

# *Study on soft soil foundation treatment technology in industrial building construction*

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**Abstract:** Because of its unstable structure, SSF (soft soil foundation) will appear obvious deformation after being subjected to external force, which will cause the foundation settlement of buildings and the overall life of buildings will be affected to some extent. With a large number of construction projects, land resources are increasingly scarce, and a large number of SSF will be used as construction land foundations. The base material in soft soil has many physical and chemical properties and active properties different from other soft soil materials. Under the action of strong external pressure, the SSF of high-speed tunnel is easy to bend. Because there are many defects in SSF, there are great security risks in industrial buildings, so it is necessary to use SSF treatment technology to change the problems in SSF during construction. By analyzing the characteristics of SSF, this paper focuses on the importance of SSF treatment and discusses the application of common foundation treatment technology in industrial building construction.

## 1. Introduction

In industrial building construction, foundation construction is a very basic construction link, which also lays a solid foundation for the safety and stability of subsequent building structures. The base material in soft soil has many physical and chemical properties and active properties different from other soft soil materials [1]. Under the action of strong external pressure, the SSF (soft soil foundation) of high-speed tunnel is easy to bend. In this case, it is easy to cause industrial buildings to sink faster because of gravity, which may affect the safety and stability of industrial buildings and pose different degrees of threat to people's life safety [2]. SSF treatment technology improves the safety and stability of engineering construction, and SSF treatment is the key to engineering construction. Therefore, in the construction of industrial buildings, the application of SSF treatment technology plays a decisive role and can effectively promote the sustainable development of China's construction industry.

## 2. Overview of SSF

SSF is mainly composed of soft soil structure, mostly with loose geological environment and rheological and thixotropic characteristics. Because of its unstable structure, SSF will appear obvious deformation after being subjected to external force, which will cause the foundation settlement of

buildings and the overall life of buildings will be affected to some extent. With a large number of construction projects, land resources are increasingly scarce, and a large number of SSF will be used as construction land foundations [3]. However, the bearing capacity of SSF is low. When the superstructure needs to bear a large load, it will be an important problem to effectively improve the bearing capacity of SSF in the process of engineering construction.

Because the SSF contains a lot of water, and the water permeability is extremely poor, it can't effectively drain water, which leads to the application performance of soft soil not meeting the expected standards and is prone to potential safety problems. The composition of SSF is extremely complex, with gravelly soil and fine particles, and the physical characteristics of different materials are significantly different. Because of the different settlement speed and degree, the stability of superstructure will be affected. SSF does not have excellent water permeability, so it needs to be drained by professional equipment and means during construction, so as to ensure soil consolidation [4-5].

### **3. Significance of application of SSF treatment technology**

#### **3.1 Improve security**

At present, the treatment of SSF is very important in the construction process of building projects. If it is not handled properly, it will easily lead to insufficient building stability and serious uneven settlement accidents in the subsequent construction. Adopting appropriate technology to improve the strength of the foundation can really play its due role, ensure the overall stability of the building, and can effectively reduce various security problems caused by the unstable foundation [6]. This can not only improve the overall quality of the building, but also ensure the personal and property safety of construction workers and building users.

#### **3.2 Improve the construction quality**

In the process of industrial building construction, foundation deformation or settlement is closely related to SSF [7-8]. Once these problems occur, it will affect the safety of the whole project construction and the later application effect, and threaten the personal safety of industrial construction workers and maintenance personnel. Under the influence of the self-weight of construction projects, there will be problems such as large settlement of industrial buildings, which will seriously affect the stability and safety of buildings. Based on the engineering experience and the development of construction technology, the construction technicians put forward the technology of compaction sand pile to reinforce the SSF.

In view of the instability of SSF structure, it will have a serious quality impact on the structure of the whole building project. In the process of SSF treatment and construction, it is necessary to adopt targeted construction technology to ensure its mechanical properties. Before construction, the construction enterprise needs to communicate with the geological exploration unit, clearly understand the soil type and soil properties of the construction site, and ensure the timely treatment of SSF through discussion and analysis with professional surveyors. The effective application of SSF treatment technology to the foundation treatment not only ensures the overall construction quality and efficiency, but also provides some support for the building to be used for a longer time.

## 4. Application of SSF treatment technology in industrial building construction

### 4.1 Mixing pile technology

Mixing pile technology is also widely used in SSF treatment. Mixing pile technology can be divided into cement mixing pile and lime mixing pile, both of which can meet the stability requirements of foundation structure. Cement mixing pile is often used in the treatment of some silt, muddy soil and peat stone, and its effect can only be fully exerted in the construction of soft soil [9]. The construction schematic diagram of mixing pile method is shown in Figure 1.

