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Design and skid resistance evaluation of skeleton-dense epoxy asphalt mixture for steel bridge deck pavement

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HIGHLIGHTS

- One skeleton-dense epoxy asphalt mixture was designed and evaluated.
- The designed mixture meets the operating requirements of steel bridge pavement.
- The designed mixture has superior rutting resistance and anti-fatigue performance.
- The designed mixture could significantly improve the pavement skid-resistance.

ARTICLE INFO

ABSTRACT

To improve the skid-resistance of epoxy asphalt concrete pavement for the steel bridge deck, an epoxy asphalt mixture with skeleton-dense structure was proposed. This paper carries out a laboratory study on the design and performance evaluation of skeleton-dense epoxy asphalt mixture. Firstly, the mixture was designed through a volume design method, and the pavement performance was investigated to evaluate the applicability of the skeleton-dense epoxy asphalt mixture for the steel bridge pavement. Secondly, the skid-resistance of the skeleton-dense epoxy asphalt mixture was evaluated, including the initial skid-resistance, long-term skid-resistance and skid-resistance under the inclement weather condition. The long-term skid-resistance attenuation law was simulated by the small traffic load simulation system MMLS3, and the skid-resistance life was predicted. The skid-resistance attenuation law under the rainy and freezing weather was investigated in the laboratory, and the influence of water film thickness, different ice situations on the pavement skid-resistance was analyzed. Finally, gray correlation analysis method was applied to the comprehensive evaluation of pavement skid-resistance. Results indicate that the proposed mixture could meet the operating requirements of steel bridge pavement and dramatically improve the skid-resistance of epoxy asphalt concrete pavement.

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1. Introduction

Epoxy asphalt mixture (EAM) has been proven to be a superior material and has been widely used in the steel deck pavement [1,2]. In general, EAM is made of suspended-dense structure, which could ensure the excellent physical and mechanical properties, such as watertightness and anti-fatigue performance [1,3]. Nevertheless, the suspended-dense EAM with insufficient pavement structure depth, tends to cause the shortage of skid-resistance on the epoxy asphalt pavement, especially under the conditions of inclement weather or large longitudinal slope [3,4].

Currently, materials for skid-resistance asphalt pavement are skeleton-dense structure [5,6], which could reinforce the skid-resistance of asphalt mixture through increasing the maximum size and proportion of coarse aggregates. However, influenced by the design thickness of asphalt pavement for the steel bridge deck, the NMAS of EAM is generally restricted to 9.5 mm (the so-called EA-10). In addition, excessive coarse aggregates would sacrifice the watertightness and anti-fatigue performance of EA-10. Therefore, this paper designed the skeleton-dense EAM, to improve the skid-resistance while balancing it with the physical-mechanical properties.

The common design methods of asphalt mixture, the Marshall and SUPERPAVE design method [7,8], are mainly based on the empirical method and laboratory tests. The SUPERPAVE method is usually used for the traditional dense-graded asphalt mixture, and demands a higher level of experimental facilities and

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