

# Slip coefficient of 90-year-old riveted joint surface with red lead paint for corrosion

Yu Chen, Takashi Yamaguchi

Graduate student & Professor, Osaka City University, Osaka, Japan

Motoshi Yamauchi, Keita Ueno

Professional Engineer & Professional Engineer, MM BRIDGE CO.LTD., Hiroshima, Japan

Contact: [cy519234505@gmail.com](mailto:cy519234505@gmail.com)

## Abstract

Before 1950, steel bridges were basically connected by rivets. Most of the steel bridge has been replaced due to aging or corrosion. However, many rivet bridges are still being in service; some of the rivets might be corroded and loosen due to the paint coating's deterioration. The riveted bridge has to repair by replacing the corroded rivets with high-strength bolts for friction connection. However, the slip coefficient of riveted joint surfaces with red lead treatment is not specified. In this study, specimens cut out from a 90-year-old riveted bridge's joint section and evaluated the riveted joint surface's aging condition by microscope observation and elemental analysis. The slip and pressure distribution tests are also conducted to investigate the slip coefficient and pressure distribution of riveted joints' surface. It is found that the joint surface is not flat, the average slip coefficient is 0.274, and the  $-2\sigma$  is calculated to 0.169.

**Keywords:** riveted bridges; red lead paint; slip coefficient; slip test; contact area; repair.

## 1 Introduction

Rivets were widely used in the world to fasten steel members in the early days, and also used for cross-section connections for steel bridges. Since 1950, countries worldwide have been issued design specifications for high-strength bolts connection, and high-strength bolts connection have gradually replaced rivet connections. However, many riveted bridges are still in service [1]. Some of the rivets might be corroded and loosen due to deterioration of the paint coating. The reduction of the volume of a rivet's head is severely affected fatigue life [2]. Studies have also pointed out the influence of rivets' material loss on these bridge structure

elements' remaining bearing capacity [3][4]. For structural performance recovery or to extend their service life, the riveted bridges have to repair or reinforce by replacing the corroded rivets with high-strength bolts, e.g., Figure 1. Replacing the rivets with a high-strength bolt for changing to the frictional joint is a desirable approach to repairing the corroded riveted joint [5].



Figure 1. Rivet corrosion