Tooth profile analysis of the vertical bearing capacity of the pile

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Abstract： The foundation-structure of the building is an important research direction in the field of the geotechnical engineering . The pile foundation is the key research direction in the field of basic research, the pile foundation with its powerful bearing capacity is widely applied in engineering areas . however, improving the bearing capacity of the foundation is one problem we are facing. Usually , we are always considering the transfer efficiency between building foundation and foundation load. In this paper, the tooth profile pile vertical bearing capacity is analyzed through flac3d analysis software, and through several experimental results prove the reliability of the results .

Introduction

The development of the profiled pile is not only reflected in the number, but also the structure and construction have some innovations. Due to the diversity of pile foundation in the form, the alienation can be from a different point of view, the alienation piles come from horizontal section and longitudinal cross section. The shape piles can be divided into constant cross-section piles and variable cross-section piles. No matter which angle it is, the objective is to distinguish the alienation characteristics from others

Clearly. The tooth shape pile is prefabricated structure of variable cross section, by tooth surface ,the tooth pile can be a whole structure with the foundation which the build is loading. The tooth pile gives full play to the body surface, to contact the soil and to increase the carrying capacity of pile body. Because of the existence of the tooth pile, the lateral force is not only as friction. This paper will simulate tooth pile under vertical load by software, observing the vertical displace at the top of the single pile, and comparing the experimental results through field experiment. Software simulate tooth pile and smooth pile bear vertical load，and contrasting experiment numerical curve [1-5].

Load simulation software
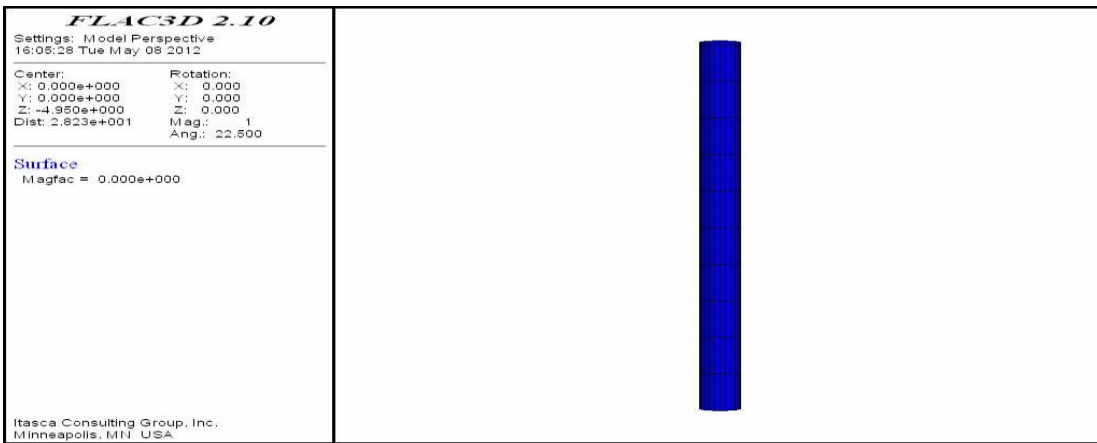
The Fig.1 The model graph of smooth pile in flac3d
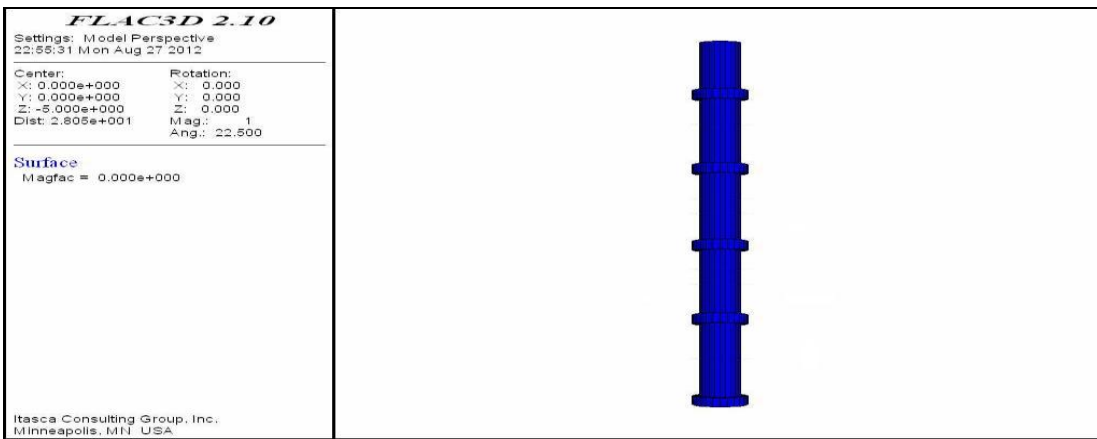
The Fig.2 The model graph of tooth shape pile in flac3d

