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Construction Technology and Maintenance Management of Roof Greening

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Abstract: With the rapid development of urbanization, land available to cities is becoming increasingly scarce and the area of green area is affected. With the improvement of people's living standards, the plane greening has been unable to meet the needs of residents, and the form of landscaping has also developed in more directions. Roof greening, as one of the important forms, has been valued and promoted in various regions at home and abroad, and the related technologies applied to it have attracted more and more attention. This paper analyzed and discussed the construction priorities and technical difficulties by combing the professional technology and maintenance management methods in the current roof greening construction, so as to provide reference for the current urban roof greening construction.

1. Introduction

The definition of roof greening generally refers to all out of the atmosphere of planting technology, also known as ‘the fifth green surface of the city’. As a supplement to the ground greening of modern cities, roof greening has been widely concerned and welcomed by people. Its forms and styles are diverse, and it has many ecological environmental effects and economic and social values, such as alleviating the heat island effect, regulating rain and flood, and purifying air.

In recent years, relevant experts and scholars at home and abroad have gradually deepened the research on roof greening. Through the research and practice of roof greening technology, many important theoretical achievements and practical technical measures have been summarized. Especially in the aspect of roof greening technology, the technical means used in the construction process and maintenance management have been deeply studied, and many research results have been obtained.

2. Construction Technology of Roof Greening

2.1. Building Loads

Building load is the most basic condition to be considered in roof greening. In the study of roof

greening load, the main concern includes permanent load, variable load and roof planting load. Roof planting load should be included in permanent load[1]. The load safety of roof greening is the primary problem in the construction of roof greening. According to different forms of roof greening, it should be investigated and analyzed according to the corresponding construction and use requirements, as well as targeted load design and calculation should be carried out.

Generally speaking, the roof greening operation layer includes the roof root resistant waterproof layer, protective layer, water drainage retain layer, filtration layer, planting medium layer and vegetation layer (Figure 1). These combined loads need to be accurately calculated, and in practical applications, people flow and roof facilities should be taken into account. In addition, it is also necessary to pay attention to the possible loads caused by some special factors. For example, in the case of heavy rain and snow, rain and ice cannot be removed in time. It is necessary to understand the relevant information, determine the technical indicators, and finally unify the accounting and improvement to ensure the safety of building loads.

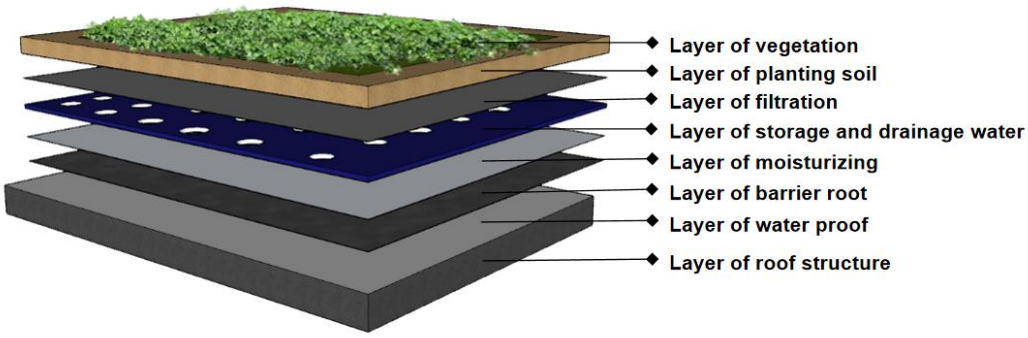

Figure 1: The schematic diagram of roof greening operation layer

2.2. Waterproofing Technique

The quality of roof greening waterproof is related to whether the building will face leakage and the user experience of roof greening. If the roof leakage is long-term or large area, it will affect the safety of the building. Setting up the roof greening waterproof layer can effectively avoid the leakage of rainwater and irrigation water. First of all, it is necessary to understand the waterproofing requirements. According to the provisions of Technical Specification for Planting Roof Engineering, the waterproof layer of roof greening should meet the requirements of first-level waterproofing, and the reasonable service life should not be less than 20 years [2].

