ISSN 2663-1563 Vol. 5, Issue 2: 10-14, DOI: 10.25236/AJAGE.2023.050202

Study on key points of soft soil subgrade construction technology in road and bridge engineering construction

Hongxi Yu[1]

[1]*Shandong Transport Vocational College, Weifang, China*

Abstract: *China has a very vast territory of state, so the geological environment between different regions is quite different, which increases the difficulty coefficient in the construction process. It is impossible to use unified standards for road and bridge construction. It is very common to encounter various complex problems in the process of construction team construction, among which the construction on soft soil subgrade is a common problem in current road and bridge engineering. Through analysis, this paper analyzes and elaborates the construction technology of soft soil subgrade based on the construction of road and bridge engineering in detail to help the construction personnel and provide them with certain reference.*

Keywords: *geological environment; construction of road and bridge; soft soil subgrade; shear-bearing capacity*

1. Introduction

The construction of road and bridge engineering projects has become an important construction part of infrastructure for urban transportation, which can greatly solve various traffic problems in the city and is also one of the important ways to beautify the city. However, the soft soil subgrade often has a large difficulty coefficient for the construction in the construction process due to the influence of the geological environment of the construction site. This is because the soft soil subgrade will make the road and bridge more unstable, leading to different degrees of settlement of the pavement, which is not conducive to the quality improvement of the engineering project.

2. Soft soil subgrade treatment

Once the soft soil subgrade is not effectively treated in advance, it will lead to the failure of the soft soil subgrade where the structure is located to reach the bearing standard of the structure in the construction process of road and bridge projects, resulting in the failure to achieve the construction goal in the construction of the project. Moreover, the load on the soft soil subgrade or the structure on the soft soil subgrade is constantly increasing during the use in the later stage until exceeding the maximum force that the soft soil subgrade can bear, which will lead to the problem of uneven settlement and serious damage to the structure. Therefore, the fundamental purpose of soft soil subgrade treatment is to smoothly improve the actual bearing capacity of the foundation in the process of soft soil subgrade treatment, so as to fully improve the stability of the subgrade. During the construction with the structure guaranteed, its construction quality can reach the construction standards.

3. Characteristics of soft soil subgrade in road and bridge construction

3.1. Poor permeability

In terms of the composition of soft soil, it is mainly composed of some clays with poor permeability, which can be used in the actual construction and needs to be constructed in a large construction area. However, the permeability of soft soil cannot be improved again due to its own characteristics, which does not meet the corresponding construction requirements. Therefore, this will lead to the failure to meet the basic requirements of the soil used for road and bridge.

ISSN 2663-1563 Vol. 5, Issue 2: 10-14, DOI: 10.25236/AJAGE.2023.050202

3.2. High water content

Soft soil has high instability due to the high coefficient of water content, which will also directly affect the overall construction quality of the project. In the current actual construction of road and bridge, there are relevant standards for water content in the construction of soil subgrade. The water content of construction on soft soil subgrade is often different from that of traditional road and bridge construction. This is because of the high water content on the soft soil subgrade, which will affect the construction of road and bridge, thereby reducing the overall quality and safety of the road and bridge and reducing the service life of the project.

3.3. Large compression capacity

In general, the liquid limit of soft soil subgrade is proportional to the actual compressive strength. Therefore, when the liquid limit of soft soil subgrade increases continuously, its compression coefficient will also increase continuously. The main reason is that the liquid limit refers to the limit moisture content of the soil that changes from flowing state to plastic state. However, the soft soil subgrade cannot fully meet the specific requirements of road and bridge in the construction of engineering projects due to the high compression coefficient, which greatly improves the overall difficulty coefficient of construction.

3.4. Low shear-bearing capacity

In the construction of soft soil subgrade, the shear-bearing capacity is always low. This low shear-bearing capacity will make the subgrade lack of good drainage capacity, which will have a serious impact on the overall quality of the project. Therefore, it is necessary to effectively improve its internal shear-bearing capacity to ensure the sufficient capacity of soft soil subgrade, in order to effectively control the low shear-bearing capacity of soft soil subgrade and the serious negative impact on the project.

