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Research on the Evaluation System of Green Highway Construction

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ABSTRACT

This paper studies the current situation of the development of green highways, analyzes the stages of the whole life cycle of green highways, and puts forward various evaluation indicators in the three stages of design, construction, operation and maintenance, which has certain reference value for the research of the evaluation system of green highways.

KEYWORDS

Green highway; Whole life cycle; Design; Construction; Operation and Maintenance; Evaluation.

1. INTRODUCTION

The concept of green transportation is determined to be based on the combination of foreign research on the sustainability of construction, derived from green construction, and the concept is also related to the sub-concept of green transportation, which is equivalent to the extension of its sub-concept. The definition of green highway should be as far as possible to ensure that the original construction project can meet its quality and safety requirements, and can be completed within the target construction period, and then adopt relevant improvement technologies and management methods to achieve the overall construction process of energy and material utilization can be improved, and its negative impact, such as noise and wastewater discharge, to the minimum, so as to achieve the sustainability of the construction of the highway project, that is, the harmonious development with the ecological environment.

2. OVERVIEW OF GREEN HIGHWAY DEVELOPMENT

2.1. Green Highway Concept

In 1987, the Ministry of Transport of the People's Republic of China issued the Measures for the Management of Environmental Protection of Transportation Construction Projects (Trial), and since the release of the measures, in the past 30 years, the state has successively issued relevant policies and work guidelines, such as the Notice on Strengthening the Environmental Impact Assessment of Highway Planning and Construction, or the Guiding Opinions on Accelerating the Development of Green, Circular and Low-carbon Transportation. These relevant documents all propose that the construction of green highways for the country should be vigorously developed. Until 2013, the Ministry of Transport provided part of the pilot for the construction of green highways, a total of 20, providing valuable experience for the progress of green transportation in China, and then, in 2016, the Ministry of Transport issued the “Guiding Opinions on the Implementation of Green Highway

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Construction", which put forward the relevant tasks of China's green highway construction, which is divided into five aspects, one is to coordinate the use of resources to achieve intensive savings; the second is to strengthen ecological protection and pay attention to natural harmony; the third is to focus on the cycle cost and strengthen the construction and maintenance; The fourth is to implement innovation-driven, scientific and efficient, and the fifth is to improve standards and specifications, and promote demonstration and guidance, all of which clearly require that in 2020, more demonstration projects should be established, so that the relevant evaluation and evaluation of green highways can have standards to follow, and the experience of construction can be tested in the later construction.

The concept of green highways is understood differently by different researchers and institutions. First of all, Wikipedia, defines the function of green highway as a combination of two aspects, that is, the transportation function should be combined with the sustainable development of ecology, and the research results of the highway and the relevant methods of environmental protection should be applied to the whole process of highway planning and construction in the coming year, so as to make good contributions to transportation, environmental and social development.

Referring to the green building evaluation standards promulgated by China, the definition of green buildings is mainly considered in the whole life cycle, and the purpose of its design is mainly to save resources and reduce pollution to the environment, so that people can effectively realize the harmonious coexistence of man and nature in the process of building buildings.

In the idea of the whole life cycle, the most important is the system theory, because its life cycle contains planning, design, operation,management and other aspects, these before and after is a system of engineering, and all parts of the system, should be green This concept should be integrated into it, so as to achieve the sustainable development of its benefits in terms of economy and environment. The planning and design stage is the initial part, which plays a fundamental role and determines the development direction of the subsequent steps. In the construction stage, if there are problems, such as poor quality or inappropriate materials, it will also increase the overall operating costs, thereby reducing the green level of the project. The vast majority of highways are continuously used, and their operation and maintenance time is unlimited, but often there is a period in the stages of planning, design or construction, which is roughly less than 10 years.

2.2. Green Highway Development

The construction goal of green highway mainly contains several characteristics and requirements, including energy saving, improving services, ensuring ecological and environmental protection, etc., and ultimately achieving sustainable development. Until 2020, the construction of green highways in China will be vigorously developed, which will play a constructive role in the low-carbon construction of the highway network, as well as the development of the green transportation system and the standardization of operation and management, which will help the country to build a series of green highways with the concept of low-carbon design and the principle of green construction, and can realize smart services and efficient operation.

In January 2018, the Ministry of Transport issued the "Notice on the Trial Implementation of Evaluation Standards for Highway and Water Transport Quality Projects", which contains three levels of indicators, including 7 items from level 1 to level 3, 22 items and 52 items at level 1, and the indicators include green environmental protection evaluation.

In May 2018, the Ministry of Transport issued the "Technical Requirements for the Assessment of Green Transportation Facilities", which lists the index system required for green highway assessment in the first part of the standard, and mentions 7 categories of first-level indicators in detail, including green concepts, ecological and environmental protection, resource conservation, energy conservation and low-carbon quality, construction safety wisdom and service improvement. The use of such

indicators is relatively common, and often each region will add its local characteristics when it is used, so there is a need for further research on the evaluation of green highways in each region.