As shown in figure 1, 2, structure model of smooth surface and tooth pile is set up, placed in homogeneous soil (the soil of simulation experiments: Moore - coulomb model, C = 10, Φ = 340; pile is the elastic model, 34 meters pile length, diameter 0.95 meters, rib diameter 1.05 meters) Loading tests are carried out, and record the change of pile top settlement.
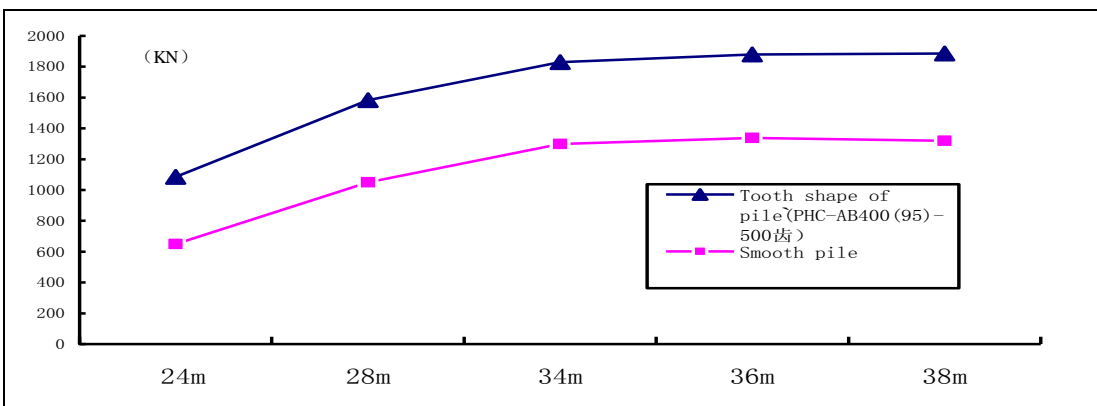

Fig.3 the bearing capacity of the different length pile model in flac3d

Establishing smooth pile model as shown in figure 1 and the tooth shape of the model as shown in figure 2 by Flac3d software, through simulating the same stress environment, as 24 meters、28 meters、34 meters、36 meters、38 meters tooth pile and smooth surface load eigenvalue. The

analysis results of load eigenvalue is from tooth shape pile and smooth pile as shown in figure 3, 24 meters pile, its bearing capacity increased by 67.18%; 28 meters pile, its bearing capacity increased by 50.86%; Take 34 m pile and its bearing capacity increased by 40.90%; Take 36 meters pile, the bearing capacity increased by 40.40%; 38 meters pile, its bearing capacity increased by 42.88%. The regular can be found of a single pile bearing capacity when pile length increase. The bearing capacity of characteristic value is not increased with the increase of pile length when pile length increase at a certain value. The ultimate bearing capacity depends on quantitative standard of the best length and the material strength soil and pile foundation. Comparing under the condition of different pile length, the characteristic value of the pile tooth vertical bearing capacity is much higher than that of smooth pile [6-16]。

Field experiments

   In order to ensure the two piles in the same soil under vertical loads, the spacing of two pile is under strict control. When the soil structure is changed, It is   observated that two pile is in the loading process and the influence to the soil. two piles is spaced as two meters, in the process of loading at the same time, the interference of another is avoided.
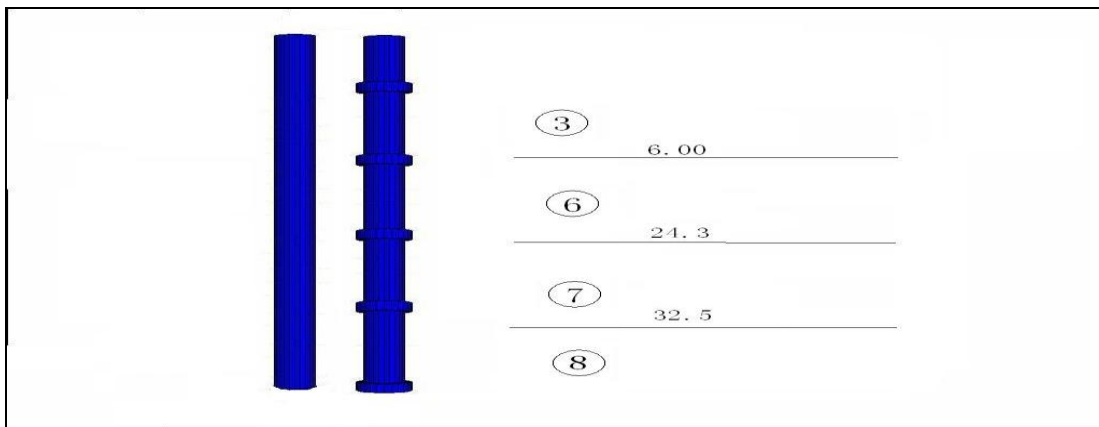

Fig.4

   Within the scope of the two meters apart, it's carried on the test experiment, the soil structure is shown as figure 4. Two pile is loaded respectively, the results are shown in table 1. In the process of loading, record the characteristic value of vertical bearing capacity and the corresponding settlement of two piles.

Soil information: ③brown gray, bearl blue, soft – flow plastic is given as main , local plastic, saturated. ⑥sand: brown gray, taupe, loose – intermediate dense , wet. ⑧ clay: dark gray, brown, gray, plastic is given as main, local hard plastic，saturated. Medium - high compressibility.

