Original Article

Static Pile Load Test in Rajamangala University of Technology Khon Kaen Campus

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Received: 30 June 2015; Accepted: 13 July 2015

Abstract

In this research, static driven pile load tests in Rajamangala University of technology Isan Khon Kaen campus were generally performed to prove that piles are capable of sustaining the ultimate design load. In order to prove test, the pile load test was conducted in two types as follows: 1) Standard Loading Procedure and 2) Cyclic Loading Procedure. The strength of test pile was greater than 240 ksc (Schmidt Hammer). Conventional statics pile load tests in driven piles consisted of constructing a reaction frame, the test pile located center position, then incrementally loading the pile with the hydraulic jack. The reaction frame was anchored by six reaction piles. The test load was measured with load cells and the pile head vertical displacement was measured with strain gauges. The test has been designed to allow safe loading of the pile (Design Load) up to 6 tons and a maximum payload test (Test Load) was equal to twice the payload safely, 12 tons. The test pile in the field (Pile load test) was used to secure that the ratio is equal to 2. Due to that the study cannot be reach to ultimate load it is necessary to predict the ultimate load of driven piles by means of Davission, Mazurkiewicz and Brinch Hansen that is corresponding to data test. Thus, it can be concluded that the piles are capable of sustaining the ultimate design load and the deflection is within allowable levels, the test has proved that the pile is acceptable.

Keywords: driven pile, factor of safety, ultimate load of pile

Introduction

The Pile Load Test was used to test the loading capacity of piles in real practical use. The test was conducted on ten piles at the back of Building 10 at the Rajamangala University of Technology Isan Khon Kaen Campus in order to find the Ultimate Load of the piles. A two number of load patterns were used for Vertical Compression (ASTM D1143-81, Reapproved 1994), which are the Standard Loading Procedure and the Cyclic Loading. The collected data was analyzed and compared by the Static Method for pile design. The Load Test was conducted as shown in the (Figure 1), (Figure 2) and (Figure 3).

Vertical Compression Load Test Installation

The research objective was to investigate the model of a pile load test of driven piles with dimensions of 0.18x0.18x4.00 m. Consisting of anchored pile, new reaction beam with cable. The test set up was as follows;

1. Reaction Beam installation consists of upper beams and lower beams. Both the upper beams and the lower beams use 3 I-Beams each.
2. A steel plate with bolts is used to combine the upper beam and the lower beam.
3. Three small hydraulic jacks are installed to distribute the load from the lower beam to the upper beam. This will reduce a deformation of the lower beam.
4. The Reaction Load to the Reaction Beams is increased by using a concrete block with 4 hollow sections which is used as a safety measure to protect the concrete block from falling down during testing.
5. A sling is used to bind the Anchors and Reaction Beam in order to increase the load efficiency and synchronize the Anchors and Reaction Beam movement. The sling should be installed between the I-Beams to protect the I-Beams from destruction. Part of the reaction force comes from the anchor piles which have 3 piles on

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each side, and each pile has a diameter of 18 x 18 cm. and is 4 m. long.

6. Load Beam Installation: The plate is put on the Test Pile for load distribution. Then the Hydraulic Jack with a load capacity of 30 tons and traveling distance of 10 cm. is put between the plate and the Load Beam.

7. Six Dial Gauges are installed by six people to read the destructiveness of the Test Pile and the movement of the Anchors. Two Dial Gauges are installed at the Test Pile head to measure the destructiveness of the Test Pile head. Two Dial Gauges are each installed on the left and the right Anchors to measure the movement of the Anchors during the test. The Reference Beam is attached to the Dial Gauges with the Support and is installed 2.5 m. from each Anchor.

8. The Loading Pattern in the Standard Loading Procedure and the 30 ton hydraulic is controlled by one person. Each load will be 25% - 200% of the safe loading weight. The weight is only to be increased when the collapsing rate is less than 0.25 mm per hour and takes no longer than two hours. When the test load is increased to the highest level (2 times the safe load weight), it is left for 24 hours. The settlement is recorded throughout every 2 hours. The testing weight is reduced to 75, 50, 25, 10 and 0% of the highest testing weight and the last settlement is recorded at one hour intervals between each recording.