In addition, the waterproofing design should also carry out waterproofing of roof covering and secondary waterproofing on its basis, and determine whether it is necessary to increase the protective layer according to the specific situation so as to avoid damaging the waterproof layer during the subsequent planting and greening construction. Attention should be paid to ensure that the materials of waterproof layer are firmly bonded in the construction of roof waterproof layer. When completed, the waterproof layer should be tested to determine that its waterproof function is qualified. Otherwise, remedial measures should be taken in time or the construction should be redesigned. Attention should also be paid to the waterproof treatment of some positions prone to water seepage, such as the vent and the corner of the daughter wall, and the key treatment should be carried out to prevent the secondary rework caused by ignoring small details [3].

2.3. Drainage and Water Storage Technology

Water storage technology is also the key link of roof greening, and the setting of water storage

layer can optimize the ventilation effect of soil. Reasonable drainage can effectively reduce roof water, thereby reducing roof load and waterproof pressure. Drainage technology can be used in the following ways. First, the terrain characteristics of roof greening are used to change the direction of water flow, so as to avoid the accumulation of water at a certain place. Second, in the construction, more drainage outlets should be built to enhance drainage capacity. Third, the water storage technology can be combined, and the water storage of roof greening is also necessary. The reasonable use of water storage technology can reduce the pressure of drainage, and can reasonably use water resources to provide water for roof greening plants when the soil is dry.

In addition, drainage materials and drainage system should be chose according to the actual situation and the type of roof greening. At present, the commonly used drainage and storage layers mainly include : (1) drainage (storage) water plate with two functions of drainage and storage; (2) drainage boards and ceramsites with drainage function only (used when weight permits); (3) drainage pipe (used when roof drainage slope is large)(Figure 2). In the roof greening project, if the construction of planting ponds, pools and other facilities is involved, the planning and design should be carried out under the premise of following the roof drainage and water storage system. The use of drainage and water storage system should not be affected, and the roof drainage outlet should be coordinated as far as possible to make it unobstructed.

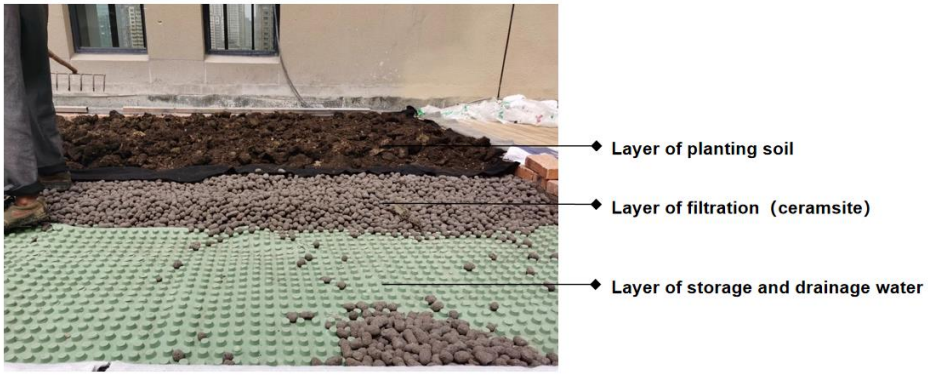

Figure 2: The construction drawing of roof greening

2.4. Planting Soil

In roof greening, the requirements of planting soil are different from those in general greening. Due to the limited load of roof greening, it is generally required to use as light and fertile soil as possible. Planting soil types generally include improved soil and artificial light planting medium. The improved soil has the advantages of light weight, good water retention and strong ventilation. Artificial light planting medium has the advantages of sanitation, clean and environmental protection.

