Using SPS Technology to Strengthen an Orthotropic Bridge Deck

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Summary

Despite their magnificent load-carrying properties, some orthotropic steel plates in steel bridge decks are showing signs of reduced fatigue resistance. This has led to much costly repair and maintenance work that in turn restricts traffic flow, an issue of particular concern within the heavily occupied German highway system.

Drawing upon the experience of the ship-building industry, which has encountered the same problem of fatigue-induced damage with roll-on/roll-off ferries, the viability of transferring Sandwich-Plate-System (SPS) technology to steel road bridges was considered. On behalf of the German Federal Ministry of Transportation, the Northrhine-Westfalia Department of Transportation and the state-owned company Strassen.NRW decided, therefore, to undergo a pilot project aimed at a permanent reconstruction and rehabilitation of orthotropic steel deck plates in a road bridge for the first time [1]. This paper reports on the reasons for such rehabilitation measures and the fundamental design issues of the project, and illustrates the repair work that has been done.

Keywords: orthotropic steel plates, steel bridge, fatigue, sandwich-plate, crack, SPS-overlay.

1. Introduction

Steel bridges are commonly used to span large distances. The bridge deck of such longer steel bridges is usually assembled as an orthotropic steel plate. This type of design dates back to a patent of the MAN Company in 1948 [2, 3], and its fundamentals are still in use [4]. Due to tremendous economic development in Germany after WWII, the demand for new bridges outpaced the existing infrastructures and forced new and faster construction methods and new design philosophies. The remarkable development of orthotropic steel plates began in the 1950s and marked an important step towards better and more durable steel deck structures when high-fatigue loads directly affect the material as well as a structure's connecting welding seams.

2. General assembly of orthotropic steel decks

Because the orthotropic deck panel is part of the main girder and participates in the overall bearing process as an orthogonal-anisotropic plate, it not only combines main girders, cross girders, and longitudinal stiffeners beneath the deck, but also significantly reduces the weight compared to older structures, where each bearing member was separately arranged. This construction method made possible our modern long-span steel bridges. The standard design of orthotropic steel decks is given in Fig. 1. Almost all longer steel bridges built after WWII in Germany and other countries have such an orthotropic steel deck.

Although the basic design rules of orthotropic steel plates have remained principally unchanged in the ensuing decades, some modifications have taken place. The longitudinal stiffeners beneath the

https://doi.org/10.2749/222137807796120364
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