By 2020, the development of green highways should achieve the following goals: based on comprehensively improving the concept of green development in the highway industry, we should also pay close attention to the ability of innovation and development, to form a green highway project that includes the concept of sustainable development, and realize its green construction, integration and fine management of first-level intelligent services. Under this goal, the green highway can be fully and efficiently used in its life cycle after construction, which will help ensure the construction of ecological civilization.

2.3. Overview of the life cycle of green highways

2.3.1. Life Cycle Concept

When conducting life-cycle related analysis, it is necessary to combine the system theory and the life cycle of industrial products. In terms of construction, Professor Zhang Zhihui applied the whole life cycle idea when conducting an environmental impact assessment of a building, believing that it includes multiple parts, such as the acquisition of raw materials, the processing of building materials, the construction and demolition of buildings, and other processes. Professor Liu Changbin is to study the whole life cycle of building products, analyze it as a system, and believes that it should contain many parts, mainly including the mining, transportation, processing, etc. of building materials, as well as the whole process of the construction products from planning to final treatment, the so-called life cycle of the green highway is the life cycle of the project, that is, the whole process of the project from life to death.

2.3.2. The whole life cycle of green highways

Taking the proposed construction of green highway as the main body, the whole life cycle is considered in four parts.

2.3.2.1. Green highway planning and design stage

For the planning and design stages of green highways, the way to consider the problem should be grasped as a whole, and the overall goals and functional requirements should be put forward. First of all, for the planning stage, the main goal is to compare the environmental impact of the green highway under different planning forms, and on this basis, estimate the environmental investment of the plan, and incorporate it into the overall economic analysis of the project, so as to ensure that it can be implemented with economic considerations in mind. The main requirement of the design stage is that the relevant indicators of each part of the design should be reasonable, and the relevant design and environmental protection investment can be implemented in the construction drawings. This stage is to decompose the entire green highway project, and implement each part into the project of each professional field, and realize it into specific work, each part can be designed and estimated separately, and at the same time realize the overall planning of resources.

2.3.2.2. Green highway construction stage

The construction aspect of the green highway mainly includes the activities of the various parts of the project and the system formed by it. This stage is relatively short, but it is rich in content, such as its large amount of information input and the use of more materials, which plays a key role in engineering. This stage will have a great impact on the entire highway project and will play a decisive role in its use and maintenance. The main goal of this stage is to implement the environmental protection requirements and related designs in practice, so as to minimize the environmental impact of the project. Through the control of the site and environmental prevention, as well as quality control, and then to achieve the ultimate environmental protection goal.

2.3.2.3. Green highway operation and maintenance stage

After the green highway is completed and put into use, it is followed by the longest stage in the life cycle of the entire engineering system, which is the operation stage, which plays a key role in the realization of the overall value of the project and can meet the needs of users. This phase lasts for a long time, often reaching decades or even more than a hundred years. At this stage, the main way is to carry out timely maintenance and cultivation of the highway, and to monitor and prevent the pollution caused by it, so that it can continuously meet the needs of people, and at the same time, a better service area should be provided to meet the comfort of users.

2.3.2.4. Scrapping stage of green highways

This stage is relatively special, the vast majority of highways can have a long vitality, and even if there are more constraints in the route selection stage of the highway, it can also be continuously used through maintenance and renewal, and the roads that need to be scrapped only account for a very small part, because this stage is not universal, so it is ignored in this article and not considered.

This paper decides to divide the whole life cycle of green highways into three stages, the first stage is green planning and design, the second stage is green construction, and finally, green operation and maintenance.

3. CONSTRUCTION OF GREEN HIGHWAY EVALUATION SYSTEM

3.1. Green Highway Development

3.1.1. At the level of the general framework, there is a lack of a perfect implementation system

At present, the domestic green highway implementation guidance document only issued the green highway implementation guidance from the guidance level, S province dased on the guidance to design its development of the implementation plan and technical route, overall, the lack of specific evaluation standards and evaluation methods.

3.1.2. At the level of assessment methods, assessment methods and assessment indicators are not sound

According to the management status and project practice of the green highway industry in S Province, a certain amount of experience has been formed in the practice and guidance of green highway engineering, and the development level of green highway is at the leading level in China, but in terms of assessment methods, there is still a lack of clear assessment indicators and methods, and it is impossible to accurately evaluate the development and practice effect of green highway in various projects. Therefore, it is necessary to improve the assessment system at different levels as soon as possible, and clarify the assessment methods for different stages of green highway management, design, and construction.

Therefore, in the research of green highway construction, it is necessary to further improve the corresponding standard system and assessment according to the development needs of green highways.

At present, China’s green highway construction has initially had a certain scale, and all provinces and cities across the country, according to local conditions, have adopted new ideas, new materials, new technologies, new processes and other innovative ways to build several low-carbon and green ecological highway demonstration projects. The new concept emphasizes energy conservation and emission reduction, resource conservation, wisdom and efficiency in the process of highway construction; New materials are to increase the application of clean materials and functional materials in engineering, develop new functional materials that can cool the pavement and purify the pavement,

and recycle waste materials such as fly ash and slag; New technologies and new processes are reflected in the development and introduction of advanced new technologies, such as building information modeling technology, charging piles and gas stations, new energy technologies, sewage treatment and water recycling processes, steel structure bridges, green slope protection, etc.

