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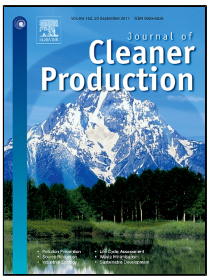

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A Combined Static-and-Dynamics Mechanics Analysis on the Bridge Deck Pavement

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Abstract

The mechanical performance evaluation on bridge deck pavement has always been a critical issue for pavement engineers since it directly bears the loadings from vehicles and environment. Due to the complex service conditions including composite structure design, massive vehicle loadings, serious environmental conditions, large vibration and large deflection deformation, the service life of bridge pavement structure is usually much shorter than the common pavement structures. To evaluate the pavement structure stress state comprehensively, a combined static-and-dynamics analysis is conducted in this paper, combining with the sites tests in the cross-sea bridge pavement deck in Caofeidian District, China. The finite element software ANSYS is employed to study both the static and dynamics stress of bridge pavement. Simulation results show that the suggested thickness for the upper layer pavement thickness is 3.5 cm ~4.5 cm and the lower layer is 5 cm ~ 7cm. And the suggested modulus for the pavement upper structure is 1600~1900MPa and 900~1000MPa for the lower structure. It is found that, along with the approaching of the load, the vertical displacement of each layer of the bridge deck pavement increases, and the vertical displacement decreases with the leaving of load. During the loading cycle, with the increase of speed, the maximum vertical displacement of bridge deck pavement decreases.

Keywords: Bridge deck pavement; static-and-dynamics mechanics; finite element; simulation.

INTRODUCTION

The mechanical performance evaluation on bridge deck pavement, usually asphalt concrete, has always been a critical issue for pavement engineers (Hou et al. 2016, 2017a) since it directly bears the loadings from vehicles and environment. Due to the complex service conditions including composite structure design, massive vehicle loadings, serious environmental conditions, large vibration and large deflection deformation, the service life of bridge pavement structure is usually much shorter than the common pavement structures.

There have been many research in simulation of the bridge deck pavement structure, where most models are based on finite element method and energy theories. ElSafty et al. (2016) proposed analysis, prediction and case studies of early-age cracking in bridges. Chen et al. (2016) developed a multiscale numerical modeling of steel bridge deck pavements. Pouget et al. (2012) evaluated the viscous energy dissipation in asphalt pavement structures and implication for vehicle fuel consumption. Hou et al. (2017b) proposed an energy-based approach to evaluate the failure in asphalt materials and pavement structures. Xue et al. (2013) studied the dynamic behavior of asphalt pavement structure under temperature-