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EFFECT ON HIGHWAY BECAUSE OF LOOP LINE CONSTRUCTION

Bolin ZHOU, Lu TANG, Haicheng LUO
School of Hohai, Chongqing Jiaotong University, Chongqing, 400074, CHINA

Abstract: In this paper, using the TuShan rail yard project as background, ANSYS finite element analysis software has been used to do numerical analysis and to study the impact of the construction of TuShan rail yard on the inner ring expressway slope . The main part and the surrounding part of highway's vertical displacement value size has been calculated via ANSYS separately. Conclusion has been reached that the safety of surrounding roads is less affected by the construction.

Keywords: Numerical Modeling; Pile Plate Supporting; Displacement Analysis

1. Introduction

Tushan Vehicle depot and Comprehensive base depot is located in the east of Tushan road and Danguang road. west of the inner ring expressway and is very near of The east China sea star cheung chau chau, the east China sea community. Car depot and the comprehensive base planning land covers an area of 276900 square metres. It is long and narrow, it is 1600 m in length from south to north. The narrowest place from east to west is located in the central area and it's about 95 m in width. Satellite image of car depot's peripheral environment is shown in Figure 1. Car depot access road near inner ring expressway adjacent to tushan road car depot is about 220 m in length. Road's elevation changes from 267.692 m to 247 m. The slope supporting plate is pile retaining wall. Each pile location is positioned before retaining wall construction .A typical profile of Pile plate retaining wall support is shown in Figure 1.

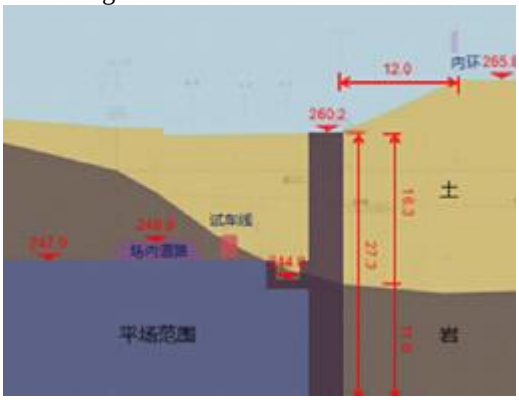

Figure 1. Typical profile of Pile plate retaining wall support

2. Geological Condition of Slope

2.1. Geological Landforms

Proposed site is located in the west of inner ring expressway, east of the east China sea star cheung chau chau, the east China sea community. Sides of the east, and west site are respectively high .the south side is high and the north side is low. Original landform of the site is tectonic denudation shallow hills, valleys. It is cultivated land or farmland at first. Excavation and backfilling of the inner ring expressway, factory, house building have caused terrain fluctuation. Terrain slope angle ranges mainly from 5° to 30°.some part's angle of scarp slope can range from 50° to 80° .The ground elevation is 205 m to 310 m, the relative elevation is about 105 m.

2.2. Formation Lithology

Exposed stratigraphic of the survey area from top to down is Q4ml,Q4el+dl and J2s.

3. ANSYS Calculation Method

3.1. The Simulation of Excavation and Supporting Process

Canceling and generating unit can be used to simulate the material elimination and addition[1]. This unit by using ANSYS function, life and death can be simple and effective simulation of the foundation pit excavation and supporting process can be easy and effective by using ANSYS' function of generation and cancel. When canceling the unit, Program will use a very small number multiplied by the unit stiffness, and achieve "killing" the unit by eliminating the unit's quality from the total mass matrix .during the excavation of foundation pit, the digged out unit will be selected first, then the order" EKILL, ALL" will be used to simulate the excavation. When applying the supporting, the corresponding supporting part killed during the excavation will be activated(EALIVE),then the material property will be changed. When the unit is activated, it will be Zero state

of strain. If large deformation option is turned on(NLGEOM, 0N),geometric properties is modified to cooperate with their current offset. Under some situation, unit's state of generation and cancel may be determined according to the result of the calculation of ANSYS like stress and strain etc. In the process of simulation, according to the calculation results ,units exceed the allowable stress (linear elastic analysis) or strain (elastic-plastic analysis) will be canceled for analog the structure's destruction of the surrounding rock[2-4].