4. Problems after construction of soft soil subgrade

4.1. It is easy to cause the instability of road and bridge

In the current construction of soft soil subgrade, its cost composition has very significant characteristics. In addition, from the actual profile of soft soil subgrade, it can be found that it is basically composed of some loose soil, mixed with some porous peat and fine sand, which form the soft soil subgrade after extrusion deformation. The water permeability and compressive capacity of the soft soil subgrade are insufficient, mainly due to the high water content in it, which will lead to the problem of compression during construction. Therefore, it is necessary to carry out compaction operation on the soft soil subgrade first in the actual construction process. This can fully guarantee the high compactness of the subgrade. In addition, when the subgrade is not compacted sufficiently, it will cause a negative impact on the stability of the soft soil subgrade, which will easily lead to the collapse of the soft soil subgrade. In addition, it will pose a serious threat to traffic. Moreover, once encountering continuous precipitation weather, the permeability problem of soft soil subgrade will be caused, and the subgrade and pavement will be soaked in water for a long time, which will have a great negative impact on the project and will not be conducive to the construction progress in the future.

4.2. Pavement hardening

It is very easy to compress soft soil subgrade because of its poor water permeability and compression resistance. However, it will lead to different degrees of hardening of the pavement in the construction process of road and bridge. It is based on the actual characteristics of road and bridge construction. In modern road and bridge construction, asphalt or concrete is mostly selected as materials. But for asphalt and concrete, their stability is also insufficient. For example, asphalt will melt under the influence of high temperature. The concrete will also change its strength with the change of temperature, so there will be certain cracking problems. The construction of such soft soil subgrade makes the material of the subgrade unstable, and cracks often occur in the interior of the subgrade, which will lead to hardening and even cracking of the surface of the road and bridge.

ISSN 2663-1563 Vol. 5, Issue 2: 10-14, DOI: 10.25236/AJAGE.2023.050202

4.3. Pavement settlement

During the construction of pavement bridge, the settlement problem in the pavement construction will be the most important construction problem of the project. After the settlement problem occurs in the project, there are many influencing factors because its causes are complex. In the past analysis, once a variety of settlement problems of the pavement occur, mainly resulting from the poor permeability of the soft soil subgrade, the rain cannot penetrate after entering the subgrade, so the internal structure of the road and bridge is subject to long-term groundwater erosion, which causes different degrees of water and soil loss in the foundation, and also leads to differences in soil content at different locations of the subgrade, resulting in the height difference. In addition, the compressive capacity of the soft soil subgrade itself is not enough, leading to continuous compression, which is also the main cause of pavement settlement.

5. Soft soil subgrade construction technology in road and bridge construction

5.1. Dynamic compaction method

When the dynamic compaction method is used, as shown in Figure 1, the construction team is required to use a hammer tool with large gravity and make it rapid fall from a certain height, to tamp the subgrade by gravity acceleration. This operation mode can improve the density of the original loose soil during the continuous pounding on the ground, so as to transform the soft soil subgrade into a subgrade with high density. The principle of this technical method is relatively simple, and the actual operation is relatively easy, which will achieve good construction results. With the development of science and technology, the rammer can be used to achieve efficient construction in the process of construction. Such construction technology can well control the input of labor cost and further improve the efficiency of tamping. But for this subgrade treatment technology, there are also certain limitations. First of all, the requirements for soil quality are high, which are only applicable to the treatment of sandy soil and unsaturated cohesive soil. Therefore, in the current road construction in the northern region, the dynamic compaction method can be well used to achieve effective treatment of soft soil subgrade. [1]

Figure 1: Dynamic compaction method

5.2. Lime block hardening method

In the process of lime block hardening treatment for subgrade, it is basically in the soft soil subgrade. The raw stone block or some auxiliary admixtures are filled, and the natural chemical

