

Research of Plant Carbon Fixation and Oxygen Release

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Abstract. Expressway service area is an important facility to provide various services for drivers and passengers on the expressway. With the rapid development of expressways in China and the continuous improvement of construction technology and operation level of service areas, more and more attention to the landscape design and plant ecological benefits of service areas. Based on the investigation of the capacity of carbon fixation and oxygen release of green plants in the service area of expressway, combined with the needs and characteristics of each functional area in the service area, this paper puts forward the basic principles and methods of low-carbon ecological landscape construction in the service area, studies the green plant combination mode in the service area, and improves the service level of green landscape and low-carbon ecology in the service area.

1 Introduction

With the rapid development of China's economy, the speed of highway construction and car ownership rate are increasing, and the carbon dioxide emissions are also increasing. Therefore, under the guidance of the concept of green transportation development, it is of great significance to reduce the carbon emission of transportation.

As an important service facility along the line, expressway service area is also a concentration area of carbon dioxide emissions. The absorption of carbon dioxide by photosynthesis is an important carbon sink method to reduce carbon emissions. At present, the design and construction of the service area is still in the level of meeting the functional requirements, and little attention has been paid to the ecological effects such as carbon sequestration and oxygen release of green plants in the service area. Although there are some researches on the carbon sequestration capacity of urban garden plants, there is a lack of research on the carbon sequestration capacity of plants in the highway area and service area combined with the regional characteristics.

With the increasing demand for the quality of Expressway travel, The service area not only needs to meet the traditional basic services such as rest, toileting and refuelling, but also needs to provide a pleasant and harmonious environment for the drivers, passengers and managers. Therefore, it is necessary to optimize the plant composition mode of service area according to the needs of different functional divisions on the basis of traditional greening design, combined with the ecological effect and landscape characteristics of plants.

Combined with the construction of expressway service area, on the basis of ensuring that the greening of service area meets the basic requirements, the project carries out research from the aspects of carbon fixation capacity of common greening plants in the area, low-carbon landscape construction of service area and plant combination mode, etc., to build low-carbon ecological service area.

2 Calculation of carbon sink capacity of green plants in service area

The commonly used methods for estimating carbon sink capacity of green plants mainly include photosynthesis rate estimation, leaf area index estimation and biomass estimation.

The photosynthetic rate estimation method is to determine the daily assimilation amount of photosynthesis of plants, and then calculate the daily fixed amount of CO₂ and the amount of O₂ released by plants. In general, photosynthetic apparatus can be used to measure the instantaneous time and efficiency of plants, and then the net assimilation of tree species on that day can be calculated by using the formula of net assimilation on that day.

Based on the leaf area index of a tree, the leaf area index estimation method deduces the ecological benefit calculation model of urban garden trees with the morphological characteristic index as the independent variable.

Biomass estimation is based on the establishment of the relationship between biomass and accumulation, so as to estimate the carbon reserves of plants. Generally speaking, the carbon sequestration of plants with large

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accumulation is also large, whereas the carbon sequestration is small.



Figure 1 photosynthesis measurement

3 Basic principles of low carbon ecological landscape construction in service area

3.1 Low carbon principle

In the process of landscape construction, carbon emission is inevitable. Therefore, in order to reduce carbon emissions, in the road construction, the staff need to conduct a comprehensive analysis of the terrain, to adapt to local conditions, and reduce the number of unnecessary mechanical operations. At the same time, vegetation protection should be strengthened.

3.2 Principle of environmental protection

In the construction of low-carbon ecological landscape, material selection is an important basic link in the garden construction. The material procurement personnel should try to select materials that are both high-quality and environmental protection, strictly control the cost of materials, preferably do not use wood, try to use new materials instead, so as to protect the natural environment.

3.3 Economic principle

In the construction of the project, the material selection should protect the economy, and after the completion of the project, it is also necessary to strictly control the cost of later maintenance and maintenance. For example, for the pruning of plants, we can try our best to plant plants that do not need to be pruned or grow slowly in order to reduce human and financial consumption. During the construction of landscape projects such as service area and interchange area, the original ecosystem should be kept as much as possible to ensure the diversity of plants.

4 Effective measures to construct low carbon landscape in service area

4.1 Pay attention to energy conservation and emission reduction

4.1.1 Low carbon ecological landscape lighting can make full use of clean and renewable energy such as solar energy and wind energy. If photovoltaic panels are used to generate electricity, the electricity generated by sunlight in the daytime can meet the lighting requirements at night. The lighting lamps on both sides of the road in the service area are wind solar complementary power generation lamps, and ground source and air source heat pumps are used to regulate the indoor temperature to reduce energy consumption.

4.1.2 Low carbon ecological landscape can make full use of natural lighting, natural ventilation, building insulation and other ways to achieve energy conservation and emission reduction of buildings in the Expressway service area. For example, public toilets can be open or semi open. In addition, setting a garden on the roof or adopting vertical greening can not only achieve the effect of heat preservation, but also make the building look vigorous and proud. When people walk and rest in it, they will have a fresh and natural feeling.

