

# Evaluation of the work of driving piles under dynamic loads

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**ABSTRACT:** The aim of the work is a complex of studies of the operation of driven piles in the presence of loads. To achieve this goal, the following tasks were set: to analyze theoretical and experimental data in the field of driven pile research; carrying out a calculated assessment of the capabilities of driven piles according to regulatory documents; comparison of comparative analyzes of indicators of bearing capacity of driven piles based on test results.

*Keywords:* pile, normative standard, tests, bearing capacity

## 1 INTRODUCTION

### 1.1 Construction site

The purpose of the tests is to determine the pile driving depth and the pile bearing capacity. The dynamic pile load tests on preliminary C70.30-8 driven piles and C70.30-6 working piles on the construction site of the Project “Construction of multifunctional family-entertainment and tourist area” in the city of Astana, were carried out by specialists of KGS-Astana LLP.

Driving of preliminary C70.30-8 piles in the amount of 21 pieces subjected to dynamic tests was carried out by KGS-Astana LLP on January 28 to February, 25, 2021. Driving of working C70.30-6 piles in the amount of 7 pieces, also subjected to dynamic tests, was carried out from January 16 to January 25, 2021.

When driving preliminary piles, a Junttan PM-20 pile-driving rig was used with an HHK-5A hydraulic hammer with a shock mass of 5000 kg with a cap, and a weight of 835 kg. When driving working piles, Junttan PM-25 pile-driving rigs were used with hydraulic hammers HHK-7A and HHK-9A with a shock mass of 7000 kg and 9000 kg, with caps weighing 990 kg and 1160 kg, respectively.

## 2 RESEARCH METHOD

### 2.1 Dynamic pile load testing

Characteristics of the tested piles: C70.30-8, 7.0 m long, section 30x30 cm. Absolute elevations: soil surface: 345.66m; the bottom of the piles according to the project: 336.325m.

Dynamic pile load tests are carried out in order to determine the possible depth of their penetration and changes in the value of refuses, as well as to assess the bearing capacity of the piles. Dynamic pile load tests should be performed in accordance with the requirements. The piles will be driven by a Junttan HHK-5A hydraulic hammer with a hammer weight of 5000kg and a cap with a weight of 835kg. Preliminarily, the pile surfaces are marked in graduations with paint every 1m, and every 0.1m on the last meter.

During the dynamic pile load testing the following types of work are carried out:

- delivery of piles to the point of driving,
- while observing measures that exclude breakages and cracks in the pile body;
- the customer defines and produces a geodetic breakdown of pile tests;
- test piles are driven to the design elevation or to their possible depth of penetration.

Testing of preliminary piles, stage 1:

- preliminary pile marking from the tip every 1m to 5m, then 10cm to the expected possible depth of penetration;
- moving the pile driving unit to the place of test pile driving;
- installation of piles at the point of their driving and driving piles with an impact energy that ensures penetration in dense soils, to the maximum depth;
- calculate the number of hammer blows for each meter of pile penetration, and on the last meters - for every 10 cm of penetration.

Testing of preliminary piles, stage 1: the ‘rest’ of the piles is maintained for 3 to 6 days; before after-driving, a millimeter measuring tape is attached to the driven piles;

- pile after-driving is carried out by single blows with the same equipment that was used during driving,
- the drop height of the striking part of the hammer during after-driving must be constant;
- after-driving is carried out with two consecutive counts of 3 and 5 blows.

The largest average refusal is taken as the estimated pile refusal; pile penetration is recorded using a measuring tape with an accuracy of 1 mm; in the process of pile driving, an observation log shall be kept, upon completion of the tests the pile test report shall be filled in.

### 3 TEST RESULTS AND DISCUSSION

Table 1 presented results of dynamic load test of construction site.

Table 1. Results of DLT.

Pile number	Pile mark and section, cm	Abs. elevations of the soil surface near the pile, m	Depth of driving piles into the soil, m	Particular value of pile ultimate resistance, (t)	Bearing capacity of piles	Design allowable pile-bearing load, taking into account the reliability factor $\gamma_k=1.4$ , (t)
1	P1 TP1	C7-30, 30x30	345.66	58.3	48.7	34.8
2	P1 TP2	C7-30, 30x30	6.20	58.3		
3	P1 TP3	C7-30, 30x30		-		
4	P1 TP5	C7-30, 30x30		36.4		
5	P1 TP6	C7-30, 30x30		60.8		
6	P1 TP7	C7-30, 30x30		64.8		
7	P1 TP9	C7-30, 30x30		68.2		
8	P1 P462	C7-30, 30x30		49.3		
9	P2 TP1	C7-30, 30x30		58.3	70.4	50.3
10	TP2	C7-30, 30x30		63.7		
11	TP5	C7-30, 30x30		65.9		
12	TP6	C7-30, 30x30		84.9		
13	TP7	C7-30, 30x30		80.7		
14	TP8	C7-30, 30x30		84.9		
15	P3 TP1	C7-30, 30x30		48.3	42.7	30.5
16	P3 TP3	C7-30, 30x30		30.6		

(Continued)

Table 1. (Continued)

Pile number	Pile mark and section, cm	Abs. elevations of the soil surface near the pile, m	Depth of driving piles into the soil, m	Particular value of pile ultimate resistance, (t)	Bearing capacity of piles	Design allowable pile-bearing load, taking into account the reliability factor $\gamma_k=1.4$ , (t)
17	P3 TP4	C7-30, 30x30		36.9		
18	P3 TP5	C7-30, 30x30		56.7		
19	P3 TP6	C7-30, 30x30		68.2		
20	P3 TP7	C7-30, 30x30		80.7		
21	P3 TP9	C7-30, 30x30		80.7		

The bearing capacity of the piles was determined on the basis of statistical processing of test results in accordance with GOST 20522-96.

#### 4 CONCLUSION

The bearing capacity of the piles according to the results of dynamic tests was 48.7 tons for Parking Zone P1; 70.4 tons for Parking Zone P2; 42.7 tons for parking Zone P3. The design allowable pile-bearing load should be taken with consideration of the reliability factor  $\gamma_k = 1.4$  SP RK 5.01-103-2013 Pile foundations should be taken equal to: 34.8 tons for Parking Zone P1; 50.3 tons for Parking Zone P2; 30.5 tons for parking Zone P3.

#### REFERENCES

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