

# Investigation and Diagnosis of Fatigue Cracks of Rib-to-Deck Welded Joints in Orthotropic Decks by the Phased Array Ultrasonic Scanner

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## 1 Abstract

Over the last decade, fatigue cracks have been observed at the rib-to-deck welded joints in many orthotropic decks in Japan. Considering the fatigue cracks can cause pavement damage and thus compromise transportation safety, it is necessary to detect and repair it at the early stage of its development. But the cracks occur from the weld route, it cannot be detected in early stage by visual check. Therefore, the phased array ultrasonic scanner (PAUS) has been developed as the method which can detect and measure the cracks with small size. And, it can simultaneously investigate the deck propagation type cracks and the weld bead propagation type cracks.

In this study, we propose a diagnosis method which considered the relation with selected countermeasures based on technological knowledge. And we propose an investigation area selecting method based on investigation speed of the PAUS which is confirmed by trial on the real bridge. In addition, the cost advantage by using the PAUS is estimated.

**Keywords:** orthotropic deck; rib-to-deck welded joint; fatigue crack; PAUS; diagnosis method.

## 2 Introduction

In the welded joints between trough ribs and deck plates of orthotropic decks shown in Figure 1, the deck propagation type cracks (Figure 1 [a]) and the weld bead propagation type cracks (Figure 1 [b]) are found [1]. The propagation of these cracks is likely to hinder safe passage of traveling vehicles. Therefore, these cracks should be immediately dealt with. On the other hand, since these cracks initiate from the weld root, they cannot be checked visually until they penetrate the deck or the weld bead.

Generally, when these cracks are found, the overlaying method of the steel fiber reinforced concrete (SFRC) is applied after crack treatment of stop holes and welding repair [1], [2]. If these cracks can be detected with sufficiently small size, it may be possible to stop the crack propagation only dealing with the SFRC pavement even if crack treatment is not be applied, and more rational measures become possible. In addition, non-destructive inspection method using the phased array ultrasonic scanner (PAUS) that can be found 3mm or more depth cracks has been proposed [3].