4.1.3 Low carbon ecological landscape adopts low-carbon, durable and recyclable materials. The carbon emission of materials should be considered from the whole life cycle. Therefore, when choosing building materials, we should not only consider the carbon emission in the use process, but also consider the carbon emission in the production process. In addition, reasonable use of all available materials in the garden construction site to reduce the use of new materials.

4.1.4 The construction of service area pursues the effect of landscape creation, but also pays attention to water management. Intelligent management of water can achieve the effect of energy conservation and emission reduction. The main measures are to collect and reuse rainwater and strengthen the management of sewage. Establish a comprehensive management system for rainwater and sewage. After the wastewater is treated, it will be converted into recycled water, and then these high-quality recycled water will be used for landscape greening in the service area.

4.2 Enhance the carbon sink capacity of plants

Carbon sequestration is one of the main functions of road and service area landscape. Therefore, low-carbon ecological landscape gives full play to the carbon sequestration capacity of garden plants, and collects and stores greenhouse gases in the air in their roots or soil, which is one of the most economic carbon reduction methods. Vegetation and soil are the main components

of green space to play the carbon sequestration function. Therefore, in order to achieve the carbon sequestration function of urban green space, it is necessary to plant, replant and maintain it reasonably to avoid too fast carbon emission. The plants with different root system and different root depth should be planted in garden green space to maximize the carbon sequestration per unit area. In addition, planting trees of all ages in the same green space can enhance the stability of carbon sink. In addition, in the maintenance process, reducing unnecessary maintenance behaviors such as mechanical weeding and defoliation removal can not only allow plants to grow naturally, but also maximize their carbon sequestration capacity.

4.3 Focus on ecological diversity

Ecological diversity is the focus of all low-carbon ecological landscapes. The more complex the ecological environment is, the stronger the period stability is and the stronger the ability of self survival and development is. Low carbon ecological landscape emphasizes the diversity of ecological layout, so as to improve the ability of survival, adjustment, recovery and development of Road area and service area landscape.

4.4 Reduce the carbon cost of ecological landscape maintenance

The choice of materials and the planning of ecological landscape management will affect the carbon cost of ecological landscape maintenance. The carbon cost of the project during the construction period is usually one-time cost, while the carbon cost during the maintenance period is continuous, which can last for more than ten years, decades or even hundreds of years. The green plants in the nature are growing and changing continuously, but in order to meet the requirements of water and soil conservation function and aesthetics, the construction of road ecological landscape often needs to keep them in a certain state, usually using irrigation, fertilization, pruning and other means for long-term maintenance, resulting in continuous carbon dioxide emissions. If more consideration is given to the principles of landscape ecology at the beginning of design, and ecological, sustainable and self-sustaining methods are used to adapt to the changes of ecosystem (such as geological change, climate change, etc.), it is possible to control the carbon cost required for the long-term maintenance of ecological landscape in the road area and service area under a relatively low standard. For example, designers can use grassland to replace artificial lawn, increase plant diversity, three-dimensional greening, multi-purpose trees, select appropriate plant varieties for extensive management, etc., which can not only effectively reduce the carbon cost of maintaining green space, but also maintain the openness and overlapping of the garden.

5 Effective measures to construct low carbon landscape in service area

Through the comparative analysis of the carbon and oxygen sequestration and release capacity of green plants suitable for supporting projects, the carbon and oxygen sequestration and release capacity of alternative plants can be obtained. When the service area is arranged with green plants, not only the ecological characteristics of green plants need to be considered, but also the needs of each functional area of the service area need to be combined. The main and auxiliary road separation zones in the service area mainly need green plants to play the role of barrier and shelter, and need the function of sound absorption and dust collection in the ecological aspect. In the parking area, the greening plants need to play an isolation role, provide excellent shade, and meet the driving requirements at the branch points. The greening plants around the service area complex building need to provide functions such as beautification and shading. Meanwhile, it is required that the plants themselves are harmless to human body and their roots do not affect the buildings. Around the gas station, the main function of greening plants is greening coverage, and its root system is required not to affect the main structure and use function of the gas station. For leisure and ornamental areas, the allocation of green plants needs to fully consider its landscaping function, requiring plants to form comfortable, beautiful, fragrant, suitable for people to stop and other functions, in addition, plants need to provide shade and harmless to human body.

According to the above research conclusions and the needs of service area landscape, the internal functional space of service area is classified. According to the service function characteristics of each functional space, the main green plant combination mode based on the needs of ecological landscape is proposed.

6 conclusion

The expressway service area is the extension and window of the city, which provides necessary services for the travelling drivers and passengers. With the concept of green, environmental protection and ecology getting more and more popular, it is imperative to build a low-carbon ecological service area. This paper starts with the research on the benefits of carbon fixation and oxygen release of green plants in the service area, puts forward the principles and methods of building low-carbon ecological landscape in the service area, and gives the green plant matching mode combined with the functional requirements of different functional areas in the service area. It provides a reference for the construction of green and low-carbon ecological service areas in China.

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