Number of test pile	model type	pile length	Characteristic value of vertical bearing capacity of single pile	Corresponding settlement
5#	PHC-AB400(95）-500	34m	2321KN	5.40mm
6#	PHC-AB400(95)	34m	1906KN	3.56mm

Through comparison and analysis, it is easily found that the characteristic value of vertical bearing capacity of tooth shape pile significantly higher than the smooth characteristic value. Before reach characteristic value, the vertical force of the unit corresponding settlement: the tooth pile is 429.81 KN/mm, smooth pile is 535.39 KN/mm. Before reaches limit, the vertical force of the unit corresponding settlement: the tooth pile is 172.08 KN/mm, the smooth pile is 144.06 KN/mm.
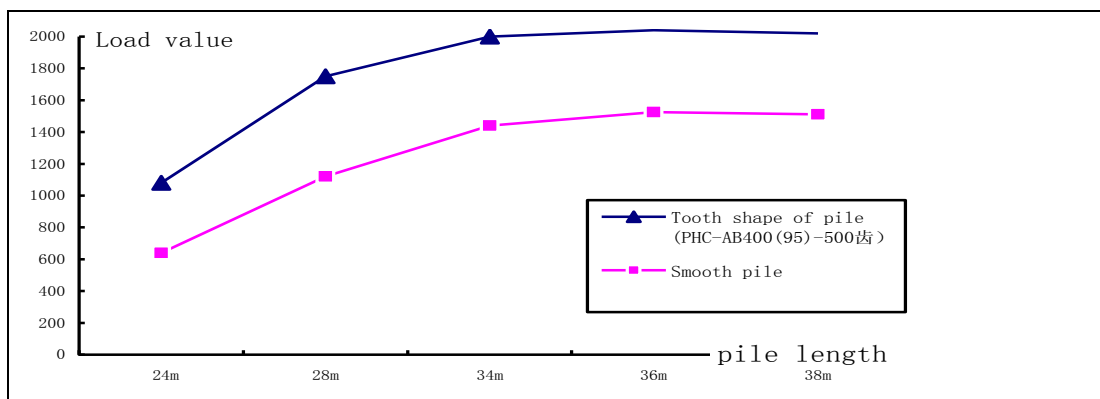
Fig.5 the bearing capacity of the different length pile

Through the site experiment of same geological conditions (sand lining information: C = 0, Φ = 340; soil layer information: C = 10, Φ = 340), result：24 m, 28 meters, 34 meters, 36 meters, 38 meters the bearing capacity characteristic value of tooth shape pile and smooth surface pile. the bearing capacity comparison results of tooth pile and smooth pile analysis is shown in figure 5.24 meters pile, the bearing capacity characteristic value increased by 68.75%; 28 meters pile, its residual value increased by 56.25%; 34 meters pile and its residual value increased by 38.89%; 36 meters pile, the residual value increased by 33.68%; 38 meters pile, its residual value increased by 33.67%. The above results can be found such a feature, the bearing capacity of pile foundation in the process of pile length increases, residual value is not increased with increasing the length of the pile. in continue to load at a certain value, residual value have a little change. The standard of the best length need to consider the material strength of soil and pile foundation. Comparison of different pile length, the vertical residual of tooth pile is much higher than smooth pile.

conclusion

Through software simulation, comparison bearing capacity result of tooth pile with smooth surface in different length is higher than smooth pile by more than 30%, in the scope of the carrying capacity. Through the appropriate modeling process, using the different loading conditions, the vertical load simulation experiment, finally it is drawn the load sharing ratio of a tooth pile

components. Through simulation of tooth distance and size differences, it is observed clearly that the tooth pile has a great advantage in bearing capacity. If increasing the thickness of the tooth, as increasing the own weight of pile, and adverse bearing. Reducing the soil layer thickness between the two teeth at the same time, it is bad for the soil and pile embedded in solid. But because the soil layer between the two teeth increased, under the condition of the unit load, the compression quantity will increase, large settlement will be produced. Through the changes of pitch and tooth thickness, the influence analysis results of tooth pile experiment is simulated [14-21]. The tooth thickness of pile and the tooth distance of appropriate numerical on-site test is found out, theory proved by experimental data.

The following conclusions is from comprehensive of the above analysis:

(1) Pile length should be within a certain range, the bearing capacity can't improve by increasing pile length.

(2) The bearing capacity contrast graphic of the smooth and the tooth pile , the bearing capacity of tooth pile is higher than the bearing capacity of smooth pile as more 30% (same diameter).

(3) in addition, the teeth thickness of the bearing capacity produce a certain influence, pile will not damage with higher intensity, and considering the influence of tooth thickness on soil layer and the build-in relationship, the tooth thickness should not too big.

(4) the distance of tooths is have certain effect on the bearing capacity of pile, the tooth is in different position, also determines the role of each tooth is different. The maximum perturbation is from upper pile foundation, then the teeth department should move upwards. Moreover, different pile spacing also determines the thickness of the soil between piles, also affects soil compression between piles. The comprehensive analysis and the experimental conclusion is that tooth arrangement should not be too close or too far. The same number of teeth, the different distance determines different carrying capacity.

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