

Research on the Integrated Evaluation System of Mountain Highway Landscape Coordination Based on Three-Dimensional Linear

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Abstract. Harmonious coexistence between man and nature is an important principle for urban construction and development. At present, as people's demand for mountain expressways increases, the concepts of environmental protection, landscape aesthetics and traffic safety have gradually penetrated into highway construction and operation, and have been highly valued by all sectors of society. To comprehensively understand the coordination of mountain highway landscape, put forward effective improvement strategies according to specific problems, and construct a perfect comprehensive evaluation system of mountain highway landscape coordination, which can provide basic guarantee for local tourism construction and economic development.

Keywords: Landscape Coordination; Comprehensive Evaluation; A Mountainous Area; Highway; Transportation Facilities; Roadside Safety.

1. Introduction

As an important channel for the circulation of people and materials, highway is a large-scale linear landscape. Its development can not only provide convenient conditions for people, but also increase the contradiction between social development and natural ecological environment. Under the background of the concept of harmonious coexistence between people and society, the public's demand for mountain expressways is not only reflected in basic functions such as character transfer, but also puts forward service needs such as environmental protection, landscape aesthetics, and traffic safety, and the work requirements of highway construction and operation are getting higher and higher. In order to effectively protect the natural ecology and cultural landscape resources around mountain expressways and ensure the sustainable development of highway projects, the design concept of people-oriented, respecting history and respecting nature was gradually put forward during the construction and management period. The relevant national policies also put forward relevant requirements for this content, and regarded the control of unreasonable resource development activities as the focus. We strengthened ecological protection of oceans, grasslands, forests, land and water resources.

The construction of a supervision and coordination comprehensive evaluation system for mountain expressways has the following practical significance: First of all, it provides a new idea for the theoretical research on expressways, systematically collates professional theories such as road and ecology, landscape coordination, and highway landscape, deeply discusses the characteristics and existing problems of landscape coordination design of expressways in mountainous areas, defines landscape coordination of expressways in mountainous areas, and provides a basis for the research on highway construction and management in the new era. Secondly, it is helpful to understand the development status of mountain highway landscape coordination, conduct a comprehensive assessment of existing design cases, and compare the landscape characteristics of mountain highways in different regions, so as to put forward more effective improvement strategies; Finally, the

comprehensive evaluation problem is divided into two parts: on the one hand, it is based on the evaluation object index system research, and on the other hand, it is based on the evaluation method research. The former is the personality of the research evaluation object, which is highly professional and targeted, and the latter is the commonality of the research evaluation object, which is rich in theory. At present, the mountain highway landscape evaluation research mainly focuses on these two aspects. The existing evaluation methods are directly applied to study and explore, and the application methods are not adjusted according to the characteristics of different objects. The three-dimensional linear construction of mountain highway landscape coordination evaluation system can provide a new idea for the comprehensive evaluation of highway landscape.

When Germany designed the highway in the 1930s, it was already recognized that the highway construction would affect the surrounding ecological environment and landscape structure, so it paid great attention to its coordination with the roadside landscape during the construction management. In the 1960s, the German Police Engineering Committee proposed the road service standard, which clarified the design problems of the highway landscape; The Federal government of Germany has also improved its environmental policy and related legal system, formulating the Federal Nature Protection Law in the mid-1970s, and revising it in the late 1980s, adding landscape protection plans for wildlife plants, wetlands, forests and other aspects. The United States began to build landscape roads in the 1920s, which opened the prelude of highway landscape design research. In order to ensure the coordination of highway and land ecological environment, the relevant institutions put forward the guidelines of highway landscape development in the early 1960s. In the mid-1980s, the Federal Highway Administration also issued visual impact assessments for highway construction projects, requiring all highway construction projects to conduct aesthetic and visual quality impact assessments prior to design and operation. These laws and guidelines have accelerated the development of highway landscape aesthetics and provided a new basis for the development of highway landscape coordinated design. Therefore, based on understanding the current research status of road landscape construction in China, this paper mainly explores the three-dimensional linear integrated evaluation system of mountain highway landscape coordination according to the current application of mountain highway landscape coordination evaluation, and finally verifies the feasibility of the design and evaluation method of mountain highway landscape coordination combined with practical cases.

