Highway bridge deck made of ductile-cast-iron

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Abstract

The application of ductile cast iron to a bridge deck is explored. Produced by casting, the deck can be of any shape without welding and expected to have little possibility of fatigue crack. The deck would be light, about a half of the RC deck, so that it could enhance the seismic resistance of a bridge. The deck is designed following the Japanese design specifications for steel highway bridges. The design is done by 3-D FEM. Through computational simulations and actual casting trials, the ductile cast-iron deck panel with uniform material property is produced successfully. To investigate its structural behavior, the panel is loaded statically. Ductile structural behavior is observed without initiating cracks. Fatigue test is carried out. No fatigue cracks occur even when the number of the loading cycles reaches 10,000,000. The wheel load running test of the 12 deck panels was conducted, ensuring that a very good fatigue resistance.

Keywords: Ductile Cast-Iron; Bridge Deck; FEM Analysis; Static Loading Test; Fatigue Test; Wheel Load Running Test

1 Introduction

Since the number of road infrastructures increased rapidly from around 1970s, their deterioration is now a pressing issue in Japan. For example, extensive renovation of expressway is now underway. This is in fact a big project: the cost estimate amounts to USD 27 billion. The bridge deck appears to be especially troublesome, since the renovation of the bridge deck accounts for 60% of the total cost [1].

Many of the old bridges are insufficient in seismic resistance. Therefore, a light bridge deck is preferred, as it contributes to the reduction in the seismic load. Needless to say, construction speed is also an important issue in the renovation. The orthotropic steel deck is often employed from those points of view. However, many existing orthotropic steel decks suffer from fatigue crack [2]. It is noted herein that cracks have been initiated in the welding.

Although not much used in Japanese civil infrastructures, the ductile cast iron is known to possess mechanical properties similar to structural steel. Besides, it can take any shape without resorting to welding. No welding indicates a low possibility of inducing fatigue crack. Stress concentration can be reduced easily by producing an appropriate shape. The weight and the construction speed would be comparable to those

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