THE RESEARCH ON CHINA GREEN HIGHWAY CONSTRUCTION THOUGHTS AND CONSTRUCTION MODE

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ABSTRACT

Starting from the development background,it mainly analyzed the history and connotative characteristics of green highway in China. It raised basic idea, major content and development model for subsequent development of green highway as well as pointed out the future direction upon the recognition and the judgment on the development stage.

KEYWORDS:green highway; construction; idea; model

1 INTRODUCTION

The Fifth Plenary Session of the 18th Central Committee of the CPC has put forward concepts of innovation-driven development, balanced development, green development, open development and development for all.Innovation is the first driving force to lead the development and green is a necessary condition for sustainable development as well as an important manifestation that people pursue a good life.Using innovative thinking and angle of view to develop green transportation is the main direction of transport industry and an important embodiment of implementing the five development concepts.Green highway, as a new model of highway construction and development in the new period, has become a crucial symbol to develop green transportation's key field and build beautiful China, which has grand strategic significance and practical significance.

2 BACKGROUND AND SIGNIFICANCE OF GREEN HIGHWAY

Since the reform and opening up, China's highway construction has achieved a leap-forward development with great achievements.In 2004, China presented a new concept of highway design and construction--"SixInsistences and SixEstablishments", which has been widely accepted and implemented by the highway industry from department of survey, design, construction to management. Meanwhile, the implementation of many demonstration projects, which were typical in the survey and design of highway and represented by Chuanjiu Highway, has greatly improved the concept and level of highway design.In 2009, China fully promoted ideas of modern project management in highway construction, proposed requirements of humanistic management, professional management, standard management, informatization management and fine management and deployed 3-year standard construction activity nationwide, driving the management level of highway construction up to a new step.Since the

“12th Five-Year Plan”, China has successively carried out demonstrative projects of energy conservation and emission reduction as well as science and technology, which are represented by green, circular and low-carbon highway. This has enriched the new concepts of highway design continuously, put measures, such as water and land saving, low carbon environmental protection, energy conservation and emission reduction, into practice and lifted management level of highway construction up to another new step.

Since the 18th Party Congress, the construction of ecological civilization has been brought into the "five-in-one general layout of the construction of socialism with Chinese characteristics.The Fifth Plenary Session of the 18th Central Committee of the CPC has further set forth concepts of innovation-driven development, balanced development, green development, open development and development for all. The green development has become a fundamental concept of the 13th Five-Year Plan” and the development of economy and society subsequently.In 2014, the Ministry of Transport put forward the strategic decision to accelerate the development of "integrated, intelligent, green and safe transport", and pointed out the direction for the scientific development of communication and transportation.Under the new situation that ecological civilization construction has been highly concerned and resource conservation and environment friendliness require to be further improved, green highway, as an important part of green transport, will definitely become an important starting point for promoting the rapid development of green transport and a vital support for driving the transformation and upgrading of highway transport of the new period. Moreover, it will further press ahead the sustainable and health development of highway construction and build a beautiful image of ecological civilization construction.

3 DEFINITION AND CONNOTATION OF GREEN HIGHWAY

3.1. Definition of green highway

Green highway is an important part of green transport. According to ideas of system theory and cycle cost, it coordinates the relation between the operating efficiency on the one hand and the quality, resource utilization, energy consumption, pollution discharge and ecological impact on the other hand for highway construction and organizes the overall process of highway planning, design, construction, operation and management. Thus, it could obtain best construction quality and highest efficiency transport service and realize the maximum balance between external rigid constraints and highway’s internal supplies through minimum resource occupancy, energy consumption, pollution emissions and environmental impact.

3.2. Characteristics of green highway

The concept core of green highway construction considers meeting the diverse needs of people as the starting point and the ultimate goal. It adheres to the ideas of system theory and cycle cost, coordinates the relation between the operating efficiency on the one hand and the quality, resource utilization and ecological impact on the other for highway construction, and organizes the overall process of highway planning, design, construction, operation and management. These

measures are carried out simultaneously to achieve a balance between external rigid constraints and highway's internal supplies as well as promote harmony between human and nature.

It contains connotation at three aspects as below.

Entire process: the development of green highway must cover planning, design, construction, operation, maintenance and management, emphasizing the overall consideration of the entire process;

Total factors: refer to all kinds of relevant factors in the development of green highway such as resource conservation, energy conservation and emission reduction, pollution control, ecological friendliness, intelligence and high efficiency, comfort and beauty.