2. Method

2.1 Highway Landscape Classification

Highway landscape is a comprehensive subject including engineering, traffic science, psychology, aesthetics and other fields. Some scholars regard it as a heterogeneous land area composed of a group of ecosystems that repeat and interact in a similar way. According to research methods and perspectives, the classification forms of highway landscape components are shown in Figure 1 below:

Highway landscape	Natural landscape	zoon	Human beings themselves, rare birds and exotic animals, general animals, etc	
		plant	Grassland, forest, ancient wood, pine, local plants, etc	
		Water body	Rivers, lakes, seas, beaches, waterfalls, streams and so on	
		The sky is in season	Clouds, rain and snow, sunrise, sunset, seasons change, etc	
		landform	Snow-capped mountains, desert Gobi, plain hills, rocky cliffs	
	Cultural landscape	Virtual landscape	Monuments and ruins, myths and legends, poems, anecdotes and so on	
		Figurative landscape	Landscape along the way	Regional customs, ceremonial costumes, local architecture, etc
			Highway landscape	Bridge tunnel, vehicle pedestrian, road alignment, etc
			Environmental art	Vegetation, greenery, sculpture, sketch, advertising, etc

Figure 1. Constitutive elements of highway landscape

2.2 Functional Requirements of Mountain Highways

With the steady development of society and economy, the functional demand of the public for mountain expressways has changed, gradually shifting from traditional simple commodities to safe transportation. At present, it is developing in the direction of satisfying the coordination of highway landscape and ecological environment as well as comfort. Functional demand at different stages is shown in Figure 2 below:

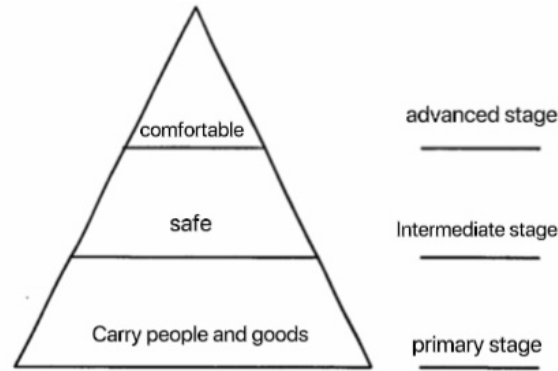


Figure 2. Functional requirements of mountain highway

2.3 Research Content of Highway Landscape Coordination

Table 1. Survey contents of landscape coordination of mountain expressway

Serial number	Research project	Specific content
1	Landscape coordination data	Collect domestic and foreign road city ecology, highway landscape design and other related materials, learn from similar highway landscape design projects at home and abroad
2	Road survey and design data	Consult the road survey and design data, harvest the main economic and technical indicators of the road, combine the natural and human environment along the road and other factors to segment the road and select the survey points, so as to improve the efficiency and quality of the survey
3	Humanistic social environmental data	To understand the status quo of social and cultural environment along Xiangxi tourism Highway, investigate the nationalities, customs, population distribution and economic conditions along the highway
4	Current situation of natural environment	The present situation of natural environment along Xiangxi tourist highway was investigated, including landform, climate condition, soil resources, river system, vegetation type, vegetation coverage rate, etc
5	Wild animals and plants	The wild animals and plants in the road city were investigated, their living habits were understood, and the influence of road construction on them was analyzed
6	Road structure	The types of structures, safety measures, formal beauty and environmental coordination of Bridges, tunnels, route crossings and other roads are investigated
7	Temporary site	Investigate the scale, distance from the road, protective measures, vegetation coverage, the length of the temporary road, the original appearance and current situation of the land, and protective measures
8	Side slope	The length, height, slope, protective measures, vegetation coverage and background integration of the slope were investigated
9	Landscape resources	The types, aesthetics and utilization status of landscape data along the highway were investigated
10	tourist	The travel mode and activity characteristics of tourists are investigated
11	Public opinion	The living customs of residents along the tourist highway and their opinions on highway construction were investigated
12	Other factors related to landscape harmony	The evaluation value of each evaluation index is measured on the spot and consulted by experts

In order to understand the status quo of ecological cultural environment and landscape resources along mountain expressways, several local highways with regional characteristics are selected for investigation, and the investigation contents are shown in Table 1.