After scientific research and analysis, under the premise of meeting the needs of plant growth and ensuring the landscape effect, the nutrient soil of 1:2:5 is generally adopted [4], and the current commonly used sawdust humus can be used to configure the soil. In order to reduce the pressure of roof bearing, it is necessary to ensure the thickness of soil to reduce the quality of soil. Besides, the depth of cover planted in the roof garden is recommended to be above the following minimum (Table 1):

Table 1: The depth of cover planted in the roof garden

Number	Types of plants	Depth of cover
1	Ground cover plant	15-30 cm
2	Flowers and shrubs	30-45 cm
3	Small tree (Height>6 m)	60-90 cm
4	Megaphanecophyte (Height>10 m)	90-150 cm

2.5. Plant Planting and Fixation

One of the key elements of roof greening landscape construction is plants. The natural environment they construct directly affects the user's sensory experience, and may have a potential impact on the user's psychology [5]. The limiting factors of roof greening plants are different from the ground. The construction of plants in roof greening is closely related to the load capacity and waterproof and drainage capacity of the roof. Therefore, in order to do a good job of plant planting and landscape effect, it is necessary to use appropriate plant planting technology.

On the one hand, appropriate plants should be selected before construction, such as plants with relatively developed fibrous roots, weak root penetration, high survival rate, wind resistance and drought resistance, and better dust retention ability. In addition, in the selection and purchase of seedlings, it is necessary to strictly check and accept the specifications, growth, diseases and insect pests of seedlings to ensure that the quality of seedlings meets the design requirements of drawings [6]. On the other hand, the construction site should be cleaned before planting, and then according to the construction drawings to start fixed-point laying, laying planting matrix and processing the original terrain. According to different plants, the planting pool is reasonably designed and the drainage pipe is well treated in the transformation. In the construction, the measuring instrument tools can be used to locate the position of plants according to the planting points on the design map. After determining the location of plants, lime is generally used in engineering to point or pile plants [5].

In addition, because the soil layer of roof greening is shallow and the root system of plants is not deep, the wind at the top of the roof is often greater than that on the ground, that is, the growth environment of roof plants is different from that of ground plants, and roof plants are more prone to dumping in extreme weather such as storms, resulting in injury or death of plants. Therefore, in the construction process, the metal mesh can be buried underground and bound to plants to be fixed, so as to enhance the grasping force of plants. The above-ground support rod fixation method, the above-ground traction fixation method, the embedded cable fixation method and the underground anchorage method could be used, or the combination of these forms can be chose for plant fixation (Figure 3).

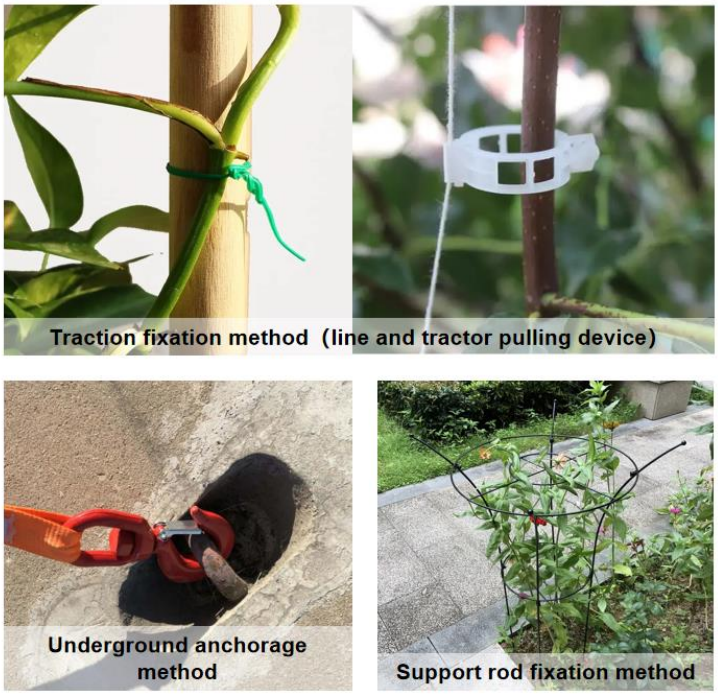

Figure 3: The method of roof greening plant fixation

3. Maintenance and Management of Roof Greening

Regular maintenance and management after the completion of roof greening construction is an essential measure in the whole process of roof greening, and also a key step to ensure the use function and landscape effect. The content, mainly include the maintenance and management of plants, landscape sketches, construction facilities and activity equipment in greening[7]. The details are as follows:

3.1. Daily Roof Plant Maintenance and Management

Timely irrigation of plants in roof greening, according to different seasons, soil moisture and other factors to determine the amount of irrigation and times[8]. Reasonable fertilization and try to use pollution-free green chemical fertilizer, reasonable fertilization should be considered according to the needs of different plants in different periods of growth and soil fertility.

