

## **Discussion on the Application of Structure and Foundation Reinforcement Technology in the Design of Civil Engineering**

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**Abstract:** as the development of the modern construction industry in China, at present, structure and foundation reinforcement technology has been frequently applied in the design of civil engineering; as the main material of buildings, steel concrete has the inherent defect that must to be remedied by means of reinforcement technology. In this paper, it emphatically analyzes the reasons of reinforcing the structure and foundation of the building, and discusses the principal theory of construction survey and the design optimization of the civil engineering, so as to provide some references to the improvement of the comprehensive level of construction and quality control of the civil engineering in China.

### **1. Introduction**

As the rapid development of Urbanization, at present, the higher requirements for the overall quality of buildings have also been put forward. Some buildings that were constructed in the past have been quite old and have been damaged to varying degrees, these problems not only trouble the normal life of the people, but also threaten the safe of people; at the some time, to some extent, the problems block the construction and the further development of the city. In order to take the best use of the original function of a building and provide more convenient services to the people, it is necessary to reinforce the structure and foundation of these buildings, to make a more perfect and scientific construction plan by means of construction survey; and then to select the reasonable construction technology so as to ensure the project of civil engineering could be completed with full quality and quantity.

### **2. Analysis on the reason of the structure and foundation reinforcement in civil engineering**

#### **2.1 Structure aging.**

At the very beginning of designing a building, the designer must assume a period of time to be the lifetime of the building. The service life of most buildings is 50 years, if the service life is over, then the structure of the building is bound to be gradual aging, and it could not use any more except reinforcing it. For example, there are lots of steel concrete workshops which are built in 1950s, the service lives of these workshops have been over, but some of them are still used by the people, it is dangerous to some extent. So it is necessary to reinforce these buildings so as to avoid collapse, as well as the loss of life and healthy or property of the people.

#### **2.2 Renovating the old building**

As the constant development of China, the designer who designed these building decades ago might not make a considered design that is suitable for the need of technology and the need of people for comfort today; in this case, it is necessary to renovate the old building. On one hand, to remove the old building directly and then to construct a new building may involve many issues on construction authority; moreover, a new building means spending quite high cost. On the other hand, the reinforcement technology has been quite advanced so that it could meet the requirement of renovation. In the process of renovation, it is feasible to reinforce the key parts and add the functions that can meet the objective requirements of the people; at the some time, the cost of

renovation is relatively lower and the overall efficiency is relatively higher.

### **2.3 Inherent quality problems of the building**

There are various problems that could influence the quality of a project in the construction process of some civil engineering projects, meanwhile, a completed project also might be influenced by a lot of external factors; under this circumstance, the project may need to be repaired. To renovate a defective building, it is important to combine the actual requirement for the quality of the project to the actual situation of the building. For example, there are a lot of buildings which were built in 1980s, in that time, the levels of technology and construction were low, so they need to be renovated in time.

### **2.4 Natural disaster**

As a country with a vast territory, many areas of China are vulnerable to various natural disasters. Excepting windstorms, fires and floods, there are also some other forms of disasters every year. It seriously damages people's lives. As an irresistible external factor, its influence on buildings is also very bad, so to reinforce some buildings are helpful to avoid the bad influence of the disasters, and it could save some national resources.

## **3. Strategies and the principle theory of design optimization of civil engineering**

### **3.1 Design and optimization of steel concrete structure**

As an important material in civil engineering, steel concrete is widely used in the construction of roads, bridges, buildings and so on; it is the crucial factor in a project. In the process of designing the structure of a building which frame would be steel concrete, it is important to use the high-quality steel concrete, and focus on the resistance to shock and ductility of it, and the some time, to exam the durability by means of referring the pre-stressed concrete structure model and to control the crack. In the process of calculation, it is necessary to distinguish the different appearance structure, and to focus on the calculation of the carrying capacity of warped surface, normal section and so on. What's more, the shape and quantity of the concrete iron also can bring bad influence to the project, so it is crucial to follow some certain methods and principles so as to ensure the safety and stability of the usage of concrete iron.

### **3.2 Steel structure connection and material selection**

In general, steel structure can be divided into the four types----steel, metalwork, sheet metal and structural section. In civil engineering, the relatively widely used material is carbon steel, although the high-quality carbon steel owns high intensity, but it owns low deformability. In the construction of steel structure of civil engineering, it is feasible to adopt the "I-shaped" structure with wide edge, in some cases, it is necessary to adopt some "cross-shaped" structure so as to reinforce the structure. In the construction process of the beam, the "H-shaped" steel beam is widely used by means of welding. Before the welding, it is necessary to do some exams for making sure some parameters and the materials for welding, and then to weld. In the process of dealing with the connection between the pillar and beam, it is feasible to use the high strength bolt, or by means of welding. The main work of hole-making includes numerical control drilling and formwork drilling which precision is low. When the bolt is used in the project, its parameters should be checked, it can not be hit by the hammer violently and directly, but wrench should be used to deal with it.

