Evaluating Drainage Consolidation Method in Soft Soil Foundation Treatment by Vane Shear Strength

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ABSTRACT

In order to evaluate the effect of drainage consolidation method in soft soil Foundation treatment more effectively, this text analyzes the soft soil Foundation’s shear strength before the drainage consolidation and Preloading uninstall based on the new south road in Jiangmen Binjiang new district. The results shows, soft soil shear strength has an obviously increasing process after pre pressure drainage consolidation. The vane shear strength before Preloading uninstall can be 5-10kPa better than before the drainage consolidation; the growth rate of shear strength is about at least 20%; some local shear strength increased more significantly, the growth rate even reach 150% or more; The growth rate of shear strength increases as the speed of The depth of the shear increases initially and decreases afterwards. This conclusion is conformed to the principle of additional stress distribution. The results provide technical reference for the design and construction of regional soft soil Foundation.

INTRODUCTION

Soft soil in the Pearl River Delta region distribution is wide, with low shear strength, compression of high, poor permeability, consolidation settlement is long characteristics, without the treatment of foundation bearing capacity and settlement are not able to satisfy the requirements of design and relevant specifications[1-2]. At present, the large area of soft foundation treatment usually used drainage consolidation method in the construction of highway and urban road engineering[3-4], which has the advantages of convenient construction, low engineering cost and the disadvantage is that the construction process to strictly

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control the loading rate to increase the soft soil consolidation strength and loading rate matching, long construction period, a longer pre pressing period to achieve the unloading requirements. At present, the evaluation of the effect of drainage consolidation method on soft soil foundation is mainly based on the field monitoring data, such as shallow layer surface settlement, deep soil lateral displacement, super pore water pressure and soil strength change. At present, the evaluation of the effect of drainage consolidation method on soft soil foundation is mainly based on the field monitoring data, such as shallow layer surface settlement, deep soil lateral displacement, excess pore water pressure and soil strength change, and so on[5-6]. According to the example of Binjiang District, Jiangmen City, the New South Road engineering, through of preloading of soft soil foundation and vane shear strength change analysis to evaluation of soft soil foundation treatment effect and provide technical reference of regional soft soil foundation treatment design and construction.

GEOLOGICAL CONDITION

The project is located in the District of the New South Road, Binjiang City, Jiangmen New District, the topography of the river alluvial land and the edge of the Delta, the terrain is relatively flat, low and open. Along the main site for the fish ponds, ditches, a small amount of farmland. According to the drilling shows, site distribution of strata are mainly artificial filled soil layer, the Quaternary alluvium and eluvium, the bedrock is Cretaceous silty mudstone. This section of the distribution of soft soil mainly has two kinds: the first kind of soft soil for silt, black, wet, flow plastic ~ soft plastic, with a small amount of organic matter, many small shells, the thickness of soft soil layer in 1.6 ~ 13.2 m range; the second kind of soft soil for the silt soil, gray and black, wet, soft plastic ~ plastic flow, soft soil thickness in 2.8 ~ 12.0 m range. The basic physical and mechanical properties of the two kinds of soft soil are shown in Table I.

<table>
<thead>
<tr>
<th>Soft soil type</th>
<th>Natural moisture content</th>
<th>Natural density</th>
<th>Soil specific gravity</th>
<th>Void ratio</th>
<th>Saturation</th>
<th>Liquid limit</th>
<th>Plastic limit</th>
<th>Plastic index</th>
<th>Cohesion</th>
<th>Friction angle</th>
<th>Compressibility modulus</th>
</tr>
</thead>
<tbody>
<tr>
<td>silt</td>
<td>61.6°</td>
<td>1.59°</td>
<td>2.50°</td>
<td>1.54°</td>
<td>100°</td>
<td>46.9°</td>
<td>26.2°</td>
<td>133°</td>
<td>7.0°</td>
<td>1.0°</td>
<td>3.2°</td>
</tr>
<tr>
<td>Mucky silt</td>
<td>42.0°</td>
<td>1.73°</td>
<td>2.51°</td>
<td>1.06°</td>
<td>99°</td>
<td>41.2°</td>
<td>24.5°</td>
<td>105°</td>
<td>10.0°</td>
<td>3.5°</td>
<td>5.0°</td>
</tr>
</tbody>
</table>