9. The Loading Pattern of the Cyclic Loading Procedure: The process of increasing and reducing the loading weight was divided into steps and the testing was done by using the same steps as per (8) Standard Loading Procedure at loading weights 50, 100, and 150 of the safe load weight. The load weights were left on for 1 hour and the load weights were reduced using the same steps that were used when it was increased. In each phase, they were left on for 20 minutes and when all the weight had been lifted, the weight was once again increased by 50% of the safe load weight each time until the previous load weight had been reached. In each phase, the weight was left on for 20 minutes. During each step, the weight was further increased as per (8) Standard Loading Procedure. When the highest test level weight had been reached, the weight was pulled out using the same steps as per the test in step (8).

Test result and discussions

From the three testing methods for finding Pile Bearing Capacity, the data of Deflection and Rebound Deflection passed the limitation of Residual Deflection at 6 mm. after maintaining the maximum load for 24 hours.

Destruction of the pile resulted from the destruction of the soil, which occurred under the conditions in which the pile had excessive deflection under a small increase in weight. In the past, the definition of Ultimate Load has been a load that causes a deflection to more than 10 percent of the pile diameter. Based on the Static pile load test conducted at Building 10 with piles of 0.18 m. diameter and 4 m. long, Standard loading procedure and Cyclic load test were performed as shown in (Figure 4) and (Figure 5).

In the comparative study, the relationship between results vertical pile load test was evaluated by 3 methods which are as follow;

1. Load Failure using The Davisson Method (1972) as shown in (Figure 6), which shows that the Pile Load Test result is relevant to the theory of Davisson with an Ultimate Load of 10.90 tons.

2. Load Failure by The 90% Brinch Hansen Method as shown in (Figure 7), which shows that the Pile Load Test result is relevant to the theory of Brinch Hansen with an Ultimate Load of 10.08 tons.

3. Load Failure utilizing the Mazurkiewicz Method as shown in (Figure 8), which shows the prediction by equally dividing the Deflection and finding the cross point which will achieve an Ultimate Load of 10.08 tons.

The Vertical Ultimate Load from the Pile Load Test compared with the safety load (6 tons per pile) shows the following: 1) the Davisson Method gave a Safety Ratio of 1.82, 2) the 90% Brinch Hansen Method gave a Safety Ratio of 1.68, 3) the Mazurkiewicz Method gave a Safety Ratio of 2.05, and 4) the Static Method gave a Safety Ratio of 1 as shown in (Figure 9).

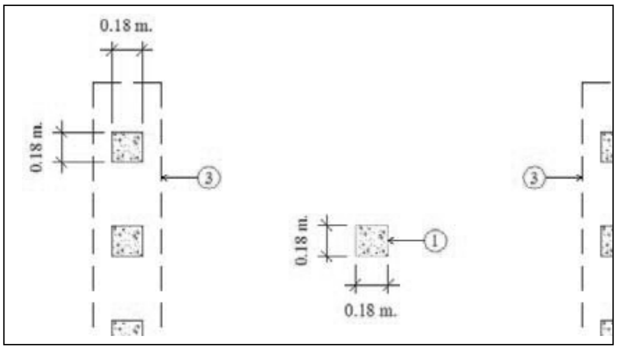

Figure 1 Test set up (top view)

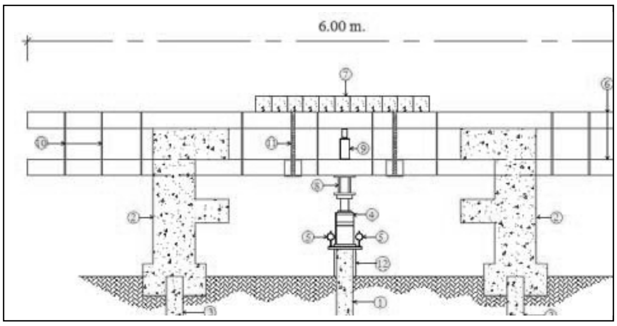

Figure 2 Test set up (front view)

