

ORIGINAL RESEARCH ARTICLE

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# Research on Present Situation, Existing Problems and Countermeasures of Highway Survey and Design

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**Abstract:** Highway survey and design as a key link in traffic infrastructure building, its development level directly affects the quality and efficiency of the transportation network. This paper focuses on highway survey and design, first expounds the current situation, technical level improvement, design concept transformation, management mode optimization; then points out the problems, there are insufficient application of technological innovation, design concept needs to be updated, management mechanism is not perfect. Finally, put forward countermeasures, including strengthening technological innovation and application, such as increasing R&D investment, promoting advanced technology, and strengthening international cooperation; update the design concept, integrate sustainable development and humanized elements; improve the management mechanism, strengthen pre-planning, improve quality supervision, and promote coordination among all parties, aiming to promote the high-quality development of the highway survey and design industry and improve transportation infrastructure.

**Keywords:** Highway survey and design; current situation; existing problems; countermeasures

## Introduction

As a key part of transportation infrastructure, the survey and design level of highways is related to the quality and efficiency of highway construction. At present, highway survey and design has made certain progress in technical level, design concept and management mode. Surveying, geological exploration and other technologies have developed, and the concept of sustainable development has been integrated into the design, and the management mode has been gradually optimized. However, there are still problems such as insufficient application of technological innovation, design

concept to be updated, and imperfect management mechanism. This paper will analyze these problems in depth, and put forward targeted solutions from the aspects of strengthening technological innovation, updating design concept, and improving management mechanism.

## 1. Current status of highway survey and design

### 1.1 The technical level is gradually improved

In recent years, surveying and mapping technology, geological exploration technology, and computer technology have developed rapidly, and highway survey and design technologies are greatly enriched.



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In the field of surveying and mapping, Global Position System (GPS), Geographic Information System (GIS) and Remote Sensing Technology (RS) are widely used, and the accuracy and efficiency of topographic surveys have been significantly improved. Large-scale topographic data can be quickly obtained, providing basic support for follow-up work. In geological exploration, geophysical exploration, drilling and other technologies continue to improve, resulting in a more accurate and in-depth understanding of underground geological conditions. It can accurately grasp key information such as geological structures and geotechnical properties, and reduce engineering risks. Computer-Aided Design (CAD) and 3D modeling technologies are becoming mature, providing intuitive and accurate tools for highway design. With the help of these technologies, designers can simulate the spatial form of highways in an all-round way, clearly showing the direction, slope, curve radius and other factors of highways, and can also simulate the operation of highways, identify potential problems in advance and make optimization adjustments. These technological advancements together promote the development of highway survey and design to a higher level, improve the quality and safety of highway construction, and provide a strong guarantee for the improvement of transportation infrastructure.

### **1.2 The design concept has changed**

In the past, traditional highway design mainly focused on meeting the needs of traffic functions, with the main goal of achieving smooth traffic flow of vehicles and ensuring the basic performance of roads. Little attention was paid to environmental impact and ecological protection, and less attention was paid to the disturbance and destruction of the surrounding ecosystem caused by highway construction. Nowadays, with the wide dissemination and in-depth acceptance of the concept of sustainable development, highway survey and design pay more and more attention to the coordination and integration with the natural environment. During the design process, efforts were continuously increased to protect the ecological environment along the route, and efforts were made to minimize the damage to the natural landscape. Ecological slope protection technology was adopted, and plant roots were used to stabilize the soil, effectively reducing soil erosion, and creating a natural

and harmonious landscape. Wildlife passages were set up to facilitate animal migration and foraging, maintain ecological balance, and achieve harmonious coexistence between highway construction and the ecological environment. In addition, the attention paid to the needs of users in highway design has also been greatly increased, focusing on improving the comfort and safety of highways<sup>[1]</sup>. In terms of comfort, rationally set the line of sight to ensure that drivers have enough vision to observe road conditions, optimize the smoothness of the road surface, and reduce the bumping feeling of vehicle driving; in terms of safety, improve traffic signs and markings, scientifically plan road alignment, reduce hidden dangers of accidents, and create a better and safer travel environment for highway users.

