Steel Decks under Temperature Loads due to Road Surfacing

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Summary

During the last 30 years orthotropic decks have become popular. In Germany the typical covering consists of a sealing to protect the steel deck from corrosion and on top 2 layers of cast asphalt, each 35 mm thick. Cast Asphalt has a good workability and does not need any roller compaction which could lead to a separation from the steel deck due to vibrations. It must be placed with high temperatures up to 250°C which may generate unacceptable high stresses in the bridge deck and reactions in the bearings due to the high heat input. So far Codes do not cover the load case "temperature due to road surfacing". In this paper a strategy for consideration of this load case is given.

Keywords: Orthotropic steel deck, wearing surface, cast asphalt, temperature load effects.

1. Introduction

A Surfacing on an orthotropic steel deck has the advantage of reducing traffic-induced stresses in the steel deck structure, especially in terms of reducing the stresses causing fatigue failures. Main effect of the surfacing is the distribution of the wheel load through its thickness and also some composite action with the steel plate itself. Since the steel deck is relatively flexible the surfacing has to follow larger deflections without cracking. This is in conflict with the requirements for high stiffness to get good wearing properties.

In different countries different solutions for the surfacing have been developed. In Germany it is found that cast asphalt surfaces meet the requirements best. They do not need further compaction with its risk of separation due to vibrations, but they must be placed with high temperature in the range of 200 to 250°C. Typically 3 different layers are applied - a 10 mm sealing, a 35 mm base layer and a 35 mm deck layer (see fig.1).

Based on temperature measurements done during placement of the surface at typical orthotropic steel decks a load scenario has been developed. Its importance in the strength design of the steel deck and the bearings will be discussed on the example of an older stay cable bridge:

The influence of width and speed of the paver in regard to the energy introduced into the deck and development of vertical and horizontal temperature gradients has to be considered in the design.

The effects on the normal stresses in the longitudinal ribs due to heating up only a part of the deck while the surrounding part remains unheated has to be addressed. This might be critical especially for ribs experiencing high basic compression forces due to global action (stability).

For the first surfacing the placement of the asphalt can be managed the way that it will not govern for the design. Later the exchange of the surfacing must typically be done while a part of the deck will be under traffic. In this case the temperature load will act eccentrically on the structure due to resurfacing of one carriageway only. A design strategy to keep those effects small will be developed.

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