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COMPARISON OF RESULTS OF SERIES PILE LOAD TEST IN ACCORDANCE WITH ASTM AND KAZAKHSTAN STANDARDS

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Abstract: The results of series field test on piles on strategic oil and gas site in Kazakhstan are presented in this paper. The test include: static load test in accordance with ASTM and Kazakhstan standards (GOST), dynamic load test in accordance with GOST and pile driving analyzer (PDA) in accordance with ASTM. The difference of standards procedures and test results is presented.

Introduction

Field load tests on piles were performed on oil and gas construction site of Kazakhstan Republic: Integrated petrochemical complex and infrastructure (IPCI) Project. The tested areas and tested pile positions is presented on Figure 1. The tests had been made by the specialists of KGS, Llp form April to Augest of 2014.

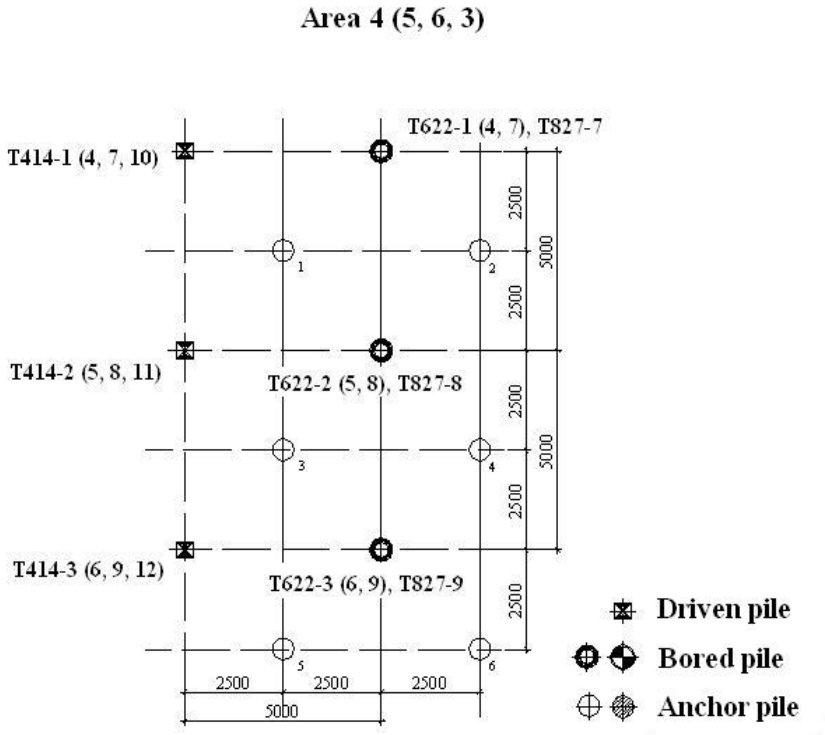


Figure 1 – Tested areas and tested pile positions

Generally 12 driven piles T414-1 – T414-12 and 9 bored piles T622-1 – T622-9 had been tested. Description of pile marks: T - tested pile, 4 - diameter of bored pile or width of driven pile (400 mm), 14 - length of pile 14 m, 1 - sequence number. The series of pile test include: compression static load test in accordance with ASTM and Kazakhstan standards (GOST), dynamic load test in accordance with GOST and pile driving analyzer (PDA) in accordance with ASTM.

Tested piles were drove by driving machine JUNTTAN PM25L with hydraulic hammer NNK7A, weight of hammer is 7 ton and hammer helmet of 990 kg. Between pile head and hammer helmet, pile cushion was used: plywood with thickness >15 cm. The load platform had been used

for driven pile static load test (Figure 2). Reaction forces from the load had been perceived by calibration blocks (weighing 2.4 tons), as well as piles of C14-40 (weighing 5.6 tons).

Tested bored piles installed by technology of CFA (Bauer) and Kelly (Soilmec). For bored piles loading the anchor-supporting stand had been used. Reaction forces from the load had been perceived by 20 m length anchor piles.

Static compression test, driven pile

Static compression test, bored pile

PDA and dynamic load test

Pile integrity test

Figure 2 – Series of tests

Technological features of the test methods

Static load tests were carried out in accordance with GOST [1], each load increments had been maintained until the rate of stabilization (Table 1). Static load tests in accordance with ASTM [2] by following methods: Standard loading procedure (SLP); Quick load test method for individual piles (QLT); Cyclic loading test (CLT).

PDA and dynamic load test by GOST had been made simultaneously. The dynamic test program meets to the requirements of GOST and includes two consecutive series of 3 and 5 blows.