Trees should be pruned regularly, and dead branches, leaves and excess branches should be treated to ensure the beautiful morphology of trees. For trees with special conditions, support should be used reasonably to ensure that they are not easy to fall, and to ensure the disaster resistance and safety of roof plants. Weeds and other exotic wild plants are regularly pruned and removed on the lawns. Replace new flowers withered or no longer landscaped.

Professionals are invited to regularly check the health status of plants, such as the discovery of plant infection diseases or moths. Effective measures should be taken in time to prevent the spread of adverse conditions by injecting pesticides into plants and spraying green environmental pesticides[9-10].

3.2. Winter Protection of Roof Plants

In winter, effective protective measures are recommended for plants with poor cold tolerance or

new plants still in infancy :

(1) Using straw rope or straw wrapping the trunk and some main branches of trees to prevent cold. Paying attention to continuous layer by layer wrapping, after winter according to the actual situation, should be removed after the late frost package.

(2) The application of lime and stone sulfur mixture to whiten the branches can reduce the damage to the sunny skin due to the excessive temperature difference between day and night, and also kill some overwintering pests and diseases [11].

(3) The establishment of wind barriers around plants can reduce the freezing and drought damage caused by the direct blowing and scraping of plants by the cold and dry wind in winter, and reduce the influence of cold wind on plants. Windbreak height to exceed the height of trees, generally with sorghum stalk and other materials to erect windbreak.

(4) For some areas where the soil is easy to freeze in winter, we can use the way of filling frozen water, that is, filling enough water before soil freezing, so that the soil around the tree root will form a frozen layer after soil freezing. The frozen layer can maintain the root temperature and reduce the damage to plants due to the rapid decrease of external temperature.

(5) If some plants are smaller, the larger basket or basin can be buckled outside the whole plant and covered with soil outside the basket or basin to prevent cold from penetrating through the gap, which can create a warm and suitable environment for plants and play a protective role.

3.3. Maintenance of Facilities in Roof Greening

For facilities and equipment systems in roof greening construction, regular maintenance are needed to ensure long-term use. The water storage pipeline system should be regularly checked to eliminate possible leakage and blockage. Due to the long-term exposure of building structures and ancillary facilities in roof greening, the surface is vulnerable to natural factors. In order to ensure the landscape effect, facilities inspection, surface repainting, parts replacement and repair are needed every other period of time. In addition, the water landscape of the roof also needs regular replacement of water, daily salvage of water leaves and other debris. In winter, more attention should be paid to the safety of roof greening, the prevention of frost cracking of water pipes, the timely removal of snow on the roof and the prevention of load problems.

4. Conclusion

Nowadays, the status of roof greening in urban greening has gradually increased, becoming the same category of urban landscape as ground greening. However, because the roof greening has its own particularity, it is different from the general ground greening in the process of construction and maintenance management, and it is different from the complexity and technical difficulty of ground greening. With the development of society and technology, the technical means related to roof greening are also constantly changing. New materials, new construction management techniques and schemes keep pace with the times. It can be said that the development momentum of roof greening is at a peak and the future development is expected. However, the existing problems of roof greening still need to be paid attention to, such as the management and cost of roof greening construction, green and sustainable building materials, safety protection setting and supervision of different buildings and the implementation of later maintenance management. Therefore, the current construction of roof greening needs to actively explore new technologies, integrate new technologies and use new materials in practical applications, standardize the whole design, construction and management process of roof greening, timely summarize experience and lessons, and strive to achieve better construction results.

Acknowledgments

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