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Application of Foamed Cement in the Settlement of Room Core Soil

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Abstract

Foam cement has good fluidity and certain bearing capacity. According to the advantages of foam cement and combined with the construction site example, the backfill soil in the center of the house is strengthened by grouting method to improve the bearing capacity of the backfill soil, so as to control the settlement and curb the continued subsidence of the ground.Practice shows that the gap between the backfill soil layer and the floor is effectively filled, the bearing capacity of the soil layer is obviously increased, the ground does not settle, and the application effect of foam cement in the backfill of the backfill soil is good.

Keywords

Foam Cement, Room Subsoil, Subsidence.

1. Introduction

Subsidence of backfill soil is a common quality problem in industrial and civil construction engineering. Due to the improper treatment of the foundation groove backfill soil, the backfill soil subsidence, resulting in the surface of the ground empty bulge, crack, and ultimately lead to the settlement and cracking of the building surface. In serious cases, the buildings and structures above the backfill soil will appear overall tilting and lodging, which will affect the use of buildings and cause safety risks[1].In view of the settlement of the soil in the center of the room, the common treatment method in the industry is to break and replace the filling, dig out the substandard part of the backfill soil layer and replace fill, re-lay the steel mesh, and build the upper board with concrete secondary casting. But this method is only suitable for a small area of construction, road engineering, for a large area of construction, high cost, time-consuming and laborious, is not applicable.I n this paper, based on the construction site example, considering the tight construction period, cost control and other factors, the traditional treatment method of breaking and replacing fill is abandoned. Foam cement is chosen as the material, and grouting technology is used to reinforce the backfill soil layer in the center of the building, so as to control settlement, improve the bearing capacity of the backfill soil layer, and finally complete the recovery of the sunken ground.

2. Project Overview

2.1 Project Brief Condition

The total construction area of the dormitory area of a construction project is 52 671.7m2,and the structure form is reinforced concrete frame structure, the foundation of the building is an independent column foundation or strip foundation under the wall, and the foundation is buried 3.9m deep. It is proposed to build eight buildings, including a dormitory, a reception center and a canteen. The height of dormitory and reception center building is 22.67m, the height of canteen building is 9.05m, and the height of commercial storefront is 4.05m.The foundation pit construction of this project adopts large excavation method. After the completion of underground construction, backfill construction is

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carried out. The backfill depth is about 3.9m, the thickness of each layer is no more than 300mm and the compaction coefficient is 0.94.

2.2 Engineering Geology

According to the engineering geological survey report and reference to regional geological data, the foundation soil within the exploration depth can be divided into the following layers, from top to bottom:

(1) fill stratum

The main color is yellowish brown, yellowish gray, with silty clay, silty soil formed by the main plain fill, containing roots, brick slag, ash slag and so on, partial to miscellaneous fill. Soil is relatively loose, uniformity and structure is relatively poor. The thickness of the layer is 0.40~1.90m.

(2) Loess like silty clay layer

The deposition time is relatively short, which is newly accumulated loess, with poor structure and low strength, It is also wet and framed. The average compression coefficient α_{1-2}=0.24MPa-1,belonging to neutral compression soil, distribution is unstable, local missing, thickness difference is large. The thickness of the layer is 0.40~4.30m.

(3) Fine sand layer

The color is yellowish gray, saturated, and the mineral composition is quartz, feldspar and mica, etc. Locally containing a clay composition or silt mass. The distribution is lenticular. And thickness of the layer is 0.40~1.50m.

(4) Pebble, round gravel, gravel sand and silty clay layer

Mainly with variegated pebbles, round gravel, yellow-brown gravel sand, silty clay, from top to bottom is getting better and better dense, The thickness of the layer is 7.1~11.24m.

(5) Mudstone layer

Color is yellowish brown or purplish red, locally greenish gray, was strongly weathered, the rock core is like a hard clay shape, belongs to the extremely soft rock. The layer is mainly sticky particles, some sections contain sand and gravel, and locally rich in calcium and sandstone blocks. The strength of this layer is not uniform, and the core is easy to soften in water and disintegrate when losing water. The maximum exposed thickness is 9.30m.

3. Analysis of the Causes of Atrial Atrial Soil Settlement

The settlement area is mainly distributed in the commercial storefront on the first floor of the corridor of Dormitory no. 1-4, the reception center, the commercial storefront on the first floor of the corridor of dormitory No. 6, and the ground floor of the canteen. The settlement mainly includes uneven ground settlement and surface cracking, as shown in Figure 1; After drilling holes on the board, it can be observed that the backfill soil layer of the room heart sinks obviously, as shown in Figure 2.