Results of tests

The results of tests are presented in tables and diagrams. The comparison of the results of the static load tests by ASTM-CLT and dynamic tests by PDA (for driven piles) are presents in Figure 4. All curves PDA test are presented by double broken line. Nevertheless, the initial elastic-plastic part of the curves has quite high convergence with static. Then the curves have sharp decline, which is typical slump.

Bearing capacity of pile (static load test) in accordance with Kazakhstan standards is determined in the range of ultimate settlement criteria 16-24mm. In case of PDA bearing capacity definition the fact of «in those hydro-geotechnical conditions, only the initial part of the curves are more or less close to static curves» should be considered, Figure 3.

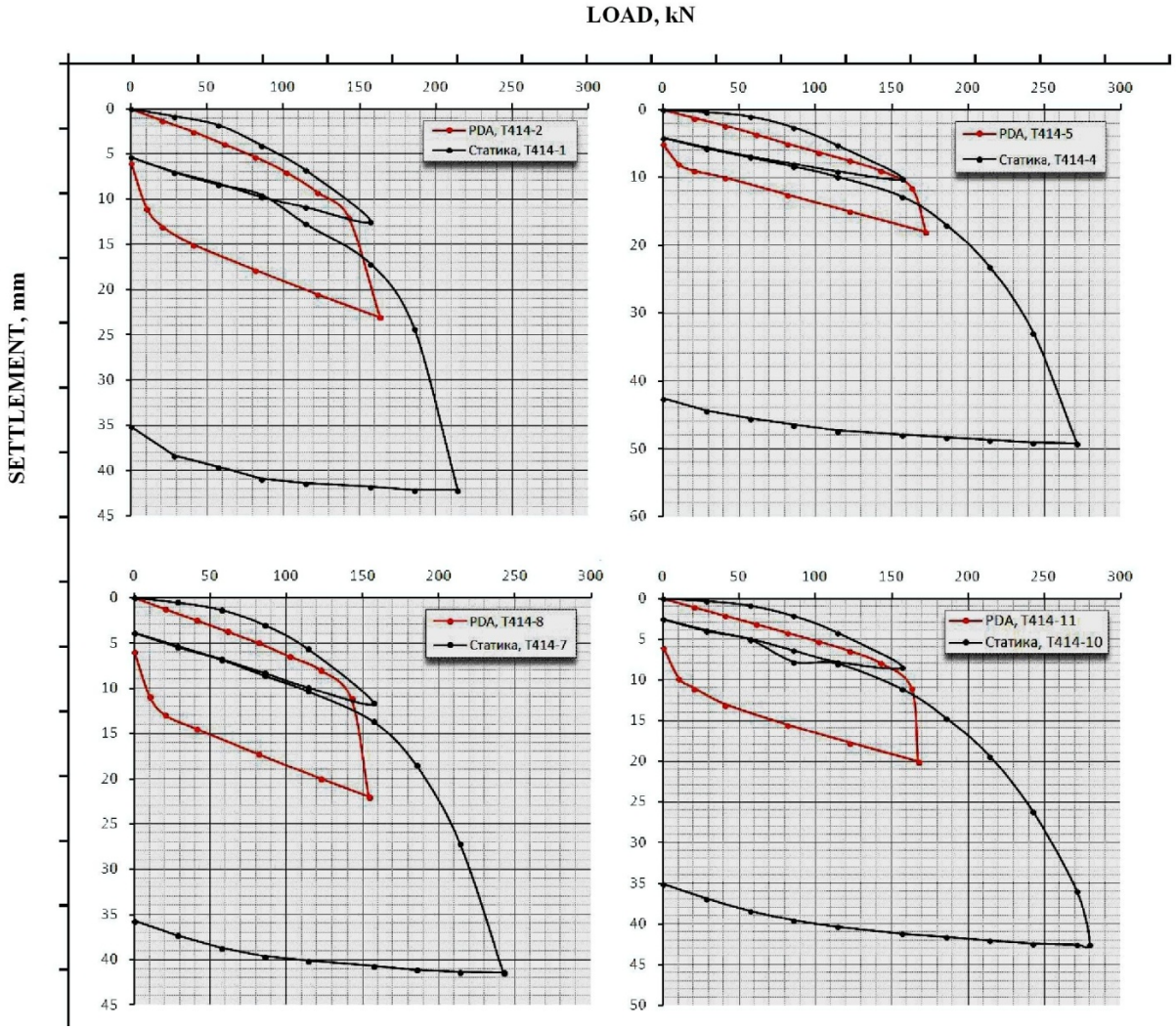


Figure 3 – Results of ASTM static load test and PDA

The comparison of the results of the static load tests by ASTM and dynamic tests by PDA (for bored piles) are presents in Figure 4. Static load test by GOST and static CLT by ASTM had been performed on Area 4; GOST and SLT by ASTM on Area 5; GOST and QLT by ASTM on Area 6.

