

# Phased array ultrasonic inspection of rib-to-deck welded joints in orthotropic steel decks

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### Abstract

Over the last decade, fatigue cracking has been observed in welded joints between the trapezoidal rib and the deck plate in many orthotropic steel deck bridges in Japan. Considering fatigue cracking at rib-to-deck welded joints can cause pavement damage and thus compromise transportation safety, it is necessary to detect and repair fatigue cracks at rib-to-deck welded joints at the early stage of development. This paper presents a new inspection method for rib-to-deck welded joints in orthotropic steel decks using phased array ultrasonic testing. Although existing inspection methods for rib-to-deck welded joints aim at detecting fatigue cracks in the deck plate solely, the developed method examines both the deck plate and the weld bead simultaneously by using an electrically driven scanner holding twin phased array ultrasonic probes. The developed inspection method is implemented at the Meiko-Chuo Bridge, a steel cable-stayed bridge, and the crack detection ability is examined.

Keywords: non-destructive testing; phased array ultrasonic testing; orthotropic steel deck; fatigue crack; cable-stayed bridge

## **1** Introduction

For bridge decks, fatigue loading is one of the most detrimental actions because of rather high live-to-dead load ratio and hence large stress range is caused in the components of bridge decks. Among various types of bridge decks, orthotropic steel decks are supposed to be subjected to the most severe fatigue loading due to the light weight for which, however, orthotropic steel decks have been commonly used in long-span bridges where the minimisation of dead load is of highest importance.

The orthotropic steel deck is a welded structure consisting of a flat and thin steel plate stiffened by a series of longitudinal ribs with support by