ISSN 1997-1400 Int. J. Pavement Res. Technol. 2(3)

Design Procedure of Asphalt Concrete Pavements in China: Current Issues and Future Development

Xiaoning Zhang
Professor, College of Civil Engineering and Transportation
South China University of Technology, China (prozxn@163.com)

Along with the rapid economic growth in the last thirty years, China has been expanding its highway systems continuously as well. To date, it has built more than 50,000*km* of expressways (equivalent to the Interstate Highways in the US). Of the entire network, 90% of the expressway consisted of asphalt concrete surface layer and cement treated aggregate (CTA) bases. Typical asphalt layer thickness is 18*mm*. In the design method used in the last 30 years, the surface deflection has been used as the design index and the flexural stress at the bottom of the cement treated aggregate bases as the principal parameter. The design is based on the principal of limiting stresses to minimize fatigue damage; the induced surface deflection and stress and strain distributions were calculated using theory of pavement mechanics. However, some very important factors, such as traffic related parameters, environmental factors, and proper design values to be used, are still largely relied on experiences.

With the continued expansion of the highway systems, the current design method is facing three distinct challenges:

1. As the CTA base layer being one of the primary load-carrying components of the pavement structure, once failure occurs, the entire structure needs to be repaired. The cost associated with the maintenance, rehabilitation, and repair activities can be substantial. With marginal load-carrying capacity, reflective cracking caused by the shrinkage cracks of CTA layer is one of the major distresses in China's pavements.
2. The current design method does not take into account other common modes of pavement failure, such as rutting, skid resistance, water related damages, etc. Even though the construction specifications define and specify material properties and asphalt mix designs, the mix designs cannot overcome the deficiencies of the pavement structure design.
3. The quality control / quality assurance (QC/QA) and final pavement structure acceptance testing and procedures are not adequate. They are mostly based on the adequacy of the materials as the acceptance criteria. The measured surface deflection has been used as the acceptance parameter for pavement construction. However, definite relationships between the surface deflection and the structural adequacy of the pavement structure have not been established. This deficiency in the QA/QC process is further magnified by the variability of the asphalt mixtures and the lack of uniformity of the construction quality.

One major shift in most recent asphalt pavement structure design in China is the use of asphalt concrete as the base/subbase layers instead of CTA bases, which makes the pavement structure more adaptable to various traffic conditions. Researches are underway to develop design methods that address various distresses, including fatigue, rutting, and others. The concept of perpetual pavements to more reasonably distribute the service lives of various layers is also under study. Another area of interest is the improvement of construction quality. In most expressways currently under construction, the owner agencies have utilized private consultants to conduct Quality Verification (QV) to supplement the QC/QA systems.

As in the current development of the Mechanistic-Empirical Pavement Design Guide (MEPDG) in the USA, China officials are also conducting researches aiming in developing M-E based pavement design. Much effort has been spent in improving the pavement design process; however, developing a more mechanistic (or theoretical) based procedure is still a long-term objective, requiring contributions from engineering communities throughout the world. China will be most grateful to be part of the effort.