Several Problems in Current Implementation of New Concept of Highway Design in China

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Abstract. Since the new concept of highway survey and design was put forward at the National Working Conference on Highway Survey and Design in September 2004, there are still such problems as lack of wide recognition of new highway design concept, one-sided understanding of the new concept, monotonous road design, and lack of guidance for creative design. Only by enhancing the publicity of new design concept, carrying out multidisciplinary research and exploring new concept design methodology can we solve the above problems and promote the sound and rapid development of China’s highway industry.

1. Introduction
The National Working Conference on Highway Survey and Design held in September 2004 put forward the new concept for highway survey and design, viz. put people first and uphold the concept of “safety first”; adhere to the harmony between man and nature, and uphold the concept of respecting nature and protecting the environment; adhere to sustainable development, and uphold the concept of resource conservation; put quality first, and uphold the concept of public satisfaction; adhere to the standards of reasonable selection, and uphold the concept of creative design; adhere to the idea of system theory, and uphold the concept of life-cycle cost.[1] The core of the new highway design concept lies in flexible design and creative design, which places high demands on engineering and technical personnel [2]. The engineering practice of highway sector in China over several years shows that there are still some problems in the implementation of the new concept of highway design.

2. The new concept of highway design does not have public appeal
The new concept of highway design is advocated in the context of the presentation and practice of the Scientific Outlook on Development. In other words, the new design concept is a concrete manifestation of the practice of “putting people first, and upholding Scientific Outlook on Development for comprehensive, coordinated and sustainable development” in highway design and construction.

Since the new concept of highway design was proposed, however, highway projects in China still face the “extensive” designs characterized by unsafe, uncoordinated, unsightly, environmentally costly and uneconomical highways, greatly compromising the economic and social benefits of highway projects. Its manifestations are diverse, such as: the common high filling or deep excavation of roadbed, wide application of trapezoidal or rectangular section open side ditch, lack of roadside clearance, the pursuit of excessive linear indicators with detriment to the environment, masonry support for slope engineering, roadside high-cost or uncoordinated artificial landscape. To a certain
extent, these show that the new concept of road design is not fully implemented by engineers and technicians. The traditional concept of “construction being development” is not fundamentally changed, and the user needs are not deemed as the centrepiece of road work. The basic starting point of highway design should be to meet the people’s needs for travel, show the care for people in the details of highway engineering, reflect personalized services, and achieve harmonious integration of road safety, comfort and pleasure, thereby providing people with best travel convenience.

3. One-sided understanding of the new concept of design

The core of the new concept of highway design is to achieve the goals of road safety, beautiful environment, resource saving, high quality and optimal system through flexible and creative design. This makes high demands on engineers and technicians who must adhere to the theory of system theory, give attention to every detail in design, and strive to achieve the ultimate goal of “system optimization.”

The author holds that the so-called “optimal system” means that the goals of safety, environment (including landscape), cost, quality (physical quality) must be realized at the same time. Otherwise, it is not in line with the new concept of highway design [3]. There is a prevalent one-sided understanding of the new concept of highway design in engineering practices, such as: blindly pursuing low-cost design while making light of other design goals (design of reducing cost is regarded as new concept design), greatly increasing the cost to realize beautiful landscape (beautiful landscape design is regarded as new concept design), getting rid of reasonable masonry support for the sake of slope greening (environmentally friendly design is regarded as new concept design) and so on. These designs that overemphasize certain goals often make light of other design requirements and are unlikely to achieve true system optimization.

4. Highway design lacks personality

Without a doubt, each highway project has its own particularity, namely the road personality. The topography, hydrogeological conditions, climatic and meteorological conditions, social and cultural environment at the place where road is located, as well as customs and habits of residents along the road and the special needs of road users distinguish a certain from other roads. China has a vast territory, and the environment varies greatly from region to region. Even different sections of the same road may have large differences in environment. In order to preserve and demonstrate this personalized road environment, flexible and creative design is essential. Flexible and creative design is also the fundamental way to achieve the ultimate goal of the new concept of “system optimization” for highways [4].

To this end, it is necessary to fully realize that the design process of a road is an artistic creation and processing process that endows it with individuality. Based on the grasp of the environmental personality by engineering and technical personnel, the designers must use the knowledge on road engineering, aesthetics, ecology, social psychology, folklore studies, etc. they master to re-process and re-integrate the general environment (including the natural environment and social environment) in which the highway is located. In engineering practices, there are many examples of lack of attention to personalized design, or simply copy of the so-called “successful experience” elsewhere. For example, the stone support wall with cement mortar made of the same material is adopted along the highways; forms of sculptures widely used in urban construction are applied to highway roadside landscape design and so on.

5. Lack of methodological guidance for creative design

As mentioned earlier, flexible design and creative design are also the basic ways to realize the ultimate goal of the new concept of “system optimization” for highways. However, at the level of design methodology, how to achieve flexible and creative designs is still a major scientific issue that demands prompt solution. The implementation of the new concept of highway design over the years has shown that designers often feel powerless when the so-called “successful practices” elsewhere cannot be
applied to existing roads. The Highway Department of the Ministry of Transportation and Communications (now Ministry of Transport) has compiled and published the *Guidelines for New Concept of Highway Design*, which comment on many positive and negative examples of implementing new concept design in highway construction and guide the new concept of highway design nationwide. However, in the long run, only when engineers and technicians master the effective methods of solving the problems in slope engineering or in creative design can they make flexible use in engineering practices according to the actual situation, and produce more and better creative design, avoiding the practice of blindly imitating other experiences [5]. The creative designs should also be inexhaustible, not limited to the existing new concept design experience and practices at home and abroad.

In engineering practices, the new concept of highway design is actually a complex multi-goal design, and under certain conditions, these design goals are often mutually exclusive and difficult to achieve all at once. Take highway slope design as an example. The slope engineering per se is complex system engineering, and complex geological conditions are faced in the design. It is not easy to ensure its stability. Coupled with many design goals such as greening, landscape and cost, it inevitably adds to the design difficulty, because it is often hard to achieve these design goals at the same time. For example, it is generally easy to ensure the stability of rocky slope with weak weathering, but it is difficult to achieve the goals of slope greening and slope landscape at the same time. Greening is relatively easy on large soil slopes with the right conditions for planting, but it is difficult to ensure its stability. As complex information elements emerge in the survey and design of rocky slopes with complex hydrogeological conditions, it is hard to achieve any goal of slope stability, slope greening, or landscape. Since the implementation of the new concept of highway design, masonry support is extensively used in China’s highway engineering. The unsightly slopes that do not match the surrounding landscape and are not environmentally friendly have greatly reduced the social benefits of highway engineering. The author believes that the principal cause is that the engineering community lacks scientific methods to solve such multi-goal problems through creative design. Obviously, it is impossible to solve such multi-goal problems through highway engineering disciplines alone.

6. Conclusion
The new concept of highway design has been put in place in China for many years. Nevertheless, there are still problems such as lack of public appeal of new concept on design, one-sided understanding of new design concept, lack of attention to the individualized design of highways, and lack of scientific methods for creative design. The new concept of highway design is actually a very complex multi-goal design, which places high demands on engineers and technicians. Only by enhancing the publicity of new design concept, carrying out multidisciplinary research and exploring new concept design methodology can we solve the above problems and promote the sound and rapid development of China’s highway industry.

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