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# A brief analysis method in plant landscape design of motorway

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**Abstract.** Plant landscape design is one of the main contents of highway design. This paper sums up the principles and methods for plant landscape design based on the compositions of expressway landscape, and discusses in detail the point of plant landscape design for the green belt on both sides of the expressway, the central separation belt and the subsidiary green area.

## 1. Introduction

Plant landscape design plays an important role in highway landscape design, which is mainly reflected in beautifying road environment, fixing soil slope protection, dust retention and noise reduction, reducing road temperature, preventing glare and so on. In the *Design Specifications of Highway Environmental Protection* (JTG B04-2010), it is clearly pointed out that: "The purpose of highway greening is to mitigate various influences brought to the areas along the road by highway construction and operation, protect the natural environment, improve the living environment, and improve the safety and comfort of highway traffic through greening.

Based on the landscape composition of the expressway, this paper discusses the plant landscape design methods, include the two sides of the expressway, the central isolation zone and the subsidiary green area.

## 2. Principles of highway plant landscape design

### 2.1. Selecting suitable tree species for sites

The environment on the highway is relatively bad because of the large amount of automobile exhaust. It is not conducive to the growth of plants. highway landscape is a long-span zonal landscape. It is relatively difficult to maintain and manage green plants, except for some important nodes. Therefore, selecting suitable tree species for sites, is a key principle in the design. That means it is need to choose native tree species which suitable for the local environment and strong resistance of tree species.

### 2.2. Sustainable principle

The sustainable principle is to integrate environmental protection thoughts and ecological design concepts into design, to achieve a reasonable combination of trees-shrubs-herbs, a reasonable combination of fast-growing tree species and slow-growing tree species, so as to create a stable ecological plant community with multiple tree species, multiple levels and multiple functions.

### 2.3. Security

This is one of the most basic principles in highway plant landscape design. On the one hand, it should be designed on the premise of satisfying the function of expressway traffic. on the other hand, reasonable plant landscape construction can also improve the driving safety.



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## 2.4. Integrity

It is needed to integrated planning, comprehensive consideration of the whole line of natural conditions and regional characteristics. In order to meet the basic requirements of ecology, protection and aesthetics, we should try our best to achieve the perfect unity between cultural landscape and natural landscape in the design.

## 3. Key points of highway plant landscape design

### 3.1. Green belts on the roadside

The planting design of roadside plants mainly includes the isolation grid, slope, edge ditch, cutting, broken platform and other parts. Its main purpose is to protect the roadbed slope, stabilize the roadbed, reduce soil erosion, enrich the highway landscape, isolate the outside interference. The following points should be paid attention:

- The soil slope should be planted with barren perennial herbs and low shrub with strong local adaptability for soil consolidation and slope protection.
- Vertical greening materials can be used to cover the stone slope of cutting excavation to increase the aesthetic feeling. Such as *Mucuna sempervirens*, *Parthenocissus tricuspidata*.
- For the purpose of protecting and beautifying the road, it is appropriate to plant small shrubs with strong adaptability and extensive management. Such as *Distylium racemosum*, *Ligustrum japonicum* 'Howardii', *Rosa multiflora*. Paragraphs should be justified.
- The lateral greening of the edge ditch mainly considers the function of ecological protection and beautifying the environment. Shallow-rooted flower shrubs can be planted. Such as *Nerium oleander*, *Prunus cerasifera f. atropurpurea*.
- The field of view of the falling table is relatively prominent, mainly planting native flower shrubs and liana plants.
- With the main purpose of protecting, enriching the landscape of the road area, vertical greening can be carried out with local vines with strong adaptability.

### 3.2. Central separation green belt

The central separation belt is located between two opposite lanes. It should consider preventing glare and landscape effect in designing plants. So as to ensure the safety of driving at night and beautify the road appearance. The central separation belt is the closest to the driver, therefore it is the most important part of the highway plant landscape design. Reasonable plant collocation can reduce the driver's sense of fatigue and tension. These plants can also play a part in purifying air and reducing noise.