All-round:green highway must be capable to create necessary conditions for green transport and safe operation at the same time of requiring green in self construction, operation and maintenance; it must not only provide low-carbon and energy-saving highway entity but also fully consider relevant demands of users for all-round development.

3.3 Functions of green highway at different historical phases

The implementation of green-highway construction is a specific action that highway industry continuously improves its development philosophy. At the same time of upgrading the philosophy of "Six Insistences and Six Establishments", it extends green, circular and low-carbon highway as well as innovates energy-saving, low-carbon and environmental protection technologies in the new period. Moreover, it levels up the quality of highway construction, acting as an important measure to transform and upgrade highway transport. Resting on the conceptual foundation of "Six Insistences and Six Establishments", green highway construction concerns more on planning the entire construction as a whole, coordinating highway with the environment and society, implementing resource conservation and environmental friendliness, building and managing the highway with good quality and high efficiency as well as improving service level according to demands. With clear target and rich content, it has its tasks and measures embodied the nature of era, pertinence and guidance.

4 STEPS AND PROCEDURES OF WORK OF GREEN HIGHWAY

The Ministry of Transport issued Instruction on the Implementation of Green Highway Construction (JBGL [2016] No. 93)on July 20, 2016, which raised the guiding thought, fundamental principle, construction target, five key tasks and five special actions of green highway construction and provided a guidance of overall direction and actions to the subsequent construction of Chinese green highway.Meanwhile, the Ministry of Transport was divided into three groups, presenting 33 green-highway demonstration projects throughout the 31 provinces, autonomous regions and municipalities of China.In the same period, the Ministry of Transport also organized relevant departmentsto researchtechnologies and policies of green-highway construction, as well as started to compile Technical Manual of Green-highway Construction, Assessment Criteria and Management Process of Green Highway, Management Policies and Incentive Mechanism of Implementing Green Highway, etc.

The work steps and procedures for typical demonstration project of green highway in each province are as follows:

(1) To compile Implementation Plan of Typical Demonstration Project of Green Highway in feasibility-study stage of the project. The typical demonstration project of green highway must refer to the five key tasks and five special actions, which were mentioned in the Instruction, in the stage of feasibility study for early planning and overall planning.Meanwhile, it must consider the characteristics of the project for presenting key, difficult, innovative points and major task of building the typical demonstration project of green highway.

(2) To start initial design and constructiondrawing. Referring to relevant requirements of the Implementation Plan and the design content of each profession, we must start the initial design and constructiondrawing with distinctive features according to local conditions, carry out the key points and solve difficult points both mentioned in the Implementation Plan and realize the mentioned innovative points and major task.

(3) To launchthe construction. According to the requirement of green-highway construction on the construction period, we deploy the specific work, and focus on the management and control of construction's quality and safety, on the application of measures of saving water, land and materials as well as on the machinery treatment and process supervision for environmental protection.

(4) To Summarize and propagandize. We must timely collect materials in the process of design and construction for experience summary, propaganda and communication after the project is completed.

5 KEY TASKS OF GREEN-HIGHWAY CONSTRUCTION

Green highway is the overall direction of our country in future highway construction. Adhering to the philosophy of sustainable development and whole life cycle, we must strengthen relevant content of "**Four Attentions and Four Improvements**" and accelerate the construction of green highway.

First, intensive utilization of resources. Resources of transport corridors and lines must be utilized intensively in accordance with the principles of "overall planning, rational layout, intension and high efficiency". At the same time of integrating the resources of comprehensive transport corridors and lines as well as transportation junction, we encourage sharing of corridors between highway and railway and of scarce lines between expressway and highway. We suggest rebuilding or extending highway to use original corridors (it is suitable to utilize existing bridges, tunnels and traffic engineering at the premise of guaranteeing the functions). In line selection, we try our best to avoid basic farmland, triangle lands and marginal lands for higher land utilization.Subjecting to terrain, we set up interchanges for less interconnected lands and even combine interchanges with service areasfor intensive land utilization. We will locate service zone flexibly with dissymmetric, unilateral or protruding layout in accordance with local conditions. We actively integrate permanent and temporary infrastructures. For instance, we try

to intensively build temporary infrastructures, such as expressway-oriented mixing plant, rebar processing factory, precast yard, stations and laboratories, as well as set up some in roadbed or service zone such as girder fabrication yard, mixing unit and camp buildings.Moreover, we arrange proper time and sequence of construction to reduce unnecessary construction roads.