3.2. Calculation Parameters

Typical profile has been taken into consideration according to the data from " TuShan rail yard construction design drawings", "TuShan car depot and the comprehensive base's geotechnical engineering investigation report". Horizontal distance of cross section of the inner ring expressway line is 12.96 m. Pile length is 27.3 m. Concrete slab thickness is 0.4 m. If the section model is simplified, X (horizontal) direction will be 51m,Y(vertical) direction from the surface will be 40 m, Z (along the road to) direction will be 23.5 m.

According to "TuShan car depot and the comprehensive base's geotechnical engineering investigation report "and" Concrete structure design code"(GB 50010-2010), calculation parameters are selected as follows: rock mass is divided into two layers, the upper is grain filling, the lower is weathering sandy mudstone ,anti-sliding Pile and plate use C25 concrete. The material parameters are shown in Table 1.

Table 1. Table of the material parameters

Number	Material type	Density ρ(kg/m3)	Elasticity modulus	Poisson ratio	Cohesion C (kPa)	Internal friction angle
1	Plain fill	2000	2	0.38	30	12
2	Sandy mudstone	2560	1.3e3	0.37	669	32.8
3	C25 concrete	2500	2.8e4	0.2	1000	42

Border terms: The surface is free border. All constraints are imposed on the bottom. Level constraints are imposed on left and right side. Z direction constraints are imposed on both front and back sides.

Anti-slide pile calculation analysis model is established. Model is divided into 57255 nodes and 57255 units. Anti-slide pile, concrete slab, rock mass use solid elements Solid45 to simulate calculation. Calculation model is shown in Figure 2.

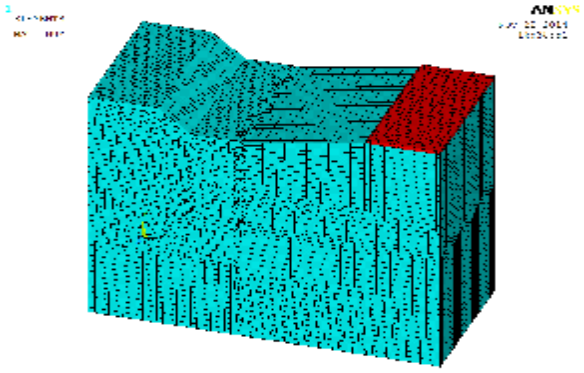

Figure 2. Anti-slide pile calculation model

3.3. Calculation Steps

The finite element simulation analysis: Process of the initial ground stress field (including gravity and the upper load), slope excavation and supporting is analyzed. The model calculation process is divided into eight steps:

first step:put load and constraints the soil , solve the soil gravity stress field

Second step: complete the anti-slide pile, excavate the slope of the first 6 m soil layer, cancel the excavation of soil unit

Third step: complete the 6m concrete slab

Of the first layer, build concrete retaining wall

Fourth step: excavate the 5m second -layer slope ,cancel the excavation of soil unit

Fifth step: complete the 5m concrete slab

of the second layer, build concrete retaining wall

sixth step: excavate the 5.3m third -layer slope ,cancel the excavation of soil unit

seventh step: complete the 5.3m concrete slab of the second layer, build concrete retaining wall

Eighth step: solve the excavation displacement of each step in the process of construction,, stress and other parameters.

The difference between construction step and the initial ground stress which means the value of displacement and stress changes of structure caused by construction should also be calculated.

4. Results of Analysis ANSYS

4.1. The results of analysis of displacement

The displacement change is reflected in the most intuitive structure, calculation and analysis to the slope construction process, analysis of each construction step vertical displacement, vertical displacement of each construction step are shown in Figure 3. Picture name fol-

lowed by 6 meters vertical displacement of excavation. The vertical displacement of 6 meters baffle, 5meters vertical displacement of excavation. The vertical displacement of 5meters baffle,5.3meters vertical displacement of excavation. The vertical displacement of 5.3 meters baffle.