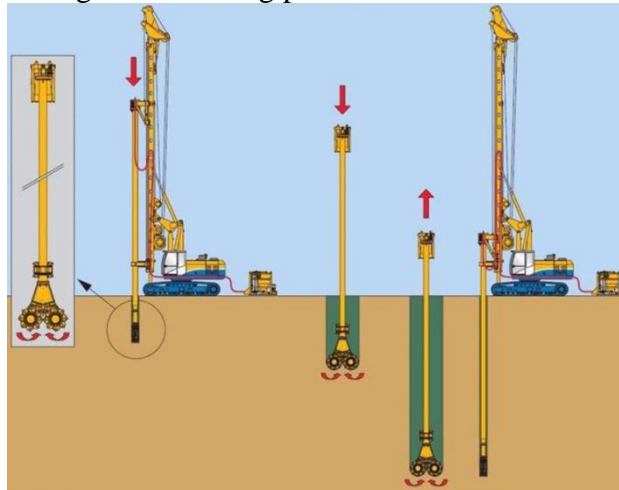


Figure 1: Schematic diagram of mixing pile method construction

Cement deep mixing pile is a widely used technology in SSF construction technology, which is mainly used in soft soil geology such as silty sand and peat soil. First of all, it is necessary to carry out scientific data test on mixing piles, such as mixing time and mixing depth, and make good preparations before construction. Secondly, ensure the cleanliness of the construction environment, clean up the construction environment before construction, and inspect the construction materials and equipment. Finally, come up with a specific construction plan, determine a reasonable construction sequence, and inspect the pipeline before construction to ensure that the mixing pile remains vertical during construction.

Deep cement mixing pile means that cement is selected as the material in the curing agent, so as to greatly improve the strength of the house. The mixing pile method is relatively simple, which can minimize the overall settlement of industrial buildings and the settlement of soil layers, and make the SSF of houses stable. The cement mixing pile also needs to do preparatory work, that is, to do a good job of site investigation and cleaning, and to do a good job of environmental cleaning and inspection before the cement mixing pile construction, so as to provide support for the subsequent cement mixing pile construction.

### 4.2 Cementing material treatment technology

In the process of SSF treatment, the method of cementing material treatment is beneficial to control the water content in SSF and mix it with handover materials. In the actual construction process, attention should be paid to the accurate calculation of the pile feeding amount per meter and the total feeding amount of the designed pile length according to the design coefficient, and the total amount of materials should be converted into the number of skip cars, and the length of the feeding pipe should be marked to ensure that the pile length meets the construction design requirements. After proper mixing of water and cement materials, the grouting pipe and grouting pump are used to inject

cement into the poor foundation soil, so as to ensure the organic integration of the original soil and water injection mud and form a solidified whole, thus enhancing the durability and strength of the foundation.

Cemented material treatment technology is widely used in the construction site, including cement-soil mixing method, grouting method, high-pressure grouting method, etc. For the use of different methods, it is necessary to combine the actual situation and construction requirements to ensure the strength of SSF and improve the stability of the whole foundation.

### **4.3 Construction technology of compacted foundation**

Tamping foundation construction technology is very common in the process of SSF treatment in construction projects, and it is necessary to use large-scale lifting machinery to tamp the poor foundation soil, so as to enhance the hardness and strength of the poor foundation soil. Heavy hammer tamping and dynamic compaction are extremely popular treatment technologies. During the construction process, according to the change of geological conditions in the construction area, the pile depth is controlled within the range of 4~14m under the foundation bed. At the same time, according to the construction technical requirements, the pile body is arranged in an equilateral triangle along the center line, and the pile body filler is selected based on the water permeability, with medium and coarse sand, and the silt content is controlled below 5% [10].

Dynamic compaction is an effective method to reinforce SSF. When the SSF is under construction, the soil mass of SSF is repeatedly rammed to improve the compactness, thus improving the bearing capacity of the foundation, which is widely used in SSF construction. Determine the compaction point, so as to bring the gravel into the foundation protection layer with the help of external force, and effectively improve the stability of the foundation through the establishment of the composite foundation. In the process of construction, construction technicians should use compaction method reasonably, and determine the potential energy, tamping times, times and intermittent time of single tamping through trial tamping, so as to meet the requirements and improve the construction efficiency.

### **4.4 Treatment technology of replacement foundation**

Replacement technology is the basic technology applied in SSF treatment. In the application process, it is necessary to replace and fill the soil of SSF to meet the requirements of foundation structure strength and stability, and finally achieve the guarantee of construction quality of building projects. When the replacement materials enter the site, it is necessary to analyze the quality and performance of the materials by a qualified testing unit according to the design requirements to ensure the rationality of the selection of replacement materials.

