Load transferring mechanism of long riveted joint partially replaced by high-strength bolts

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Abstract

Rivet joints are widely applied in the connections of steel bridges prior to 1950 owing to their tightness and strength. Some rivets become loosened or corroded after repeated loading and long-term usage. Previous studies indicate that replacing riveted joints with a high-strength bolt to achieve friction may be the best approach for repairing a riveted joint. However, for a long riveted joint, which has an uneven load distribution, the removal of individual rivets may overload the other rivets. This study focuses on long riveted joints at the bottom flange of an actual riveted bridge. The load redistribution mechanism involved when the rivet is removed under a dead load is investigated by performing a finite element (FE) simulation. The FE analysis results show that when a rivet is replaced by a bolt, the rivet's load transferring ability is affected more by rivets near the bolts, whereas more distant rivets pose almost no effects.

Keywords: riveted bridge, long riveted joint, high-strength bolt, load transferring mechanism, FE analysis, rehabilitation.

1 Introduction

Rivet joints are widely applied in the connections of steel bridges prior to 1950 owing to their tightness and strength. In fact, many riveted bridges connected by these rivet joins remain in service [1]. Figure 1 shows a riveted bridge built 90 years ago that is in service currently. Some rivets are loosened or corroded after repeated loading and long-term usage, as shown in Figure 2. The reduced volume of a rivet's head significantly affects the fatigue life of the joint [2]. The effect of rivet corrosion on the remaining bearing capacity of bridge structural elements has been investigated [3].

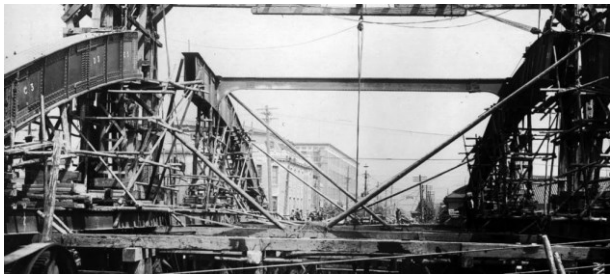

Figure 1. 90-years old riveted bridge (courtesy of Osaka City)

To recover the structural performance or extend the structural service life, riveted bridges should be repaired or reinforced appropriately.