Investigation of Actual Wheel Load Distribution and Its Practical Implication for Design

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Summary

The orthotropic steel deck system has been widely adopted to construct long span bridges due to the well-known advantages such as light weight, easy quality control, rapid construction, etc. As bridges become longer and slender, for example, super-long span bridges, two-balanced objectives to prevent fatigue cracks without actually increasing the self-weight of the deck system should be accomplished at the same time. In the previous study, an optimal connection detail regarding the shape of scallop as well as bulkhead plates was suggested and utilizing the proposed connection detail of the system that hardly increases the weight was proved analytically and experimentally to enhance fatigue performance under uniformly distributed wheel load. The actual distribution of wheel load, however, has been reported to be concentrated more above the intersection between deck and cross-beam, which results in stress concentration beneath the region accordingly. The region of interest is located near the welding between longitudinal ribs and a cross-beam. In this study, wheel load test is carried out to investigate the aforementioned load distribution effects to compare with those obtained from finite element methods using commercial program and then analytical model to simulate the actual wheel load is proposed from the comparison between experimentation and analysis.

Keywords: fatigue; orthotropic steel deck; bulkhead plate; wheel load test; concentrated stresses; long span bridges; optimal connection details.

1. Introduction

The orthotropic steel deck system has been widely employed in the field of bridge construction, especially for long span bridges, because it is of great advantages that (1) dead weight of the structure can be significantly reduced, (2) quality of the structure can be monitored at the manufacturing facilities with relative ease, (3) construction of the structure can be finished in a relatively short span of time, etc. The dead weight of the super structures using the orthotropic steel deck system is just about 1/2~1/3 compared with that made out of concrete, so the orthotropic steel deck system has been considered more efficient structural system, particularly for long span bridges.

The orthotropic steel deck system is composed of a couple of orthogonal layers of longitudinal and transverse ribs, which were connected with numerous welding in order to support a deck plate. Even if the welding technique has been greatly improved, fatigue failure occurring at welding

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