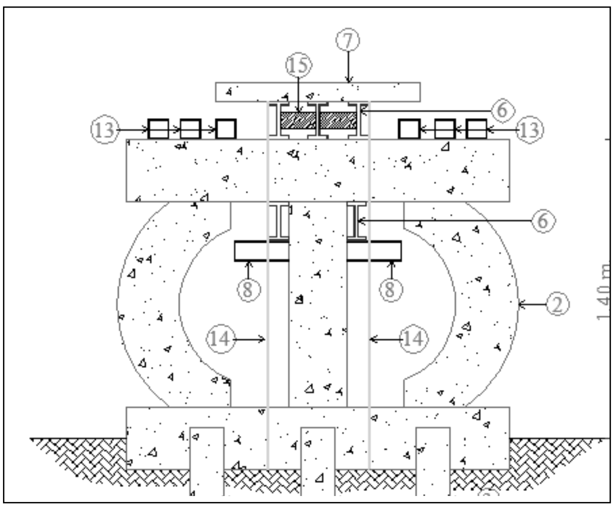

Figure 3 Test set up (side view)

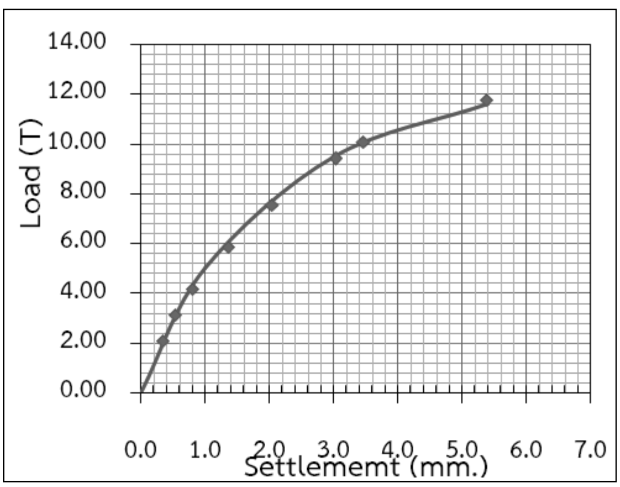

Figure 4 Load-settlement curve for standard loading test.

