Study on foundation stability of a mountain project in Tianjin Binhai district

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Abstract. With the development of our economic, there are more and more demanding for natural landscape. A heap mountain project is located in Tianjin Binhai district whose foundation is recent filled. This paper is based on this project, analysis the stability of soil foundation under the action of each loading stage while the shear strength of filled is different, calculate the minimum shear strength of filled soil to meet the foundation stability.

1. Introduction

In order to satisfy the demanding for the environment of people's living landscape, there is a heap mountain project which is local in the recent filled foundation [1-3]. The soil for heap mountain project is reinforced by vacuum preloading method, many researches shows that there is much influence of shear strength to foundation stability.

For this reason, this paper makes much attention on the stability of the heap mountain. Analyze the influence of shear strength to the stability. Calculate the minimum shear strength providing base dates for the construction of the project.

2. Engineering case description

A heap mountain project is located in Tianjin Binhai district whose foundation is recent filled. The elevation is +3.9 m; soil foundation's bearing capacity is 80 kPa; mountain height is 14m. The calculate section is shown in Figure 1, and the soil parameters are shown in Table 1.

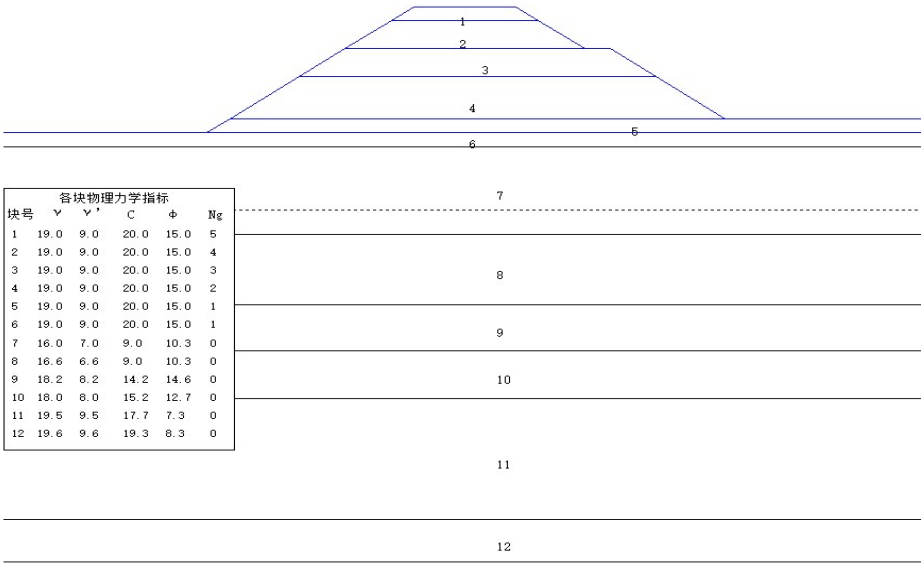

Figure 1. The calculate section.

Table 1. The soil parameters.

Soil layer	Bulk density /kN/m^3	Floating bulk density /kN/m^3	Cohesive force /kPa	Internal friction angle/
Plain fill	19	9	20	0
Dredger fill	16	7	9.03	10.35
silt	16.6	6.6	9.03	10.35
Silty clay	18.2	8.2	14.22	14.56
Silty clay	18	8	15.15	12.71
Soft clay	19.5	9.5	17.69	7.27
Soft clay	19.6	9.6	19.28	8.29

The mountain elevation is from 4.0 m to 14 m. The load is in six stages, which are 6.0 m, 9.0 m, 11.0 m, 13 m and 14 m and the crowd average load of 5 kPa. The calculated water level is +2m, and the main load after the completion of the heap is crowd load, the size is 5 kPa.

3. The global stability of heaping mountain

The stability of the heaping mountain is calculated by the foundation calculation system software (2008). The safety factor of each stage is calculated by circular slip method. The calculate results are shown in Table 2.

Table 2. The safety factors.

Loading stage	Height	Safety factor (circular slip method)			
		Forward slope	Does it meet the specification requirements?	Negative side slope	Does it meet the specification requirements?
1	6m	2.812	Yes	2.745	Yes
2	9m	1.324	Yes	1.375	Yes
3	11m	1.339	Yes	1.108	Yes
4	13m	1.066	No	0.919	No
5	14m	0.937	No	0.739	No
6	crowd load	0.910	No	0.710	No

The standard of Port Engineering Foundation (JTS 147-1-2010) stipulates that the safety factor obtained by arc sliding method should meet the requirements of 1.1-1.3. Therefore, the shear strength of plain fill is c = 20 kPa and φ= 0. The height of the mountain can only reach 11 m, and then there will be an unstable safety hazard. So the plain fill should be reinforced twice. Drainage boards are set up at the position of + 4 m, and the depth of drainage board is marked - 8 m, the distance is 0.9 m, and the drainage board is arranged square. The total loading time is 50 days, every stage loading time is 2 days, and the stopping time is 8 days. The vertical consolidation coefficient is 0.00432 m^2/day, the horizontal consolidation coefficient is 0.00432 m^2/day.

According to the results of field cross-slab test, the shear strength of the Plain fill foundation is c=35 kPa, φ =0 after the second reinforcement. The arc slip method is used to calculate the safety factor of each loading processing, and the results are shown in Table 3.

Table 3. The safety factors of the second reinforcement.

Loading stage	Height	Safety factor (circular slip method)			
		Forward slope	Does it meet the specification requirements?	Negative side slope	Does it meet the specification requirements?
1	6m	2.812	Yes	2.745	Yes
2	9m	1.324	Yes	1.375	Yes
3	11m	1.339	Yes	1.108	Yes
4	13m	1.066	Yes	0.919	Yes
5	14m	0.937	Yes	0.739	Yes
6	crowd load	0.910	Yes	0.710	Yes

As shown in Table 3, when the shear strength of plain fill used in heap hill is c = 35kPa and φ = 0, the safety factor has just been met the requirements of the standard of Port Engineering Foundation (JTS 147-1-2010). Therefore, the minimum shear strength of plain fill used in the landfill should not be lower than c=35kPa, φ = 0.

4. Conclusion

Based on a heap mountain project in Tianjin Binhai district, the influence of shear strength of plain fill on the stability is calculated. The minimum shear strength of plain fill which meets the safety requirements is calculated. The main conclusions are as followed.

(1) There is much influence of shear strength of the plain fill to the stability. The standard of Port Engineering Foundation (JTS 147-1-2010) stipulates that the safety factor obtained by arc sliding method should meet the requirements of 1.1-1.3.

(2) The shear strength of plain fill is c = 20 kPa and φ= 0. The height of the mountain can only reach 11 m, and then there will be an unstable safety hazard.

(3) To ensure the safety of the heaping mountain project, the minimum shear strength of plain fill used in the landfill should not be lower than c=35kPa, φ = 0.

References

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