Monitoring and Analysis of Stress of Anchors in Vertical Prestressed Anchored Cement Soil Wall

Ge Tao¹, a, Zhang Zhigang¹b
¹Aeronautics Engineering College, Air Force Engineering University of PLA, Xi’an, Shanxi, China
getaoge@163.com, b57931087@qq.com

Abstract. The underlying law of the anchor’s stress distributing and change in vertical prestressed anchored cement soil wall is realized by project examination in which the stress in anchor increased at first and decreased to a steady state. For the question of stress of Anchors smaller, some technical advices as to techniques are put forward. The analyzed results show that vertical prestressed anchored cement soil wall has good deformation control capability and the setting of vertical prestressed anchored is reasonable.

1. Introduction
The anchor rod in the vertical prestressed bolt type water mud retaining wall is a pull rod, and it can be seen from the theory that the pull of the bolt is changed with the excavation of the foundation pit. In the actual construction process, how many prestressing can spread to the anchoring bolt? In the process of excavation, the stress in the bolt is how to change? The above problems not only through the theoretical analysis to solve. In addition, due to the passage of time, the anchorage segment is likely to creep, causing stress loss. The stress of the bolt is complicated, so it must be tested.

The working principle of the vertical prestressed bolt type water retaining wall is mastered. This paper will carry out the analysis and research through the actual engineering experiment.

2. Stress monitoring of anchor bolt of vertical prestressed bolt type cement
The main contents of site monitoring for monitoring program layout are as follows: (1) The determination of monitoring items, the selection of monitoring means and instruments and tools; (2) The determination of location and location of measurement points; (3) The formulation of implementation plans.

2.1 Monitoring station layout
The project consists of two 33-storey (A, B), A 28 (numbered C), A 32nd floor (numbered D, E, F) and an underground garage and skirt building. The main building is 87~100m, and a basement is set. Based on the pile box, the pile is 450mm * 450mm * 28m reinforced concrete precast pile, and the foundation pit is dug deep 6.8m. The underground garage adopts pile foundation, the pile type is 300mm x 300mm x 25m reinforced concrete precast pile, and the foundation pit is dug deep 5.8m. Foundation pit

In the form of protective structure, two sets of monitoring points are set up on the anchor rod in the vertical prestressed bolt type water mud retaining wall. The number is GL1~GL2. GL1 on the 109# bolt, GL2 on the 159# anchor. See fig.5-1 for the position of the bolt and the no.159 bolt. The monitoring
points are equipped with stress test sensors at different depth of 4m, 10m and 15m. The stress sensor number is GL1-1 ~ GL1-3, GL2-1 ~ GL2-2, and the layout of the stress sensor is shown in figure 1.

The GLL steel string dynamometer is selected for the stress observation of the vertical prestressed bolt, and the force transducer is welded together with the anchor rod. Zxy-ii steel string digital frequency receiver was selected for the observation instrument, and the reading accuracy was plus or minus 1.0hz, and the test accuracy was plus or minus 1.0mpa.

![Fig.1 Sketch of monitoring points for stress of vertical prestressed anchored](image)

2.2 Monitoring results of anchor bolt tension monitoring
On July 16, 2002, the excavation of the foundation pit began, and the excavation of the composite soil nail wall was carried out by means of the excavation of the layered part. By July 20, 2002, dig A, B building foundation pit and E, F floor foundation pit section, dig deep to -3m. From the 20th to the 25th, the excavation of the foundation pit of C and D buildings will be dug deep to -3m, from the 25th to the 1st of August to excavate A, B building foundation pit and E, F floor foundation pit section, dig deep to the design depth. From August 1 to August 6, the excavation of C and D buildings will be dug deep into the design depth. By August 12, the composite soil nailing wall was finished and concrete was poured.