Criteria of settlement stabilization for GOST static load test had taken as 0.1 mm/h and CLT and SLT by ASTM as 0.25 mm/h.

During the GOST test performance time interval increased with each load increments, the last stages (total load applied) time interval came up to 10 hours of observation. Limitations of time interval in case of ASTM test lead to slightly low results compared to GOST.

Relatively high total load maintains (24 hours) in case of CLT by ASTM lead to comparability with GOST result.

Time interval of intermediate and peak steps of QLT accepted - 10 min. Immediate unloading maintained for 5 min. As a result the curves showed a difference of soil resistance and pile settlement both.

If the time interval of the last stage to increase at least to 1 hour, the difference of ultimate settlement would have been much more essential.

The quantitative evaluation of test series is presents in Figure 5. Figure 5b shows comparison of bearing capacities within allowable criteria of settlement of 16-24 mm. Quantitatively, dependence is expressed by $y=a \cdot x$; distinction of argument a from 1.0 had evidence of less convergence of compared data.

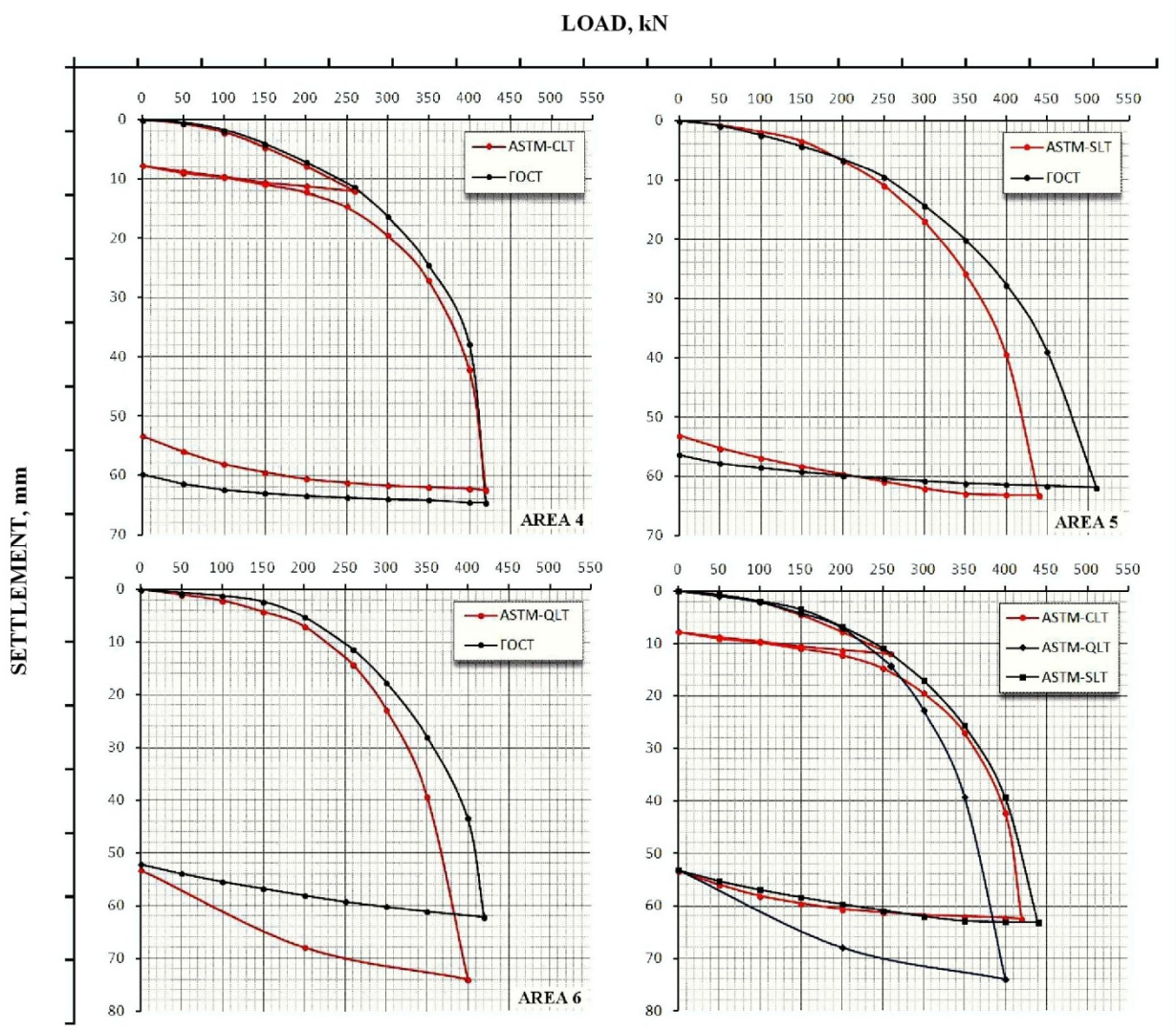
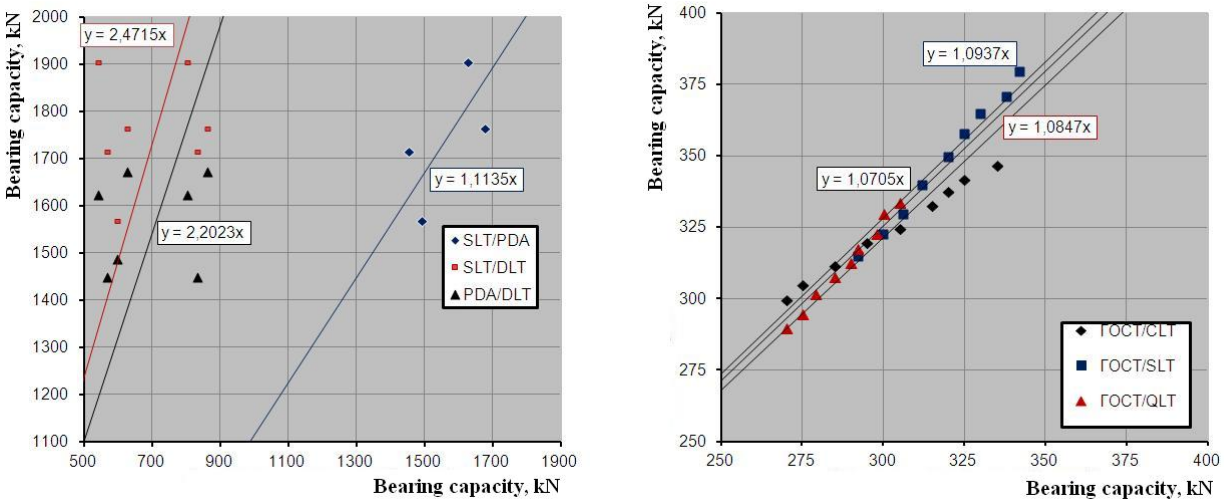


