
8	0	1 h
9	80	6 h
10	100	1 h
11	125	6 h
12	100	10 min
13	80	10 min
14	60	10 min
15	40	10 min
16	20	10 min
17	0	1 h

Each stage of unloading shall proceed after the expiry of the period; for any period when the load is constant, time and settlement shall be recorded immediately on reaching the load, and at approximately 15 min intervals for 1 hour, at 30 min intervals between 1 h and 6 h after the application of the increment of load; loading shall continue until one of the following is first to occur: the maximum compression test load. The total movement of the pile base equals 10 % of the least cross-sectional dimension of the pile in table 2.

Based on results of program of load stages of piles fig. 1 presented graph Load-Settlement for piles PP/5, K/3, CC/3.

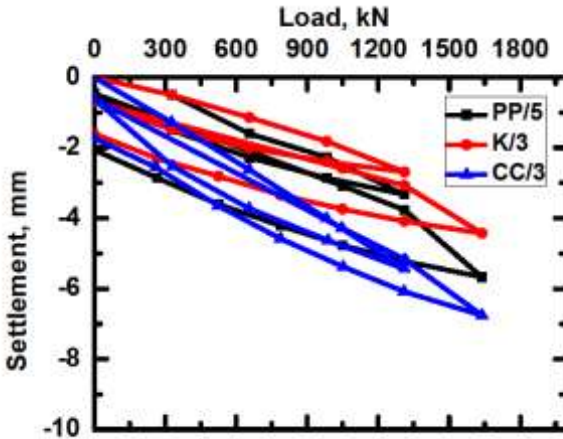


Fig. 1. Comparison piles K/3, PP/5, CC/3

Results. The overlapping of the curves showed that the convergence of the graphs to K/3, PP/5 is observed only at the initial loading stage, then a change in the trajectory of the SLT curve is observed. With a maximum pile load of 1639 kN, the K/3 pile settlement is 4,43 mm in the winter period, the CC/3 pile is 6.76 mm in seasonally freezing periods

### Conclusion

In site “Prorva” is presented results of 2 segment piles types which were been used in different frozen and freezing soils ground conditions.

There were 3 piles CC/3, K/3, PP/5 carried out test method of SLTs. Results of data bearing capacity all pile foundations consist are 1639 kN, temperature  $-10^{\circ}\text{C}$ .

Frost heaving swelling is about 10 cm in Atyrau region site “Prorva”. Comparison of the results of the settlement values of foundations on the construction site “Prorva” in the seasonally freezing soils showed that the value is 0,6 % and the depth of ground freezing does not significantly impact the bearing capacity of the piles.

In Kazakhstan reinforced precast piles are used in cold regions.

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