ISSN 2663-1563 Vol. 5, Issue 2: 10-14, DOI: 10.25236/AJAGE.2023.050202

characteristics of its lime are used. With the strong water absorption and heat release characteristics of this material, the calcium ions can effectively penetrate into the subgrade by means of ion exchange. This will form a lime block composite subgrade, effectively improve the physical and mechanical properties of the soft soil subgrade, and control the actual settlement distance of the subgrade to the greatest extent. Moreover, the calcium ion seeping into the subgrade can effectively form a calcium carbonate hard protective layer in the natural environment, which can act on some miscellaneous fills, or some soft soil sections with certain viscosity and large degree of damage. When using this technology, it is often destructive to the benign soil, so it cannot be applied to some agricultural areas. [2]

5.3. Soil replacement method

The so-called soil replacement method is an important technical means that can effectively solve some bad problems in the construction of soft soil subgrade during the construction of road and bridge. The soil replacement method is to effectively replace the bad soil in the construction site with some effective soil types to promote the smooth construction of road and bridge. This kind of soil needs to have the characteristics of high compression resistance, stability and moderate water content. The silt soil, flood soil and underground ditch soil will be replaced in the specific construction, which greatly improves the actual bearing capacity of the subgrade and has a high compression resistance. The compressive capacity and bearing capacity of the project can be well improved after replacing the soil, to make the project have a high stability. In addition, it also effectively controls the water content of the project, so that it will not cause certain corrosion to the pavement and bridge due to the high water content, effectively improving the service life of the project. [3]

5.4. Soft soil surface treatment technology

When this technology is used, mainly after treatment, it can improve the internal stability of the foundation, so as to control the pavement bridge from serious cracking and deformation, and further improve the compressive strength and bearing capacity of the surface soil of the subgrade. In the process of soft soil surface treatment, its technology is mainly applicable to the cushion material method. Moreover, when this technology is used for treatment, it is mainly to ensure the use stability of mechanical equipment, especially in the laying of soil and the treatment of sand cushion, it is necessary to ensure the evenness of the laying, so that the construction ground shows a high flatness.

5.5. Cushion material method

When using this technical method, it is mainly aimed at the scientific and reasonable treatment method after the subgrade is uneven, or the settlement and lateral displacement occur locally. In the use of this method, the compressive strength and shear-bearing capacity of the material can be well used to greatly improve the loading capacity of the fill. After such treatment, the lateral change of the subgrade and some local settlement problems can be effectively improved, so that the subgrade has a strong supporting capacity. However, in the construction of road and bridge, once the soft soil subgrade in this area has a high viscosity, it is necessary for the construction personnel to use certain additives in the construction area, which can effectively improve the soil strength in this area and make the project progress smoothly. Generally, the training of the best construction personnel is also required. Many construction personnel are not familiar with the newly adopted technology, easily leading to operational errors in the construction, which will have a negative impact on the development of technology. [4]

6. Conclusion

To sum up, different degrees of settlement will occur in the construction of pavement bridges due to many characteristics of soft soil subgrade, which is not conducive to the improvement of the quality and safety of the project. Therefore, it is necessary to adopt targeted soft soil subgrade treatment technology, effectively improve the strength and stability of soft soil subgrade, and carry out construction smoothly based on the actual situation.

References

[1] Zhang Taomeng. Study on Construction Technology of Dynamic Compaction Method for Soft Soil

ISSN 2663-1563 Vol. 5, Issue 2: 10-14, DOI: 10.25236/AJAGE.2023.050202

Subgrade of Municipal Roads [J]. Intelligent City, 2021, 7(04): 134-135.
[2] Feng Yi. Exploration on Construction Technology of Soft Soil Subgrade of Road [J]. China Highway, 2021(03): 98-99.
[3] Liu Xuejuan. Application of riprap and silt removal dynamic compaction replacement method in the construction of soft soil subgrade of road [J]. Transpo World, 2020(36): 121-122.
[4] Gao Xuesong. Discussion on Soft Soil Subgrade Construction Technology of Municipal Road Engineering [J]. China-Arab States Science and Technology (Chinese and English), 2020(12): 62-65.