In the study of the above content, the staff can follow the following steps: First, select the research section. After understanding the local geographical location, plant characteristics and resource content, several typical mountain expressways are selected as the research objects. The length of the selected highway should be suitable, and the address, landform, vegetation and customs and culture of the whole route should be closer to each other. After comprehensive consideration, the research steps are designed and each connecting line is divided into a research section. Secondly, the research preparation. Sort out and analyze highway survey and design data, highway environmental impact reports, statistics, yearbooks, etc., and lay a solid foundation for field research after clarifying the basic conditions of the main technical and economic indicators, human environment, and regional nature of the road; Finally, the field research began. Prepare professional instruments, such as GPS, digital cameras, laptops, mobile hard disks, buses, etc., professionals systematically study the local ecological environment, human environment, and road landscape, use cameras to photograph the road landscape during the process of vehicle driving, shoot vision, and try to be consistent with the driver's career. It can fully display the overall landscape design by using landscape, greening and traffic facilities, and organize the recorded information into a book to provide reference for subsequent research.

2.4 Comprehensive Evaluation System of Mountain Highway Landscape Coordination

When constructing a three-dimensional linear mountain highway landscape coordination comprehensive evaluation system, it is necessary to conduct comprehensive thinking according to the function, characteristics and research status of the highway. After following the basic principles of feasibility, independence, simplicity and systemization, the objective decomposition method and del illegal construction of mountain highway landscape coordination comprehensive evaluation system are adopted. According to the objective decomposition method, a hierarchical index system composed of target layer, target layer, criterion layer and index layer is selected. Three objectives should be formulated according to the coordination between highway landscape and natural environment: Firstly, it refers to the coordination between highway landscape and operation safety, secondly, it refers to the coordination between highway landscape and visual environment, and finally, it refers to the coordination between highway landscape and ecological environment. After comprehensively considering various influencing factors of mountain highway safety transportation, the evaluation indicators as shown in Figure 3 are constructed according to landscape classification, route rationality, facilities, safety and other indicators:

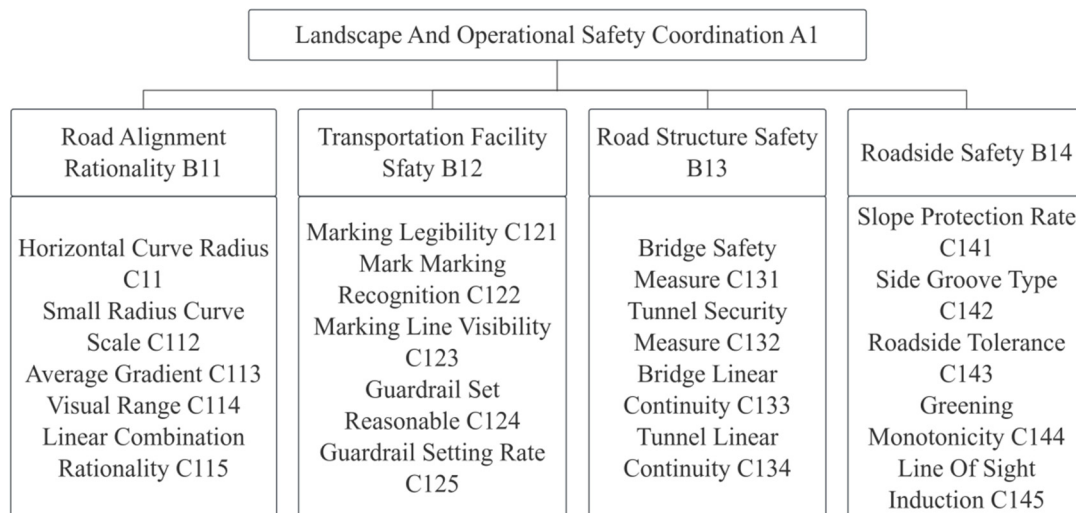


Figure 3. Structure of evaluation index

Due to the large number of indicators selected at the initial stage, the low feasibility of some indicators, and the relevance problems of some indicators, it is necessary to use the improved system to effectively screen, invite experts and scholars in various fields such as traffic safety, landscape environment, and road engineering to conduct comprehensive evaluation, and score according to the degree of political leaders. Finally, the evaluation system as shown in Table 2 below is obtained:

Table 2. Comprehensive evaluation index system of mountain expressway landscape coordination