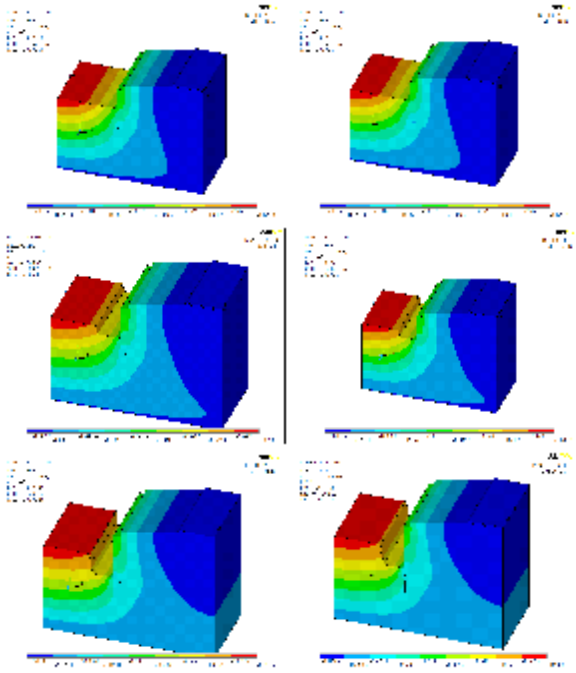

Figure 3. Vertical displacement of each construction step

The anti slide piles and form board supporting calculation analysis, get the construction step of vertical displacement variation, the specific vertical displacement variation value as shown in Table 2.

Table 2. The vertical displacement meter (unit: mm)

Change value	Minimum placement variation value	Maximum placement variation value
Second step	-0.847	7.198
Third step	-0.753	7.197
Fourth step	-0.847	7.304
Fifth step	-0.848	7.297
Sixth step	-1.122	7.345
Seventh step	-1.125	7.335

Calculation and analysis to the retaining wall construction process, analysis of changes in each constructionstep road vertical displacement, vertical displacement variation of inner ring road is shown in Figure 4. Picture name followed by 6 meters vertical displacement of excavation. The vertical displacement of 6meters baffle,5meters vertical displacement of excavation. The vertical displacement of 5meters baffle,5.3meters vertical displacement of excavation. The vertical displacement of 5.3 meters baffle.

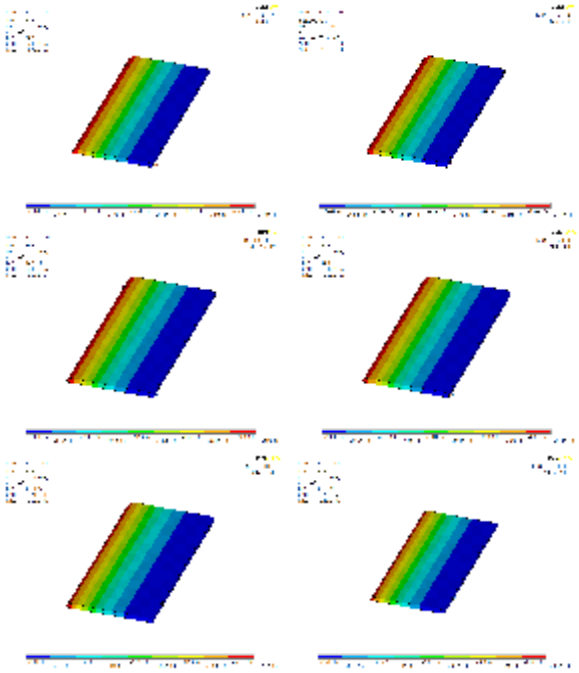

Figure 3. Vertical displacement variation of inner ring road

On the retaining wall section, the anti slide piles and form board supporting calculation analysis, get the excavation and supporting construction step inner ring expressway road vertical displacement, vertical displacement variation of specific values as shown in Table 3.

Table 3. Expressway highway vertical displacement scale (unit: mm)

Change value	Minimum placement variation value	Maximum placement variation value
Second step	-0.747	-0.478
Third step	-0.751	-0.487
Fourth step	-0.847	-0.560
Fifth step	-0.848	-0.563
Sixth step	-1.122	-0.818
Seventh step	-1.125	-0.825

5. Conclusion and Suggestion

According to the specification[5],The maximum vertical displacement of the inner ring expressway is 1.123mm by calculation, which means slope excavation has little effect on inner ring expressway.

A variety of plans should be made before construction. Alongside pipeline's location and type should be definitudeapp:addword:definitude. Various types of pipelines'.

interrupt measures need to be put forward, such as recovery measures .Various plans should be made.

The monitoring of the slope in the construction need to be strengthened. The construction plan should be adjusted timely according to the deformation monitoring data. Quality of construction process should be controlled. The influence of the inner ring expressway will be reduced. Injury and damage to the inner ring expressway caused by the construction will be avoided.

During the process of slope excavation , prompt shotcrete was used to close excavation surface, reduce the exposure time of surrounding rock.

In the process of the backfill, a layered crush has been suggested as long as crush strength can meet the design requirements.

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