### **3.3 Installation and construction of steel structure**

On choosing the worksite of constructing the steel structure, the area of the worksite must 1.5 times larger than the area of the steel structure. At the same time, the steel structure must be transported from the yard of assembling to the construction site and then to settle down by the specialized equipment in the radius of gyration. If the shapes of some steel structures have changed in the process of transportation, it might to remedy these structures at the construction site. In the process of installing the steel structure, it is necessary not only to ensure the scope of arm extension

of the equipment, but also to adjust to the maximum lifting capacity to meet the lifting requirements of different types of steel structures. When a lot of equipments are work at the same time, it is also necessary to comprehensively fulfill the lifting height and adjust the appropriate speed, to ensure the height difference of the arms of the cranes and the safety distance between the cranes, so as to ensure the safe operation of the equipments, and to prevent the collision.

#### **4. Application of foundation reinforcement technology in civil engineering design**

In the process of constructing the foundation of civil engineering project, the common reinforcement technologies are the 4 methods----replacement method, cushion method, compaction method, and consolidation method. The main technology characteristic and the relevant analysis are as below:

##### **4.1 Replacement method**

Replacement method is a low-cost method which principle theory is by the use of other materials instead of the original soft soil under the foundation so as to effectively improve the intensity of the whole foundation system. Because this method is often used to reinforce the soft soil foundation, in addition, it is easy and cheap to acquire the materials for replacement and then reinforcing the foundation, so, there is little influence on the cost of the project. It is necessary to notice that it is crucial to dig out all the soft soil before replacing the hollow by other materials and make sure the other material is more than the soft soil; and then, to roll the foundation by road roller again and again, so as to ensure the old and new soil can integrate together, and to ensure the result of reinforcement. In the process of applying the replacement method, it is requested to calculate the thickness of the soil layer; before the application, it is necessary to calculate the thickness accurately, and then to replace the hollow according to the qualified design, so as to ensure the construction result of the method.

##### **4.2 Cushion method**

The characteristic of cushion method is to pave a cushion, which is made of the relative harder materials, over all the area of foundation, then backfill the soil. This kind of special treatment is soft soil layer foundation cushion method. From the perspective of applying the technology, this method can not only effectively improve the carrying capacity of the foundation, but also improve the drain ability, so as to ensure the stability of the foundation. Of course, it not means that the thicker the cushion is, the better the foundation is; in general, the thickness of the cushion is from 0.8 to 1.5. On one hand, it could not increase the cost a lot; on the other hand, it could play a role of reinforcement. At the some time, it could shorten the time of concretion of the water and soil, so as to ensure the stability of the foundation.

##### **4.3 Compaction method**

Under the circumstance that the soil structure is incompact in a foundation, or the moisture content is in a high level, the stability of the foundation could be low. In this case, to choose compaction method is the best way for reinforcement. By this method, the excess moisture can be effectively drained away, and the stability of the structure also can be improved by increasing the granularity in unit area, so that the carrying capacity of the soil would be reinforced. There are two kinds of compaction method that are commonly adopted in the application----lime filling method and forceful tamper method, and the principles of the two methods are different. Lime filling method utilizes the chemical characteristic of limestone that it will react when add water to it, so as to decrease the moisture content by means of this kind of absorbent materials. While the tamper method that uses some compaction equipments such as road roller to compact the foundation again and again, then the soil granularity gap within the foundation becomes smaller, so as to effectively enhancing the compactness of the soil.

#### **4.4 Consolidation method**

Consolidation method is a kind of technique that drains away the excess water in the soil by special equipment; this method can let the soil become concrectionary in a very short time. When the moisture content of the soil becomes relatively lower, its stability can be improved, it is very helpful to the following construction. The advantage of this technique is that the requirement of technology for this method is not high, so the operator can apply it relatively easier; at the some time, the raw materials are easily to acquire, so it can effectively reduce the overall cost of the project. In addition, the operator just needs to operator the special equipment several times to drain away water, so it is not necessary to buy it, and to rent the equipment is also a good way of reducing cost. This method is widely used to lots of construction projects which soil foundation are relatively soft, and it has been highly praised by the construction circle.

#### **5. Conclusion**

To sum up, at present, China is in the critical period of socialist modernization, and the quality control level of civil engineering projects directly affects the quality and stability of the construction of modernization. Combined with the past construction cases, only by means of scientific construction of structure and foundation reinforcement of civil engineering can enhance the overall level of designs on civil engineering, and create the favorable conditions for carrying out the scientific and effective civil engineering construction subsequently. It also creates favorable conditions for the application of the structure and foundation reinforcement technology in civil engineering.

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