Figure 4 – Comparison GOST and ASTM test results



А Б

SLT – static load test, DLT – dynamic by GOST, PDA – dynamic by PDA,
CLT – cyclic loading test, SLP – standard loading procedure, QLT – quick load test.

Figure 5 – Comparison of test results

CONCLUSION

1. A series of field load tests of soil by piles loading had been made by following methods: PDA, GOST and ASTM. The main technological features of procedure of methods are presented (Table 3 and 4).
2. PDA results showed a higher convergence with results of static tests (in accordance with GOST) than the results of standard GOST dynamic test. It should be noted that a close relationship PDA and GOST (static) results is observed at the initial stage of piles loading.
3. Comparison results of static tests in accordance with GOST and ASTM (by different methods) showed that the curves are directly dependent on the load maintains (time intervals).
4. The most distant from the static test results showed dynamic tests according to GOST. It should be noted that the direct method of energy determining (visual evaluation of the height of the hammer fall) is not always accurate, as part of the energy can be expended (absorbed) by pile cushion (mostly wooden).

The author expresses his deep gratitude to the leadership and specialists of KGS, Llp for the organization and helps during the tests performance.

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ПРОВЕДЕНИЕ ИНЖЕНЕРНО-ГЕОЛОГИЧЕСКИХ ИЗЫСКАНИЙ НА ОБЪЕКТЕ «МНОГОКВАРТИРНЫЙ ЖИЛОЙ КОМПЛЕКС «ЭКСПО-СИТИ 2017»

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Введение

В результате тайного голосования на 152-й Генеральной Ассамблее Международного бюро выставок столица Казахстана Астана, набрав большинство голосов, опередила бельгийский город Льеж и была объявлена местом проведения «ЭКСПО-2017».

Выставка пройдет с 10 июня по 10 сентября 2017 года и примет около 100 стран-участниц и 10 международных организаций. На всемирной специализированной выставке 2017 года странами-участницами будут продемонстрированы достижения и перспективы в