The monitoring results of anchor rod tension monitoring points are shown in table 1 after the excavation of foundation pit and excavation.

| point depth | The 109th point before(KN) | The 159th point before(KN) |
|-------------|-----------------------------|-----------------------------|
| GL1-1       | 41.73                       | 45.16                       |
| GL1-2       | 15.96                       | 17.78                       |
| GL1-3       | 8.93                        | 9.76                        |

| point depth | The 109th point after(KN) | The 159th point after(KN) |
|-------------|---------------------------|----------------------------|
| GL1-1       | 67.83                     | 81.42                      |
| GL1-2       | 35.72                     | 39.16                      |
| GL1-3       | 15.08                     | 15.17                      |

During the excavation of the foundation pit, the monitoring results of GL1-1 ~ GL1-3 and GL2-1 ~ GL2-3 were obtained, as shown in FIG. 2 (only the results of GL1-1, GL2-1, and other omitted).
2.3 Analysis of monitoring results

Through a series of experimental data, we have a certain understanding of the stress variation law of the anchor bolt of the vertical prestressed bolt type water mud wall.

(1) In the vertical clamp design rules of prestressed anchor, before the excavation, vertical anchor prestress value far stress value, its free period of anchor rod stress value of prestress of 20 ~ 22%, and the beginning of the anchoring bolt stress value of the prestressing 8 ~ 9%, the anchoring bolt stress value of the lower for prestressing 4 ~ 5%. The stress distribution of the whole bolt is large at the top and smaller at the bottom, which is consistent with the horizontal displacement of the wall.

(2) In the excavation of the foundation pit, the stress value of the vertical bolt increases greatly, which is mainly due to the increase of stress value of the vertical bolt due to the horizontal deformation of the retaining wall after the excavation of the foundation pit. Since the excavation of the whole foundation pit is divided into different layers, the change of the stress of the bolt shows the change rule which tends to be stable and then increases. At the end of the foundation pit excavation, the free section of the anchor rod stress value increased to 35-40% of the prestressing, the beginning of the anchoring bolt stress value of the increase to the prestress of 18 ~ 20%, the anchoring bolt stress value of the lower increase to 7% of the prestress. The stress distribution of the whole bolt is large and small in the lower end.

There are several reasons for the low stress of anchor bolt in the vertical prestressed bolt type water retaining wall.

(1) When prestress on the vertical clamp design of prestressed anchor, the need for anchoring the lock. No matter how tight the screw nut screw, when jack is unloaded, part of the prestress loss is always. The size of the prestress loss is executed on the degree of the nut tightening and the strength of the nut.

(2) In the process of constructing: although vertical anchor is divided into free section and anchor in theory, and take some measures to guarantee free period with slurry does not produce cohesive force, but the actual construction process is very difficult to guarantee free period is really "free", bolt is likely to be "full anchoring bolt" that applying prestress can't spread to the anchoring.

Although the initial stress value of the bolt is small, the increase of bolt stress in excavation of foundation pit is large, which is helpful to control the deformation of the enclosure structure.

3. Conclusions

The analysis shows that the stress value of the vertical bolt is different from that of the loading prestress, but it is larger in the excavation of the foundation pit, which shows the ability of controlling the deformation.

Due to the small vertical bolt stress value, so the resistive overturning stability and checking calculation of retaining structure and horizontal deformation analysis, the need to convert of prestress value, due to the different depth of anchor rod tension size, the reduction factor should also be different.
Due to the vertical prestressed anchor bolt cement-soil retaining wall stress slants small, can not fully play its role, in the actual need to improve the construction technology of foundation pit engineering, for the cause of small stress value, puts forward some Suggestions for process improvement:

(1) the free section should be specially treated when working with the bolt. It is recommended to use a plastic casing with a large diameter and thickness to completely separate the free section bolt from the slurry.

(2) when the anchor bolt is locked, it is impossible to prevent the anchor bolt from being fully anchored due to the loss of prestress. Therefore, only the extra prestress is used to make up for it, and it is suggested that the overtension should be locked directly after the design value of 1.2 times.

References
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