Figure.1 Cracking of the surface

Figure.2 Sinking of the atrium backfill

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According to the investigation and analysis, there are mainly the following factors causing the subsidence cracking of the building ground [2]:

(1) Using plain soil backfill, compaction degree is not up to standard

According to the design requirements of the drawings, graded sand, gray soil or plain soil with good compaction can be used as the material for foundation pit backfill. Before the backfill, water need to be removed, empty soil and construction waste and other foundation pit debris need to be removed, too. All sides should be compacted simultaneously, with the thickness of each layer not exceeding 300mm and the compaction coefficient not less than 0.94.In order to reduce the economic cost, the backfill materials are selected with plain soil backfill, with low strength; And because of the tight construction period, in order to save time, backfill is not layered compaction according to the design requirements, and the compaction coefficient is not up to standard, resulting in backfill soil subsidence, and then lead to building ground settlement cracking.

(2) insufficient plate reinforcement

During the construction, the workers did not allocate steel bars according to the requirements of the drawings, and cut corners, resulting in insufficient bearing capacity of the plate surface, and unstable damage phenomenon such as cracks.

(3) Impact of subsidence site and rainfall

According to the geological survey report, the soil on the second floor of the project has collapsibility. After the foundation pit backfilling, the compactness is insufficient and the porosity is large. And due to the influence of typhoon, local heavy rainfall, water around the building has not yet been constructed, surface water infiltration into the foundation, causing the heart of the house soil immersion and subsidence, backfill soil subsidence, ultimately resulting in uneven settlement and cracking of the building ground.

4. Application of Foamed Cement

The project is in the final stage of construction, the construction period is relatively tight, the task is heavy, the site is mostly cross-construction of various types of work, and pipeline lines are complex; The construction progress of the steps and water dispersion around each building is slow, most of the ground beams are exposed, the closed environment is poor, and the grout is easy to lose, which seriously affects the construction speed and quality of grouting, causes material waste and increases the cost. Foam cement has bearing capacity, low cost, good liquidity, and grouting technology equipment operation is relatively simple[3],construction speed is fast. According to the features of foam cement grouting technique advantages, in line with the economic and reliable, does not affect the other face the construction principle, the reinforcement backfill soil effectively, make the foam cement filling backfill soil compaction gap, between the plate and the backfill soil condensate, raise the backfill soil layer, improves the backfill soil bearing capacity, to prevent surface subsidence deformation is increasing, After grouting is completed, the surface of the subsidence area will be replenished again to solve the problem of soil settlement in the center of the room[4].

Foam cement is used as the material to carry out pressure grouting in the settlement area. The spacing of grouting holes is 2m, the diameter is 110mm, and the grouting holes are distributed on both sides of the floor beam. The cement is ordinary 32.5 Portland cement, and the ratio of water to cement is 0.46. The grouting pressure is controlled at 1.5~2.0MPa, and the single hole is injected twice. The foam cement with settlement of 50%~70% is injected for the first time, and the second time is filled up, which can avoid material waste and improve the grouting effect.

4.1 Secondary Grouting Technology

Before grouting, the layout of water and electricity pipelines has be planned to ensure the smooth grouting construction without affecting the field operations of other types of work. Arrange mechanical or manual treatment of exposed ground beam, do a good job of environmental closure; Considering that foam cement has shrinkage, one grouting will settle and shrink, so the second

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grouting technology is adopted for grouting. When 50%~70% foam cement is injected into the first grouting, the injection will be stopped immediately when the slurry is found to be extravasated, and the second full injection will be carried out after the foam cement is fully permeated and solidified in the backfilled soil layer, which can effectively avoid material waste and reduce construction cost. Improve the backfill reinforcement effect [5].

Figure.3 Grouting site

Figure.4 Grouting to complete

4.2 Effect Evaluation

(1) Save on materials and reduce costs. Foamed cement due to foaming, it's volume greatly expanded, can use less material to fill a larger space, and the price of foamed cement is low, compared with pure cement slurry, foamed cement can save the cost of 50%, compared with composite slurry, can save the cost of 15%[6,7].

(2) Good quality effect. After the backfilling soil layer is reinforced with foamed cement, the bearing capacity of the soil in the center of the building is obviously improved, the gap between the soil layer and the ground is filled, and the ground subsidence is effectively prevented.

(3) The grouting technology and equipment is simple to operate and has a fast construction speed.

(4) The new method is used to solve the problem of soil settlement in the center of the building.

(5) The foam cement construction process is less pollution and green.

In conclusion, through the application of foamed cement in the settlement of the soil in the center of the room, the gap between the backfill soil and the ground can be effectively filled, and the foamed cement penetrates into the soil, so that it can be filled and compact, the soil can be strengthened, the bearing capacity is significantly improved, and the ground will no longer sink, so as to control the settlement and curb the continued subsidence of the ground, save time, and achieve good economic benefits.

5. Conclusion

Atrial backfill subsidence is a common quality problem in construction projects, and most of the reasons for the quality problems of backfill soil are inadequate design and irregular construction, etc. Based on practical engineering, this paper analysis the site of atrial soil settlement, with foam concrete as the grouting method material, to effectively reinforce the backfill layer, greatly reduce the construction cost, improve the backfill efficiency, to obtain a good construction quality, simple equipment operation, fast construction speed. For other engineering's handling of the similar situation to provide experience and reference.

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