### **1.3 The management model is continuously optimized**

In the field of highway survey and design, from pre-project planning, to design process control, and then to the later design review and acceptance, corresponding management systems and norms have been constructed in each link to provide a basis for the orderly development of management work. Some areas have actively introduced modern management models, such as the project legal person responsibility system, clarify the project legal person responsibility, to ensure the smooth progress of the project; invite tenders bidding system through fair competition, select high-quality survey and design units; engineering supervision system to supervise the survey and design process to ensure the quality of design. The application of these models has strengthened the whole process management of survey and design projects, and improved the design quality and project management efficiency. In addition, information management methods are increasingly widely used. Through the establishment of a project management information system, electronic management of design documents is realized, information barriers are broken, and information sharing is achieved. This allows the project participants to obtain the required information in a timely manner, facilitates communication and collaborative work, further improves management efficiency, and promotes the development of highway survey and design management in a scientific, standardized and efficient direction.

## 2. Problems with highway survey and design

### 2.1 Insufficient application of technological innovation

Although the overall technical level has improved, there is still a gap in innovative application. In practical projects, the promotion of advanced technologies and equipment is not good. Some enterprises are restricted by factors such as lack of funds and limited technical capabilities, and still choose traditional survey and design methods. This not only greatly reduces work efficiency, but also makes it difficult to ensure that the design quality meets high standards, which affects the overall efficiency of highway construction. At the same time, the industry has insufficient investment in research and development of new technologies and insufficient research depth, resulting in a lack of core technologies with independent intellectual property rights. When encountering complex geological conditions, such as karst, soft soil and other areas, or facing special engineering needs, such as large bridges, extra-long tunnels and other projects, often only foreign technologies and equipment can be used to solve the problem <sup>[2]</sup>. This makes the industry technically beholden to others, increases construction costs and risks, and also limits the improvement of the industry's own innovation capabilities, hindering the long-term and sustainable development of the highway survey and design industry.

### 2.2 The design concept still needs to be updated

The concept of highway survey and design still needs to be further updated. Although there have been some changes, there are still some inconsistencies in the actual design with the requirements of sustainable development. Some designers focus too much on highway alignment indicators and project scale, and do not pay enough attention to the integration with the surrounding environment. During highway construction, ecological protection areas are not properly planned, causing great damage to topography, vegetation, etc., and affecting ecological balance. During the design process, traffic safety and comfort are not considered comprehensively enough, and the needs of different traffic participants are not deeply analyzed. Insufficient attention is paid to the travel characteristics of pedestrians, non-motorized vehicles and other groups, resulting in defects in highway functional settings, which cannot meet diverse travel

needs. Moreover, when comparing and optimizing design schemes, too much emphasis is placed on economic indicators, and insufficient comprehensive trade-off of social and environmental benefits. Due to the pursuit of low cost, the impact of the scheme on the surrounding community and environment is often ignored, which is not conducive to the coordinated development of highway construction and economy, society and environment. It is necessary to continuously promote the update of design concepts to meet the requirements of the times.

### 2.3 The management mechanism needs to be improved

In the pre-planning stage of the project, the depth of the feasibility study was insufficient, and the analysis of key factors such as traffic demand and environmental impact was not comprehensive and systematic enough. This caused some projects to have frequent design changes due to unreasonable pre-planning during subsequent construction, which led to investment exceeding budget, resulting in waste of resources and hindered project progress. In the design process management, the quality supervision system is defective and not perfect enough. The review of the design documents is not meticulous and strict enough, and it is difficult to find hidden design loopholes and quality hazards, which may plant safety risks for the subsequent use of the highway. In addition, the coordination and cooperation among the project participants is not good, and there is a lag in information communication <sup>[3]</sup>. Due to the lack of an effective communication mechanism and collaboration platform, all parties are prone to problems in the connection of work, and there will be mutual blame when the division of responsibilities is not clear, which not only affects work efficiency, but also interferes with the normal progress of the project, which is not conducive to the high-quality and efficient completion of highway survey and design projects.

## 3. Countermeasures to solve highway survey and design problems

### 3.1 Strengthen technological innovation and application

(1) Increase investment in research and development of new technologies. The government and enterprises should jointly increase investment in research and development of highway survey and design technologies, and promote