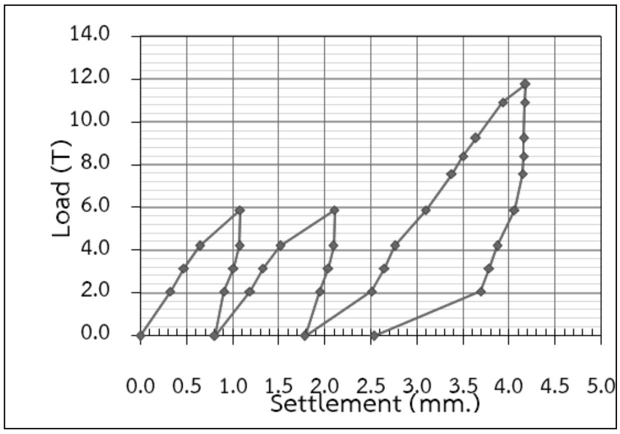

Figure 5 Load-settlement for cyclic loading test

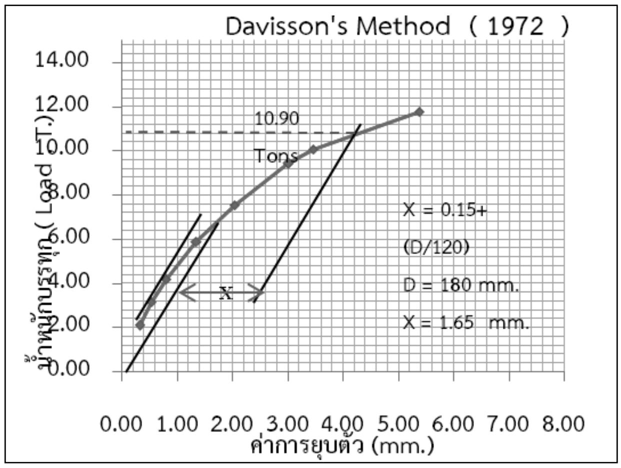

Figure 6 Davisson ‘s method

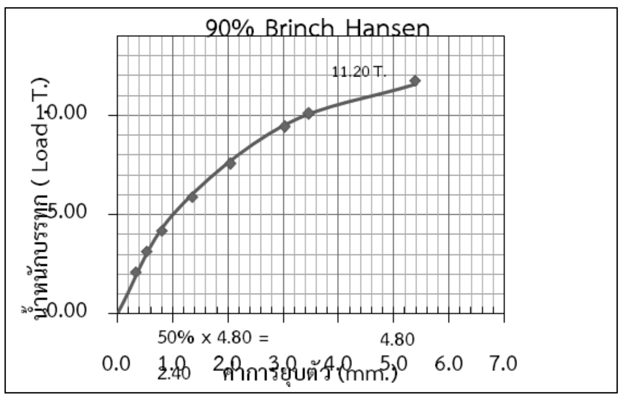

Figure 7 90% Brinch Hasen ‘s method

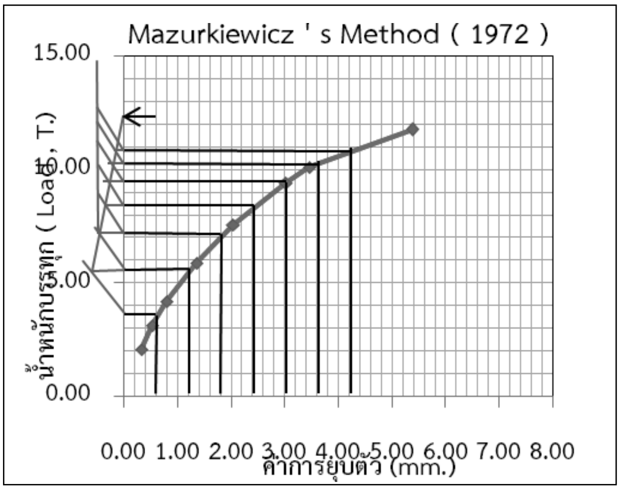

Figure 8 Mazurkiewicz 's method

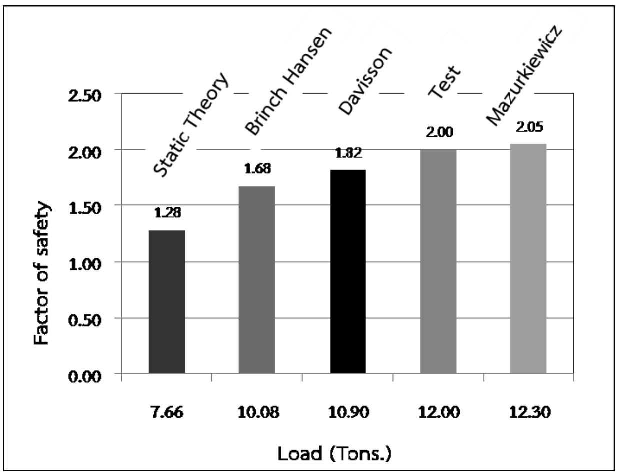

Figure 9 Factor of safety

Conclusion

The Pile Load Test was used to test the loading capacity of piles in real practical use. By using Vertical Compression (ASTM D1143-81, Reapproved 1994) which includes the Standard Loading Procedure and the Cyclic Loading Test, testing was conducted on a square pile with a section of 18 x 18 cm. and 4.00 m. long at the back of Building 10 at the Rajamangala University of Technology Isan Khon Kaen Campus

The first Vertical Load Test results were compared to the Vertical Ultimate Load and Safety Ratio during the field Pile Load Test, and the predictions made by the Static Pile Load Test were in the same cluster. As for the Static Method, the result was lower than the two methods mentioned above and the test pile with a section of 18 x 18 cm. and 4.00 long was able to sustain the designed Ultimate Load without Load Failure. The Cyclic Load Test was compared to the code which allowed for maximum Deflection at Bearing Load of 0.25 mm. per hour and maximum Deflection of 6 mm. after the 24 hour load test. The result was that the pile was able to sustain the load no more than the limitation.

Acknowledgement

Acknowledgement is to Rajamangala University of technology Isan Khon Kaen campus that supported the research.

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