#### 3.2.1. Key points of planting design in central separation belt

The central separation of green belt design points mainly have the following points:

- The central separation green belts are so long and narrow, in addition, the speed of traffic on the highway is so fast. Frequent changes of plant species are easy to cause visual confusion for drivers. And if the plants are too monotonous, drivers will feel tired. Therefore, regular planting design should be considered in the planting design of this area. Generally, every 15km is a planting unit. The same regular plants can be planted within this range, and the plant configuration can be changed for the next 15km. This allows drivers and passengers to create a sense of rhythm and rhythm, giving people a sense of beauty.
- When the width of the separation belt is less than 3m, the space is small, so it is not suitable for natural layout, and the regular design is the main one (Fig 1). When the width of the separation belt is longer than 3m, the space is relatively large, and it is usually based on natural configuration.

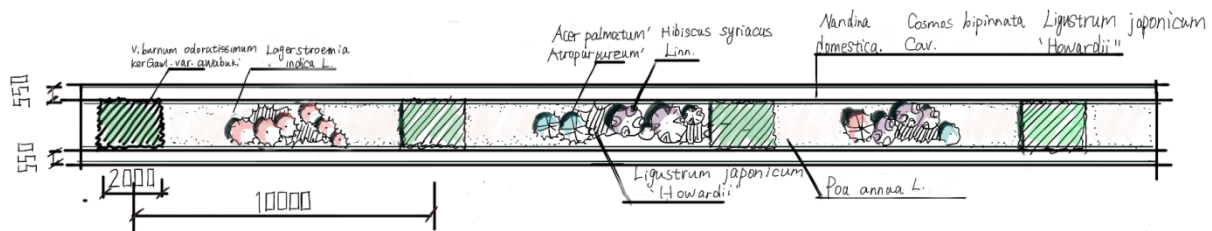


Fig 1. Central separation zone regular greening

- In order to prevent dazzle, the height of planting plants should be controlled reasonably. The plant height of anti-dazzle function is generally required to be about 1.6m, and the plant height will be determined to be about 1.8m at the bend or the section with longitudinal slope.

### 3.2.2. Selection of tree species in the central separation green belts

The tree species in the central separation green belts can be divided into anti-glare plants and matching plants. Anti-glare plants should be mainly evergreen shrubs, with dense branches and leaves, slow growth, wind resistance and drought resistance. The matching plants can beautify the road, adjust and alleviate the visual fatigue. It is appropriate to choose the shrubs or small trees with beautiful shape, long flowering period and pruning resistance. Table 1 and Table 2 respectively list some species of anti-glare plants and matching plants.

Table 1 Selection of anti-glare plants

Name	Distribution	Landscape effect
<i>Photinia serrulate</i>	Yellow River basin and south area	Evergreen hedge
<i>Viburnum awabuki</i>	The Yangtze River basin and its south	Evergreen hedge
<i>Platycladus orientalis</i>	All over the country	Evergreen hedge
<i>Euonymus japonicus</i>	The Yangtze River basin and its south	Evergreen hedge
<i>Pittosporum tobira</i>	The Yangtze River basin and its south\Coastal areas	Evergreen hedge
<i>Pyracantha fortuneana</i>	Yellow River basin and south area	Ornamental fruit shrubs
<i>Ligustrum quihoui</i>	North,northwest, southwest,central China, etc	Deciduous hedge
<i>Berberis thunbergii</i>	All over the country	Deciduous hedge
<i>Distylium racemosum</i>	The Yangtze River basin and its south	Evergreen hedge

Table 2 Selection of matching plants

Name	Distribution	Landscape effect
<i>Lagerstroemia indica</i>	Yellow River basin and south area	Small trees that bloom in summer
<i>Cassia alata</i>	he Yangtze River basin and its south	Small trees that bloom in autumn and winter
<i>Hibiscus syriacus</i>	he central provinces of China	Small trees that bloom in summer
<i>Prunus salicina</i> 'Atropurpurea'	All over the country	Small trees with red leaves
<i>Acer palmatum</i>	Provinces of East, central and Southwest China	Small trees that turn red in autumn
<i>abina chinensis</i> . cv. Kaizuca	he Yangtze River basin and its south	Small evergreen tree with beautiful shape
<i>Sophora japonica</i> var. <i>pendula</i>	All over the country	Small evergreen tree with beautiful shape
<i>Berberis thunbergii</i> var. <i>atropurpurea</i>	All over the country	The shrub with red leaves

<i>Ligustrum × vicaryi</i>	South, East and Central China of North China	The shrub with yellow leaves
<i>Amygdalus persica</i> var. <i>persica</i>	All over the country	Small trees that bloom in spring
<i>Chaenomeles speciosa</i>	All over the country	Spring-flowering shrubs

### 3.3. *Subsidiary green area.*

In the critical area of expressway, such as interchange area, service area, tunnel, etc., the plant landscape should be designed separately.

