November 11, 2024, 異分野研究交流会

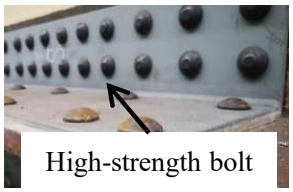
Study on design method of combined joints with high-strength bolts and adhesive for steel bridge

This study investigate the influence of hygrothermal environment on combined joints and obtain the method to enhance slip coefficient of combined joints, assess the suitability of combined joints for repairing corroded bridges

Osaka metropolitan university, Graduate school of engineering
Bridge engineering Lab. Yao Lingbo

1. Research motivation

Corrosion on bridge



Example of repair by combined Joints

Corrosion damage is common for steel bridge. To repair the corrosion plates, the high-strength bolted joints with adhesive can be applied to repair and reinforce steel bridges suffering from corrosion.

Key words: Adhesive, high-strength bolt, slip coefficient, hygrothermal

Purpose:

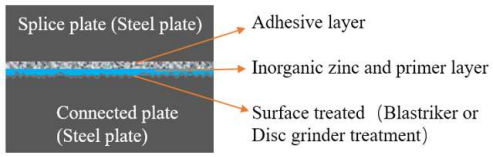
1. Investigate influence of hygrothermal environment on combined joints
2. Enhance slip coefficient of combined joints
3. Assess the suitability of combined joints for repairing corroded bridges

2. Methods

1. Tensile test of combined joint (Experiment finished)

Treat the contact surface with Blastriker and Disc grinder to achieve different roughness, conduct a tensile test of hybrid joints to investigate the influence of surface treatment on the hybrid joints in the hygrothermal environment.

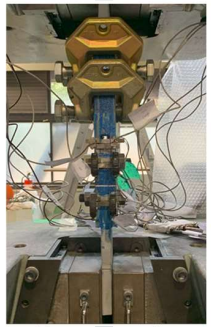
Fabricated specimen



Sketch of the cross-section of specimen joints

$$\mu = \frac{F_s}{n_f * \sum P}$$

F_s: Slip load
μ: Slip coefficient
n_f : Number of friction surface
N: Bolt axial force



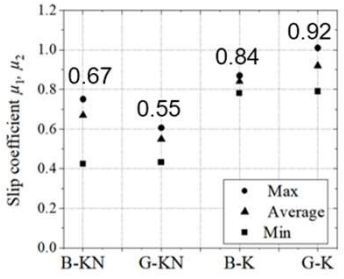
Tensile test of combined joints

2. Shear strength of steel cubes (Experiment, Plan)

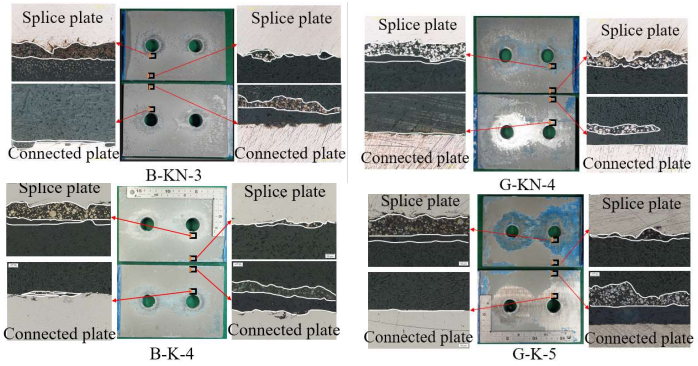
Study on the effects of curing temperature, curing time, pressure and surface treatment on the shear strength of steel cubes separately.

3. Bending test of beams with flange repair by combined joints (Experiment and Finite element method, Plan)

3. Test result



Comparison of slip coefficients



Contact surface condition after test

Around hole: Mixed failure
Edge: Cohesive failure

Around hole: Interfacial failure
Edge: Cohesive failure

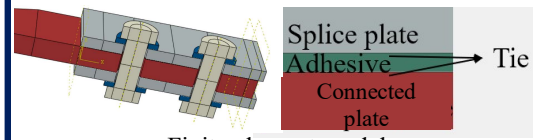
4. Summary

(1) For the combined joints without one-month hygrothermal environment. The slip coefficient of the specimens treated with the Blastriker power tool is 1.2 times greater than that of the specimens treated with the Disc grinder power tool.

(2) For combined joints with one-month hygrothermal environment, higher roughness does not result in a higher coefficient.

(3) Surface treatment can change failure mode around bolt hole, hygrothermal environment does not have a significant effect on the failure mode.

5. Further research



Finite element model

(1) Establish a finite element analysis model and compare it with the experiment. (On going)

(2) Study the effects of temperature, curing time, pressure, and roughness on the joint separately. (Plan)

(3) Conduct a bending test for beams repaired with combined joints. (Plan)