Second, to realize no spoiling and less borrowing in earthwork.roadbed cut-fill in highway construction is a key factor directly affecting land use and environmental protection. Hence, we control roadbed cut-fill and earth adaptation with reasonability to reduce borrowing or spoiling ground for further land conservation and better protection of vegetation and natural environment along the line in order to make highway and the environment harmonious.Meanwhile, to reach cut-fill balance and minimum influence on environment, we must attach great importance to environmental protection in the process of design and construction through flexible use upon technical indicators, perfect comparison and selection of schemes between embankment and bridge and between slope and tunnel as well as proper design of cross section and vertical section.The core idea of realizing no spoiling in earthwork is to turn waste into treasure, which is to preserve and use spoiling soil from traditional practice.At present, most expressways in China are mountain roads with higher bridge and tunnel, resulting in the production of massive mucking debris from tunnels.Therefore, we must formulate reasonable construction procedure and use ratio of mucking debris from tunnels at first. Then we can use the debris in the construction of infrastructures such as sightseeing platform, self-driving camp and connecting line, or in the settlement of micro-topography in connected areas and in the creation of lands and farmlands. To achieve less borrowing in earthwork is to optimize the horizontal and vertical surface of road in shape and control the cut-fill height of roadbed properly.

Third, to build green service area. Service area is crucialto implement circular, low-carbon, ecological highway construction with environmental protection. Better construction of green service zone plays a vital role in promoting achievements of highway'sgreen development and erecting social image of highway industry.In the construction of green service area, we must carry out energy-saving design for buildings, promote technical application such as heat preservation in building, clean energy, renewable energy, energy-saving ventilation and natural lighting, and put wastewater treatment and utilization of service zone into practice as well as generalize water-recycling technology to achieve rational use of recycled water.Actively, we promote waste recycling technology in service area to realize separate waste collection and harmless treatment, and promote the application of solar energy, wind energy, air energy, geothermal energy and other clean, renewable energies in supporting facilities in the service area, tollgate and highway monitoring system.Moreover, we encourage building new service areas to deploy special design of eco-environmental protection and ensure the up-to-standard discharge of exhaustgas, wastewater and other pollutants.

Forth, to expand tourism functions of highway. Currently, China stays in a developing period of important strategic opportunities, transiting from incremental development to stock optimization and facing the era with large-scale resource integration of resources, regional

cooperation as well as highly integrative development.Integration development of transportation and tourism has become a hotspot and a focus in current integration development of industries.With the arrival of the self-driving era, highway has become an important basic guarantee for consumer upgrades and personalized travel.Highway occupies about 70% of total traffic in the global tourism development.Travel in the new era requires highway to expand an operational path of tourism market for integrating highway and tourism.Therefore, it is urgent to improve the design of highway functions, expand highway services and tourism functions to drive the tourist economy development along the route and promote industrial transformation and upgrading as well as green economic development.In highway construction, we must conform to local conditions, combine natural scenery with tourism resource along the route, ensure proper theme of design, make the highway and natural scenery harmonious and enable highway to become a landscape itself. Meanwhile, we must consider the travel demands of the public, encourage to perfect tourist service facilities on the wayside of highway and build a slow traffic system, expand highway tourist service to benefit the mass along the highway.

Fifth, to intensify scientific and technological innovation. We must make full use of information technology and intelligent manufacturing technology, promote technology upgrading of highway construction and achievement introduction of domestic and international cutting-edge technology and vigorously carry out technical research and development of key technology of green highway at the same time of speeding up the research on the energy conservation and emission reduction of green highway.Meanwhile, we must strengthen the research, development and application of BIM technology, a three-dimensional data technology applied in the engineering design, construction and management. BIM technology is able to realize information sharing and delivery in the entire life cycle of project’s planning, information sharing and delivery. It enjoys characteristics such as visualization, simulation and figure-production.At present, we must further use BIM technology in overall process of highway construction, such as planning, design, construction, operation and maintenance. We can expand its application in space scene of high-precision project, route selection of simulation design, model selection of structures, delicacy management, remote real-time monitoring, organization and design of project construction, visual analysis and control on engineering progress as well as open and transparent management information. Moreover, we must speed up all-round technological innovation and management innovation of highway construction toachievetraceless and intellectualization construction of projects.