#### 3.3.1. *Plant landscape design for interchange area*

Interchange is the part with the largest site, the best site condition and the most flexible landscape setting in expressway landscape design. Interchange is usually located at the entrance or fork of the highway, where the speed of vehicles slows down, Passengers can enjoy the view for a long time, and have a panoramic view of the landscape. Therefore, the design of this part should pay special attention to the ornamental value under the premise of satisfying the driving function. The greening design of interchange areas usually takes the following three forms:

- Hedge shaped: This form is use of pruning and shaping evergreen shrubs to form geometric patterns, show concise and lively, grave, atmospheric effect. But this green form need high maintenance management requirements, also can't meet the requirements of biological diversity, it is not suitable for large area application, can use small area in a particular location or match with other forms of two kinds of use. but can be used in a particularly small area or match with other two forms of use.
- Nursery garden: That is, one or several trees and shrubs were planted in neat patches. The advantage of this form is that it is easy to plant and does not require much maintenance and management. However, it is not highly ornamental and suitable for use in places where the visual viewing point cannot be noticed.
- Natural community: This is the latest greening model. To simulate the natural growth of plant community, and makes reasonable collocation of trees, shrubs and shrubs to achieve the combination of woody and herb, evergreen tree and deciduous tree, arbor and shrub, ornamental tree and ornamental tree. In order to facilitate management, we should reduce the amount of lawn as much as possible, and replace it with a variety of ground cover plants. In terms of tree species selection, we should make it "easy to live, easy to plant, well managed and good-looking". This way can fully reflect the ecological benefits, is a more recommended way of planting in recent years.

#### 3.3.2. *Plant landscape design of service area*

The service area is one of the few areas in the expressway for people to stop and watch, the courtyard design method can be adopted. It can be landscaped with the combination of regular and natural design, so as to adjust the abrupt conflict between the building and the surrounding natural environment. Moreover, it can be according to the regional characteristics to express the local cultural characteristics through planting design. For example, the overall style of the Yangcheng Lake service area in Jiangsu completed in 2019 is dominated by jiangnan garden style, with the design of the building facade based on the elements of Jiangnan folk houses, and the external landscape recreation space created by muxi garden, Lotus Garden and bamboo garden.

#### 3.3.3. *Plant landscape design for tunnel entrance and exit*

The greening design of the entrance and exit of the tunnel includes the key design of the central separation zone, the design of the roof and the side of the entrance and exit. Tall trees can be planted on both sides of tunnel entrance to reduce the interference of "black hole" effect on drivers. The preparation

of the roof of the cave and both sides of the cave should be coordinated with the mountain vegetation to achieve a natural transition, and the function of protecting the solid slope should also be considered.

#### 4. Conclusion

Plant landscape design is one of the main contents and key points of highway design. Because of its special zonal distribution and dynamic viewing characteristics, expressway landscape has its special requirements and principles in plant landscape design. The design should be based on the principle of safety first, the principle of integrity as the foundation, the principle of sustainable development as the pursuit, and the principle of Selecting suitable tree species for sites as the guidance. The design of the green belt on both sides of the road should take into full consideration as aesthetics, dust retention, noise reduction and soil and water conservation. The main purpose of the greening design of the central separation belt is to prevent glare interference, guide the line of sight and beautify the highway environment. The plant landscape design of subsidiary green area is mainly to meet the requirements of beauty and harmony with the surrounding environment. Clarifying the functional requirements and objectives of each part helps to form a clear thinking in design. With the rapid development of economy, people pay more and more attention to the impact of economic construction on the environment and pursue sustainable development, which puts forward higher requirements for plant landscape design. The plant landscape design of China's expressways still needs to advance in continuous exploration and development.

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