Target layer	Subtarget layer	Paraclinic bed	Index level
Tourism highway landscape and environment coordination	Landscape and operational safety coordination	Road alignment rationality	Stadia
			Minimum radius of a flat curve
			Average grade
			Linear combination rationality
		Traffic facility safety	Traffic signs are set up reasonably
			Effectiveness of traffic marking facilities
			Guardrail setting rationality
		Road alignment rationality	Structural safety measures
			Linear continuity before and after the structure
		Roadside safety	Roadside tolerance
			Line of sight inducement
	The harmony of landscape and visual environment	The beauty of the road itself	Alignment and terrain integration
			Slope and background compatibility
			The integration of structure and environment
			Traffic signs and environment integration
		Ecological landscape aesthetics	Vegetation naturalness
			Ornamental water area
		Aesthetic degree of human landscape	Topography and geomorphology ornamental
			Custom and culture
	Landscape and ecological environment coordination	Topographic and geomorphic effects	Local architectural features
			Earthwork per unit mile
		Drainage effect	Intensity of soil erosion
			Water quality
		Animal and plant influence	Water system connectivity impact
			Vegetation coverage
			Vegetation community stability
			Localization rate of greening species
			Animal barrier effect

3. Result Analysis

3.1 Practice Cases

Taking the mountain expressway of a certain region as an example, it is a representative mountain tourism highway. The evaluation indicators are selected according to the basic principles of feasibility and safety, and the contents are finally obtained as shown in Table 3 below:

The fuzzy comprehensive evaluation method is used to evaluate the coordination of mountain landscape, and it is found that this method is very suitable for local investigation and research, and the method is feasible, reasonable and accurate.

3.2 Application Development

This paper studied and understood the relevant theories of mountain highway and landscape coordination, clarified the basic definition of mountain highway and landscape coordination, built a comprehensive evaluation system of mountain highway landscape coordination on the basis of field investigation, clarified the contents and definitions contained therein, and carried out application verification based on practical cases. This system includes four aspects: index selection, index quantification, weight model and evaluation model. In the landscape design and management of

mountain expressway, it can strengthen the safety and effectiveness of highway construction management, enhance the local visual aesthetic effect, and reduce the damage to the ecological environment on the basis of understanding the current situation and changing characteristics of the local landscape. Ensure the benefits of highway landscape to maximize. At the same time, the factors that affect the landscape coordination of mountain highway are systematically understood, and the index weights are divided into two forms: value and information quantity. Therefore, the combined weight model is constructed, and the objective weighting method is used to improve the evaluation results. Although this study has clarified the comprehensive evaluation system and contents of mountain highway landscape coordination to ensure its accuracy and effectiveness in application, in the future, the modular characteristics of the evaluation system should be comprehensively considered to ensure that all links influence each other and are independent of each other, and different methods and measures should be selected to improve and innovate. To solve the problems of landscape coordination design of mountain highway scientifically, and provide effective basis for landscape construction and management of urban highway in the new era.

Table 3. Case evaluation contents

Target layer	Subtarget layer	Paraclinic bed	Index level
Tourism highway landscape and environment coordination	Landscape and operational safety coordination	Road alignment rationality	Defect rate of stadia
			Minimum radius of a flat curve
			Average grade
			Linear combination rationality
		Traffic facility safety	Traffic signs are set up reasonably
			Effectiveness of traffic marking facilities
			Guardrail setting rationality
		Road alignment rationality	Structural safety measures
			Linear continuity before and after the structure
		Roadside safety	Roadside tolerance
			Line of sight inducement
	The harmony of landscape and visual environment	The beauty of the road itself	Alignment and terrain integration
			Slope and background compatibility
			The integration of structure and environment
			Traffic signs and environment integration
		Ecological landscape aesthetics	Vegetation naturalness
			Ornamental water area
			Topography and geomorphology ornamental
		Aesthetic degree of human landscape	Custom and culture
			Local architectural features
	Landscape and ecological environment coordination	Topographic and geomorphic effects	Earthwork per unit mile
			Intensity of soil erosion
		Drainage effect	Water quality
			Water system connectivity impact
		Animal and plant influence	Vegetation coverage
			Vegetation community stability
			Localization rate of greening species
			Animal barrier effect

4. Peroration

To sum up, mountain expressway landscape is crucial to urban construction and development. Current research has not put forward a complete evaluation system. Therefore, in the future, it is necessary to build a comprehensive evaluation system in line with the development of The Times by combining existing research results and three-dimensional integrated traffic theory, so as to systematically understand the development status of mountain expressway landscape coordination. Finally, the research content that shows the comprehensive urban transportation system is intuitive,

complete and effective. In addition, it is necessary to strengthen the training and introduction of professional and technical personnel, and actively learn from the theoretical knowledge and application technology proposed by domestic and foreign scholars, so as to contribute to the construction of a harmonious development of society.

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