Sixth, to increase operating efficiency of highway network. We must promote management withinformatization and intellectualization.Based on the "Internet plus" concept and Internet-of-Things technology, we must accelerate integrated innovation and the application of modern information technology, such as cloud computing and big data, and build a monitoring system for green-highway operation. Only thus can we realize the visual, measurable and controllable management of highway network gradually and increase the safety, operational efficiency and intelligent level of highway-network management effectively.Meanwhile, we must actively develop vehicle infrastructure cooperative technology, thereby guaranteeing

delicacy management and travel services with high quality in the operation of highway network.Moreover, we must speed up the construction of environment monitoring network to provide a basis for regulating and managing pollutant discharge of highway industry.

Seventh, to improve travel services. To make the “passing economy” stronger, we must adapt to the new changes of public demands for travel, innovate highway service method, increase service carrier, enrich service connotation and expand service range at the same time of diversifying service experience of the public in travel. Meanwhile, we must develop diversified service facilities, reasonably arrange the interval and scale of viewing platform, service area and parking lot and other highway service facilities, expand structural function of highway service facilities such as tourism service and logistics connection so as to upgrade the service quality of highway service facilities.Moreover, we must enrich comprehensive service method of highway, adhere to the people-oriented development philosophy, utilize new media means such as SMS platform, web portals, WeChat and microblog to provide all-round and personalized travel service for users,and structure an information service system of highway travel that combined public service with personalized and customized service.

Eighth, to enhance capacity of environment supervision. Transportation departments and highway administrative departments at all levels shall strengthen the supervision in each link of green highway such as design, construction and operation, formulate annual supervision and inspection plans and steadily press ahead the construction of online monitoring and database platform for energy consumption and environment. During the highway construction and operation, they shall grasp the impact on the environment, take preventive measures and carry out green, circular and low-carbon requirements in the entire process. Meanwhile, they shall deploy preliminary design and construction drawing strictly according to the concept and requirements of green highway, ensure less influence on environment from the source and provide special technical advice of green highway design.In the construction phase, they must carry out environmental monitoring and supervision strictly in accordance with national environmental protection laws and regulations before the project acceptance.Amidst the operation phase, they must carry out environmentalmonitoring for the environment-sensitive targets, which may be affected, and the operation of pollution control facilities and deploy pilot evaluation work on the operation of green highway gradually.

6 COGNITION OF GREEN-HIGHWAY CONSTRUCTION

First, the popularization and application of steel bridge and assemblage construction technique is the inevitable course for transformation and development of highway transport.For the moment, the popularization and application of steel-structure bridge is still restricted by factors such as high investment of preliminary stage, non-uniform technological cognition, unmatched standards and regulations and poor on-site assembling, especially the poor control of welding process.However, standardized design, factory construction and assemblage construction are the ultimate goal that highway transport pursues in transformation and upgrading.The government shall give its support on a basis of policy guidance, gradually extend the application of steel-structure bridge and emphasize technical research. Meanwhile, it shall unify the cognition,

perform well in cultivation of design, building, construction market as well as capacity, and create conditions for the wide promotion of assemblage construction.Only the component-based and industrialization road could make the 100-year service life of bridge and culvert come true.

Second, green-highway construction must makea breakthrough via correct direction and key point. Green-highway construction must seek for "bright characteristics and outstanding highlights" instead of reaching every aspect of a matter; it must keep its feet on the ground rather than create something new and original.In each project, we must point out the target, special points and key task in line with corresponding regional characteristics, natural environment, engineering characteristics and technological difficulty, and complete the key task throughout each stage such as design, construction and operation.

Third, green-highway construction must start from the source and emphasize overall design. It is suggested to make overall planning and system planning in the stage of feasibility study of the project, making the concept of green-highway construction throughout.In addition, what changed traditional green-highway construction is just the cognition on greening and environmental protection. We must pay attention to the implementation and integration of green-highway concept in preliminary design process of main project, enhance overall design and complete the links well in advance, such as overall cut-fill transition, cut-fill balance, intensive infrastructure layout, resource utilization, the improvement of service functions and the implementation of environmental-protection concept. Only thus can we enable the concept of green highway to truly guide the engineering practice, manage each stage and work throughout the whole process.

7 BRIEF SUMMARY

Green highway has respect to the sustainable development of highway traffic and it is a great measure of highway industry to implement the five development concepts as well as the CPC Central Committee's ecological civilization strategy. Highway industry will shoulder heavy historical responsibilities to speed up the transformation of highway development, focus on the improvement in energy resources' utilization efficiency, ecological environment, highway’s operational efficiency as well as travel service level in all respects, and promote the harmonious development between highway and nature.With highway greening to drive the green development of communication and transformation, it will provide powerful support for the full establishment of a moderately prosperous society and make due contributions for accelerating the construction of ecological civilization and beautiful China.