scientific research institutions and enterprises to deepen cooperation between industry, university and research. Concentrate efforts to overcome key technical problems and develop core technologies and equipment with independent intellectual property rights. In response to complex geological conditions, develop new exploration technologies to improve the accuracy and depth of surveys; develop high-efficiency data processing software to improve data processing speed and analysis capabilities, so as to improve the accuracy and work efficiency of survey and design, and gradually get rid of excessive dependence on foreign technologies. (2) Promote advanced technologies and equipment. Through policy guidance and technical training, encourage survey and design enterprises to actively adopt advanced technologies and equipment. Establish new technology application demonstration projects to demonstrate the application effect and advantages of new technologies in practical projects, and guide enterprises to accelerate the pace of technological updates. At the same time, strengthen the supervision and evaluation mechanism construction of the application of new technologies to ensure that new technologies can be effectively applied in practical projects, and effectively improve the quality and efficiency of the project. (3) Strengthen international cooperation and exchanges. Actively carry out international cooperation and exchange activities, and introduce advanced highway survey and design technology and management experience from abroad. Organize technical personnel to participate in international academic conferences and technical training to keep abreast of the cutting-edge trends and development trends of the international industry. Cooperate with internationally renowned enterprises to carry out scientific research projects and technology development, realize the sharing of technology, talents and other resources and complement each other, promote the improvement of the overall technical level of our country's highway survey and design industry, and enhance our country's international competitiveness in this field.

### 3.2 Updated design concept

The first is to strengthen the concept of sustainable development. The concept of sustainable development should be fully integrated into all aspects of highway survey and design. When formulating the design plan, factors such as ecological environmental protection, rational use of resources and social benefits should be

taken into account. At the same time, strengthen the education of designers on sustainable development. Through training, lectures and other forms, improve their environmental awareness and sense of social responsibility, so that designers can actively follow the principles of sustainable development in the design process, and realize the harmonious coexistence of highway construction and ecological environment. The second is to pay attention to humanized design. Carry out design work with the needs of highway users as the core, and fully consider the travel needs of different traffic participants<sup>[4]</sup>. Reasonably plan the layout and scale of sidewalks, non-motor vehicle lanes, bus stops and other facilities to ensure the safety and convenience of various transportation modes. In addition, attach importance to highway landscape design, combine local cultural characteristics and natural landscapes to create a beautiful and pleasant driving environment, improve the cultural heritage and overall quality of the highway, and provide users with a comfortable and pleasant travel experience. The third is to strengthen the comparison and optimization of multiple programs. In the design stage, it is necessary to widely carry out the comparison and selection of multiple programs, and conduct a comprehensive analysis from multiple dimensions such as economy, society, and environment. Establish a scientific and reasonable program evaluation system, use the evaluation method combining quantitative and qualitative methods, conduct a comprehensive and objective evaluation of each program, and select the best program to ensure that the highway survey and design program is both scientific and reasonable.

### 3.3 Improve the management mechanism

First, strengthen the pre-project planning and management. Carry out a solid feasibility study, comprehensively analyze traffic demand, environmental impact, social benefits and other factors, and build a solid scientific foundation for project decision-making. Focus on in-depth demonstration and optimization of key parts such as project site selection and route plan to prevent major decision-making deviations. At the same time, build a complete pre-project planning and management system, clearly define the responsibilities and authorities of each participant, ensure that the pre-project planning work is carried out in a standardized and orderly manner, and control the project quality from

the source. Second, improve the quality supervision system. Increase the supervision of highway survey and design quality, and build a complete quality supervision system. Optimize the censorship of design documents, strictly review the content integrity, depth suitability and quality compliance of design documents, and ensure that they meet relevant norms and standards. Strengthen the dynamic tracking of the design process, find and solve problems in the design in a timely manner. Establish a quality responsibility investigation system. For engineering accidents caused by design quality problems, hold relevant personnel accountable in accordance with laws and regulations, and enhance the quality awareness of designers. Third, strengthen the coordination and cooperation of all participating parties. Establish an efficient communication and coordination mechanism to promote the information flow and cooperation between the project owners, survey and design units, construction units, supervision units and other participating parties. Regularly organize engineering coordination meetings to deal with problems arising in the implementation of the project in a timely manner<sup>[5]</sup>. Clarify the scope of work and division of responsibilities of each participating party, put an end to the situation of poor work connection and responsibility shirking, etc., and ensure the smooth progress of the project.

## Conclusion

To sum up, although highway survey and design has made progress in terms of technical level, design concept and management model, it still faces problems such as insufficient application of technological innovation, lagging behind in updating design concepts, and imperfect management mechanisms. These problems restrict the improvement of highway construction quality and

efficiency, and hinder the sustainable development of the industry. To this end, it is necessary to make efforts from three aspects: strengthening technological innovation and application, updating design concepts, and improving management mechanisms. Multi-pronged and coordinated promotion. Through the joint efforts of all parties, we can improve the level of highway survey and design, and create a better, safer, environmentally friendly and humanized highway, which will provide solid support for the development of transportation and economic and social progress.

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