In the construction design of SSF, on the basis of ensuring that the mechanical properties of replacement materials meet the construction technical standards, the mechanical properties of the whole foundation are improved and the bearing capacity of SSF is improved through replacement treatment of SSF soil. As the most basic method in SSF treatment construction, replacement foundation treatment technology effectively enhances the soil bearing capacity of the foundation during construction.

Composite foundation is a foundation composed of vertical reinforcement, surrounding soil and mattress laid on the top of reinforcement. It is one of the most effective methods for foundation treatment to set up reinforcements with high strength and stiffness in the foundation. These reinforcements, together with the surrounding soil and mattress, form a composite foundation to bear the load of the upper structure, which can greatly improve the bearing capacity and reduce the deformation compared with the original natural foundation.

Composite foundation includes bulk material reinforced composite foundation, compressible reinforced composite foundation with certain bonding strength and rigid reinforced composite foundation with high bonding strength. The bearing capacity and deformation of composite foundation depend on the bearing capacity, length, area replacement rate of reinforcement, the nature of foundation soil and the degree of bearing capacity. The foundation bearing capacity can be enhanced in four ways, as shown in Figure 2.

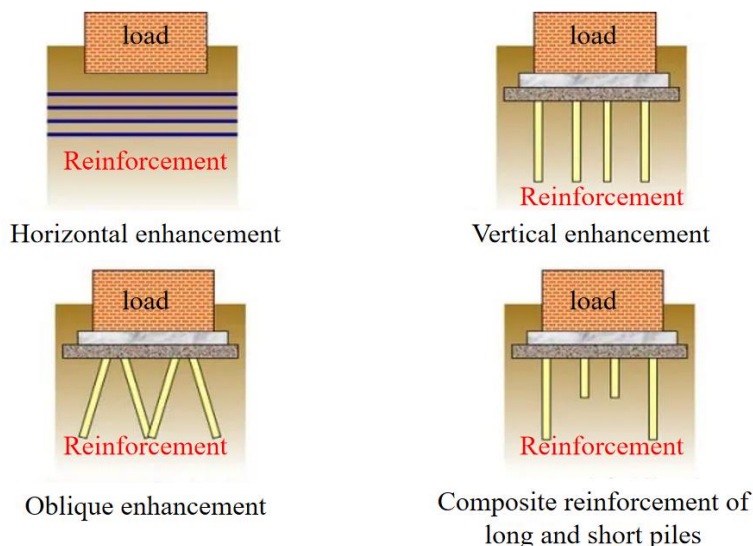


Figure 2: Strengthening method of foundation bearing capacity

In the concrete construction, the soil mass of the soil layer that does not meet the quality requirements is dug out, and the materials with good stability such as sand and gravel are replaced in the foundation to replace the original soil mass, and then the replaced soil layer is compacted, and the soil mass is compacted by sand filling method to improve the compactness of the soil mass and ensure that the bearing strength of the foundation soil meets the construction technical requirements.

In short, the application of replacement technology can ensure that the SSF can be effectively solved and meet the construction requirements of building structures. However, due to the high cost in the application of replacement technology, it is necessary to increase the optimization and comparison of various materials when selecting replacement materials, and finally select replacement materials with high cost performance to meet the improvement of capital utilization rate in construction.

#### 4.5 Drainage consolidation technology

There is a lot of water in SSF, and the way of drainage consolidation is to treat the water in SSF. In actual construction, drainage consolidation technology is to use manual technology to add a certain number of drainage pipes according to the actual situation. There are three common methods, including sand drain method, surcharge preloading method and electroosmosis drainage method.

The principle of sand drain method is to fill effectively on the basis of the original foundation structure, and to ensure the water content requirement by forming the drainage pipeline of sand drain, so as to achieve the ideal design effect. The advantage of this method is that it is convenient and the drainage speed is relatively fast.

The surcharge preloading method makes the SSF achieve satisfactory drainage consolidation effect under the influence of external force by using load preloading, and the removal of surcharge structure generally depends on whether the SSF is effectively improved.

Electroosmosis drainage method, in the specific construction process, needs to insert the DC motor into the soil to ensure that the water in the soil can gradually permeate from the anode, transfer to the cathode, and then discharge from the cathode.

## 5. Conclusions

SSF treatment technology improves the safety and stability of engineering construction, and SSF treatment is the key to engineering construction. Therefore, in the construction of industrial buildings, the application of SSF treatment technology plays a decisive role and can effectively promote the sustainable development of China's construction industry. SSF is an unsafe factor in the construction of construction projects, so it needs to be treated according to the actual situation of the construction site. To ensure the treatment effect of SSF, it is necessary to choose scientific and reasonable treatment technology, optimize the treatment technology of SSF, save the treatment cost of SSF and realize the improvement of the overall quality of construction projects.

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