3.2. Principles and methods for the construction of evaluation system for green highway construction

3.2.1. Construct an indicator system method

To make the index system not only contain the construction principle of scientific and standardized, but also be satisfied with the development of regional characteristics, the evaluation index selection of green highways in S province is mainly through the following three ways:

a. Based on the "Technical Requirements for the Assessment of Green Transportation Facilities" and other documents, select the evaluation index options with a certain research basis and value.

b. According to the research on the construction of green highways in various construction projects in S province, select certain representative evaluation indicators.

c. Investigate and consult with experts and professionals with rich work experience for the established indicators, and select indicators with practical significance.

3.3. Establishment of an evaluation system for the construction of green highways

3.3.1. Establishment of index system in the design stage of green highways

On the premise of satisfying the basic use functions of highways, it is the essence of green design to integrate the concept of sustainable development into the highway construction process and to adopt the whole life cycle technical, economic and environmental impact analysis. Not confined to traditional design measures, scientific and flexible, comprehensively consider and analyze the impact of each stage of the life cycle on the environment, and finally achieve the development goal of more energy saving, environmental protection, comfort and safety.

In the green design stage, in order to avoid rework or repetitive redundant work caused by unreasonable design and the loss and waste of labor and materials caused by this work, in the design and planning stage, we should comprehensively analyze the environment, energy, capital, difficulty and other factors, and perfectly integrate the concept of green highway design into the whole life cycle, which is also the first step to implement the concept of green highway.

Green design can be divided into 5 second-level evaluation indicators and 18 third-level evaluation indicators.

Table 1 Three-level evaluation system for green design

Level 1 Indicators	Level 2 Indicators	Level 3 Indicators
Green design	Green Concept	Develop a strategic plan
		Set up dedicated line funds
	Environmental Assessment	Environmental Impact Assessment
		Soil and Water Conservation Assessment
		Energy Saving Assessment
	Resource conservation	Reasonable line selection
		Land use
		Adapt to local conditions
	Eco-friendly	Acoustic pollution prevention and control design
		Design for the prevention and control of light pollution
		Design of soil protection scheme
		Ecological restoration scheme design
	Smart innovation	Renewable resource utilization program
		Integrated program for construction, management and maintenance
		Green Construction scheme
		Green Conservation Program
		Green Service Area Scheme

3.3.2. Establishment of index system in the construction stage of green highway construction

Green construction is not only the embodiment of the concept and achievements of green design, but also lays the foundation for the next green maintenance, and is an important part of the whole life cycle of green highways. Under the premise of ensuring the quality and safety of construction, the use of new equipment and new energy, the use of environmentally friendly materials and new processes, the maximum increase in energy use, and the reduction of pollution, innovative management to improve humanized construction behavior, are all categories of green construction.

In the construction stage of the green highway, each component is independent and interconnected, and it is a synthesis of the interaction and influence of the human environment and the environment. The green highway can not only meet the comfortable, safe and beautiful appearance, but also meet the purpose of energy saving and material saving.

According to the requirements of green construction, the assessment components of green construction can be divided into 4 second-level evaluation indicators and 18 third-level evaluation indicators.

Table 2 Three-level evaluation system for green construction

Level 1 Indicators	Level 2 Indicators	Level 3 Indicators
Green construction	Resource conservation and intensive utilization	Reasonable division of bids
		Eternal Bonding
		Site Layout
		Balance of Fill and Cut
	Energy saving and emission reduction	On-site energy saving
		Site energy saving
		Process energy saving
		Technology energy saving
	Environmental protection	Ecological and environmental protection
		Water environment protection
		Acoustic environmental pollution protection
		Atmospheric environmental pollution protection
		Cultural relics preservation
		Ecological restoration
	Quality Engineering	Standardization of construction
		Management informatization
		Integration of landscape and route

3.3.3. Establishment of the index system for the operation and maintenance stage of green highways

The operation of green highways is mainly reflected in two aspects: green maintenance and green service areas. Referring to the research on the evaluation index system of green highways and the evaluation index system of green service areas, the main influencing factors of how to practice the concept of green ecological and environmental protection in highway maintenance and service areas are analyzed. After discussion with professionals, it was finally determined that the green operation evaluation indicators mainly included two secondary indicators, namely green maintenance and green service areas, and 11 third-level indicators were involved.

Table 3 Three-level evaluation system for green operations

Level 1 Indicators	Level 2 Indicators	Level 3 Indicators
Green operations	Green maintenance	Preventive maintenance planning
		Preventive maintenance techniques
		Informatization of maintenance management
		Traffic safety management
	Green service areas	Resource conservation
		Energy utilization
		Ventilation and lighting energy saving
		Landscape enhancement
		Prevention and control of environmental pollution
		Service quality improvement
		Safety and Security

4. CONCLUSION

This paper first analyzes the development process, development status and development trend of highway construction in S province, constructs the green highway construction system in S province

according to the needs of the green highway evaluation index system in S province, and proposes 3 first-level indicators, 11 second-level indicators and 47 third-level indicators of green design, green construction and green operation for the three stages in the whole life cycle of green highway.

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