Visual aesthetic evaluation of highways in subtropical mountains areas

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Abstract: With the development of economy, the road construction of our country gets a rapid progress. Especially in mountain roads, the influence of road construction on environment has increasingly been focused. The environmental problems of road construction on project are mostly embodied in those problems of water, air, and ecology. landscape, this paper is taking the Baise-Leye highway as the study area, using the remote sensing and uc-winroad to assess the view of highway. The landscape consideration of public roads mainly focuses on the internal coordination and the protection and use of topography. The purpose is to form highways with smooth and changeable visual landscape corridors.

1. Introduction

Ecology investigation is the base of environmental impact assessment of highway construction. The core content is also the focus and heat of ecological research at home and abroad. Ecological problems arising from road construction and operation, due to wide spatial range, long duration, high ecological monitoring and evaluation costs. The reason is that road ecological impact assessment has been difficult to be accurate and quantitative. Remote sensing (RS) in all types of scale, long-term monitoring with the advantages and low cost, and its monitoring indicators are stable, Geographic Information System (GIS) has a strong spatial analytical function make the analysis of highway ecological impact more scientific. Therefore, RS and GIS can solve traditional roads well. This paper is taking into account the natural and social environment along the Baise-Leye highway, combined with 3S technology, through the field survey and remote sensing image analysis, the characteristics and distribution of the natural landscape resources and human landscape resources of the project are extracted.

2. Construction of evaluation index system

Based on the principles of science, reality, operability, comparability, conciseness and comprehensiveness. According to the results of the investigation and collection and monitoring, a comprehensive evaluation index system will be formed. Landscape evaluation of road high-grade highways is a multi-level and highly integrated evaluation system. In actual project application, the selection of specific indicators varies with the different aspects of landscape evaluation of different projects. In the evaluation process, a hierarchical evaluation system is constructed according to the characteristics of the evaluation area and the overall target requirements for evaluation. According to the specific content of the “Environmental Impact Assessment Standards for Highway Construction
Projects”, the first-level indicators that constitute landscape quality are divided into three aspects: the road itself, the background landscape on both sides of the road, and the artificial landscape on both sides of the road. The secondary vegetation is finalized according to the typical characteristics of the project, namely the high-grade highway in the karst area. According to the above factors and referring to the principle of landscape evaluation, screening is performed, and finally several factors are selected. The road itself includes the road's own factors, such as closure, curvature, etc.; slope conditions, such as slope height, slope length, slope and so on. The background landscape on both sides of the road includes topography, vegetation, ecological environment damage and water conditions. The human landscape, urban landscape, historical and cultural monuments on both sides of the highway, the impact of highway construction, such as the degree of damage, scenic spots and mining landscapes.

![Diagram of Level 1 indicator of landscape evaluation system](image)

Fig 1. Level 1 indicator of landscape evaluation system

3. Conditions for the formation of landscape visual impressions

3.1 Viewpoint

The viewpoint is a place where the aesthetic subject views the visual object. It is an objective point in visual behaviour. Any point on the highway's driving trajectory can be called a viewpoint, and it does not transfer by human will. As an important viewpoint field of regional cognition, the expressway should try to make the aesthetic subject easy to see at the viewpoint, so as to form a good visual impression in the mind, and use this as a value benchmark. In the landscape planning, the viewpoint is drawn concept. For the same view object, the difference in the viewpoint position will cause a great difference in the landscape seen, which shows that the viewpoint occupies a very important position in landscape planning. The viewpoint changes the landscape, because the landscape is what you see at the viewpoint. This is extremely important for the difference in the landscape, which can be used to distinguish between good and bad viewpoints. The middle-scale problem is the focus of highway ecology research, with a scale of about 200-1km, mainly related to the vegetation characteristics along the highway, including the direct and indirect effects generated during road construction and operation. In addition to the direct damage to the habitat caused by the land occupation, it is more important to affect many ecological factors, thus indirectly affecting vegetation and movement.
3.2 Sight
The visual field is the visual range of the aesthetic subject before its visual axis is obstructed at a certain point of view. The visual field of the highway can be understood as the range of sight of the aesthetic subject on the flowing viewpoint of the highway. For the highway landscape experience, there are two main factors that hinder the aesthetic subject's sight, namely the visual barrier and the visual axis obstacle. The visual barrier exists in the highway space and can be removed by landscape preparation. The visual axis barrier exists outside the highway space, such as off-road billboards, buildings, or other towering objects, which will obscure the vision of the aesthetic subject and make the viewing change. It is difficult, because these obstacles are not within the scope of highway land, so they can only be avoided in route planning.

4. Result
In order to complete the research purpose, the project team selected two key sections of Baise-Leye highway (K143 + 360 ~ K156 + 878 and Lingyun section K115 + 200 ~ K125 + 795) respectively in accordance with the design documents, and set up 3D road scenes to carry out The driving simulation experiment was completed, and based on the analysis of the experimental data, the safety evaluation of the two road sections was finally completed.

Based on the design data of plane, longitudinal and cross sections in the design file, 3D real-world models of two test roads were built in the UC-WinRoad driving simulation 3D modelling software.

![Fig 2. Plan and top view of Lingyun section test road](image)

5. Conclusion
Affected by the difficulty of data collection and acquisition, the speed consistency evaluation in traditional road safety evaluation is based on design documents, and the road is divided into different test sections. The present model is used to calculate the speed change of the vehicle as it passes...
through the road. Then use the speed difference between the forward and backward sections and the
difference between the predicted running speed and the design speed for analysis and evaluation.

Research on driving simulation experiments, build a three-dimensional road model through 3D
real-world modelling, and then carry out driving simulation experiments in a driving simulator. The
device can collect and obtain all operating behaviour data of the driver while driving on the entire road.
So there is no need to pass to analyse the predicted running speed, it is only necessary to analyse the
driving behaviour data of all experimental subjects.

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