Engineering soft foundation section are fill area, to solve the subgrade stability and settlement, reduce the project cost, use plastic drainage plate surcharge preloading drainage consolidation method to soft foundation treatment method to disposal soft soil foundation. The drainage board is arranged in a plum blossom shape with a distance of 1 m, the length of the drainage plate below the depth of soft soil, the upper part of the construction of the top of the sand layer at
the top of 0.2 M. Control the soft foundation section and meet the requirements of the technical indicators, and to timely notify the unit design of the field monitoring of soft soil foundation data to correct the design of soft foundation as the basis of unloading time determined to construction site soft base monitoring data and the monitoring data.

**ANALYSIS OF TEST RESULTS**

The field vane shear test is a kind of can sensitively reflect the strength of soft clay, the shear strength measured by the test is equal to the strength of the non-drainage shear strength of the natural soil layer under the natural pressure, which is equivalent to the indoor triaxial undrained shear strength and unconfined compressive strength of the half. Because this test does not need to take soil samples to avoid the disturbance of soil and the change of natural stress state, it is an effective in situ testing method [7].

To fully study the shear strength change in the soft soil before the drainage consolidation and unloading in pre compression, provide the design of soft soil foundation and the construction of the project in this area, the project team carried out a vane shear test on the monitoring section of drainage consolidation, preloading before unloading of soft soil on the western part of the a new South Road, the interval between these two tests for 8-10 months. The position of the two test of each section is close located near the middle of each section so as to be able to be compared effectively. The test depth start at the ground surface, each interval 1m as a measuring point.

**Analysis of Shear Strength Growth**

Table II statistics the soft soil Vane Shear before Drainage consolidation and pre pressing in every monitoring section. The data shows the soft soil’s shear strength increased significantly by preloading drainage consolidation, compare with pre drainage consolidation, pre unloading preloading’s vane shear strength increased 5-10kPa; shear strength growth rate at least in more than 20%, some local increase in the shear strength of the more obvious, its growth rate even reached more than 150%.

Figures 1-11 are the correlation curve of before the drainage consolidation and before the unloading preloading.
Figure 1. K0+110 Initial test and comparison of the shear strength of the cross plate before the pre-compression and unloading.

Figure 2. K0+310 Initial test and comparison of the shear strength of the cross plate before the pre-compression and unloading.
Figure 3. K0+510 Initial test and comparison of the shear strength of the cross plate before the pre compression and unloading.

Figure 4. K0+710 Initial test and comparison of the shear strength of the cross plate before the pre compression and unloading.

Figure 5. K0+870 Initial test and comparison of the shear strength of the cross plate before the pre-compression and unloading.

Figure 6. K1+710 Initial test and comparison of the shear strength of the cross plate before the pre compression and unloading.
Figure 7. K2+170 Initial test and comparison of the shear strength of the cross plate before the pre-compression and unloading.

Figure 8. K2+370 Initial test and comparison of the shear strength of the cross plate before the pre-compression and unloading.

Figure 9. Initial test and comparison of the shear strength of the cross plate before the pre-compression and unloading.

Figure 10. K2+770 Initial test and comparison of the shear strength of the cross plate before the pre-compression and unloading.
CONCLUSIONS

Based on the field engineering example, through the comparison between before the drainage consolidation of soft soil foundation and before unloading’s vane shear strength by plastic drainage board, the main conclusions are as follows:

The soft soil’s shear strength increased significantly by preloading drainage consolidation, compare with pre drainage consolidation, preunloading preloading’s vane shear strength increased 5-10kPa;

Shear strength growth rate at least in more than 20%, some local increase in the shear strength of the more obvious, its growth rate even reached more than 150%.

Shear strength growth rate will decrease with the increase of cutting depth, which is mainly because of the superimposed stress generated by the embankment and the effect of drainage consolidation on soft soil layer decreases with the increase of depth the embankment of the additional stress with the increase of depth. The shear strength of the cross plate in the soft soil layer is obviously increased, which is mainly concentrated in the depth of 8-10m, the higher embankment fill, the greater impact depth.
REFERENCES


