Review and prospect about China natural regionalization for highway

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Abstract: In the 1950s, research on natural regionalization for highway was set out in China. This paper reviews its history and introduces the relative research in other countries. Based on the comparative analysis of the different research angles among different countries, suggestions about the future work are offered. The relations between physiographical indexes and the indexes directly related with highway engineering are suggested to be studied and the basic data for highway be tested and collected all over the country. These works will be of help to the guidance of regionalization for highway engineering. And the impact of highway on the geographical environment should also be considered in highway natural regionalization.

Key words: China; natural regionalization for highway

1 Introduction

Highway, as a kind of man-made structure, will become a part of the geographical environment and be impacted by all sorts of natural factors after it is finished. On the other hand, highway also brings some changes to the geographical environment. A highway often passes through different natural regions, so it must be adaptable to any geographical environments. On the basis of deep understanding of the geographical environment, service life and normal level of the highway can be ensured and the impact on the geographical environment can also be effectively lessened through technical measures suitable to the environment during the period of design, construction and maintenance. These subjects attracted wide attention of researchers all over the world, but researchers from different countries have different views.

China is a vast country with different climates from north to south and different reliefs from east to west. Geologic and highway hazards are widely distributed throughout the country. According to these characters, researchers of China chose natural regionalization as the main method for studying the impact of geographical environment on highway engineering. The former Soviet Union used the macroscopic regionalization to analyse the impact of the geographical environment on highway. Considering its geographic and climatic conditions, researchers of the former Soviet Union made climatic zoning for highway mainly based on latitudinal zonality. For much of the territory in the former Soviet Union is plain, latitudinal zonality is the main influencing factor on highway. So, they gave little consideration on non-zonality.

While the United States, Canada etc. set about research from microcosmic direction. In the Strategic Highway Research Program (SHRP) initiated in 1987, researchers paid special attention to the indexes directly related with highway engineering and made a lot of research in this aspect (Solaimanian M et al., 1993; Thomas W Kennedy et al., 1994; Kennedy T K et al., 1994; Mohseni A, 1996; Peter J Bosscher et al., 1997; Jill Ovik et al., 1999). A new grade of asphalt was put forward based on pavement performance. The indexes used in it were directly related with highway engineering. The environmental data were obtained by converting historic air temperatures to pavement temperatures. SHRP also started tests of basic climate data and

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founded database for highway engineering to serve for highway workers (Rabinow S D et al., 1993). Analogous researches were also taken in the Canada-Strategic Highway Research Program (C-SHRP) initiated in 1989 (Watson D K et al., 2000). In addition, seasonal moisture variation in subgrade was studied in some research projects in the USA (Maureen A Kestler et al., 2001).

2 History and today

The research of China natural regionalization for highway began in the 1950s and the whole research course can be divided into three stages. The first stage is from the 1950s to the early 1960s. In this stage, research personnel, mainly from Xi'an Highway Institute and Tongji University, originated the research of China natural regionalization for highway and put forward 2 versions of it in 1959 and 1964. In the second stage, research personnel from Highway Planning and Design Institute of the Ministry of Communications and Geography Department of Peking University started the research in 1972 on the basis of achievements of the first stage. They compiled *Map of China Natural Regionalization for Highway*, which was published by the Ministry of Communications in 1978. Based on these works, *Standard of Climatic Zoning for Highway* was issued in 1986. In the third stage, which is from the 1980s to this day, most research works are focused on the regionalizing of tertiary regions and some regionalizations for specific application.

2.1 General situation of the first stage

The differences among design, construction and maintenance of highway under different natural environments, especially different climatic conditions, were noticed right after the founding of P. R. China in 1949. At the same time, research personnel, mainly from Xi'an Highway Institute and Tongji University, originated the research of China natural regionalization for highway (Li Bin, 1957; 1959, Highway). *China Climatic Zoning for Highway* was compiled in 1958 after overcoming a number of difficulties, such as lack of basic data. This version was revised in 1959 based on the *China Integrated Physiogeographical Regionalization*, which was finished by the Institute of Geography, CAS in 1959 based upon which the subgrade and complete survey all over the country and the regionalization works of some provinces were achieved (1959, Highway). A main purpose of this regionalization was to guide to the solution of frost heaving and boiling and some special problems. It was made according to the principle that zonal factors and regional factors were considered together and a three-level system was taken into account. The primary and secondary regions, which were made nationally, mainly based on zonal factors and the tertiary regions, which was made by each province, mainly based on regional factors. In this version, temperature was the key index of the primary region. According to soil frozen or not and freezing degree, which is differentiated by freezing depth of 80-100 cm, China was divided into five primary regions. Humidity was the key index of the secondary regions. According to humidity coefficient, the whole country was fallen into five levels. In light of characteristics of landscapes, soils and vegetations, 16 secondary regions were identified under the primary regions. As this version had a clear purpose and high practicability, some problems of highway engineering were solved under its guidance and highway construction was promoted at that time. In addition, the three-level system was established in this version, which has been used from then on. However, this version is not perfect for it only focused on the influence of climate on highways while geological structure, geomorphy etc. have not been considered.

After several years' accumulation of basic data and experiences, research personnel, mainly from Xi'an Highway Institute, put forward a new version of *China Climatic Zoning for Highway* in 1964 and brought it into the *Specifications of Flexible Pavement Design for Highway*. But they were not issued because of the Great Culture Revolution (1966-1976).

When highway research workers were absorbed in climatic zoning for highway, some researchers in geography also began to recognize the necessity of natural regionalization for highway. In 1964, according to research on the climatic zoning for highway, Yang Wuyang, from