Study on the Design Method of Combined Joints with High Strength Bolts and Adhesive for Steel Bridge Repair

Osaka Metropolitan University Graduate School of Engineering Bridge Engineering Lab Yao Lingbo

Study on Surface Treatment on the Slip Coefficient of Combined Joints under Hygrothermal Conditions

BACKGROUND

Fig. 1 Example of repair a corrosion bridge 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. (Fig.1)

Purpose:

1. Investigate influence of hygrothermal environment on combined joints
2. Enhance slip coefficient of combined joints

METHOD

Step 1: Achieve different surface roughness levels by power tools. (Table 1, Fig.2, Fig.3)
Step 2: Assembled and cured either in an indoor environment or under hygrothermal environment. (Fig.4, Fig.5)
Step 3: Conduct a tensile test of combined joints.

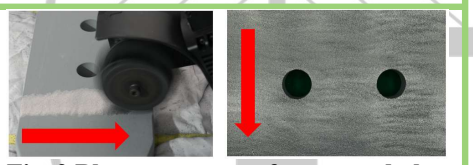


Fig. 2 Blast treatment of connected plate

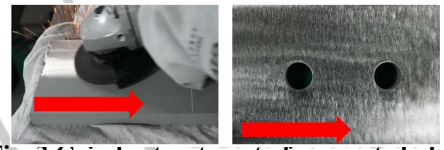


Fig. 3 Grinder treatment of connected plate

Table 1 Summary of specimens

Case	Surface treatment	Hydrothermal environment
B-KN	Blast	None
G-KN	Grinder	
B-K	Blast	Have
G-K	Grinder	

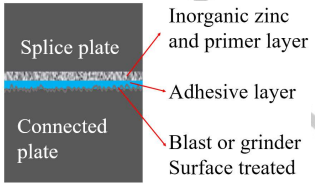


Fig. 4 Sketch of the cross-section of combined joints

Fig. 5 Fabricated specimen

KEYWORDS

Adhesive, Combined joints, Hygrothermal environment

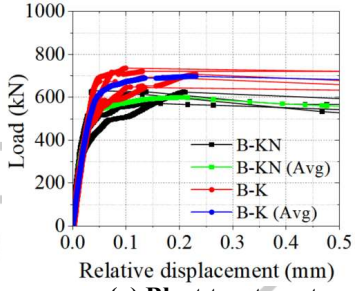
RESULTS

Ra (arithmetic average roughness) (Fig.6)
B-KN & B-K: 6.1–9.4 μm (average 7.9 μm)
G-KN & G-K: 1.6–2.4 μm (average 2.0 μm)
A significant difference in surface roughness

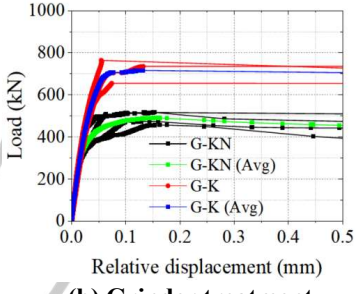
Bolt axial force reduction ratio (Fig.7)
Min: 6.7%, Max: 9.6%
B-KN & B-K: Average 8.4%
G-KN & G-K: Average 7.7%
No significant difference in the bolt axial force reduction

***μ* average** (Fig. 8, Fig,9)

G-KN: 0.57 → Higher *Ra*, Higher *μ* → B-KN: 0.73
G-K: 0.86 ← 1-month hygrothermal environment ← B-K: 0.84



(a) Blast treatment



(b) Grinder treatment

Fig. 8 load-relative displacement curve

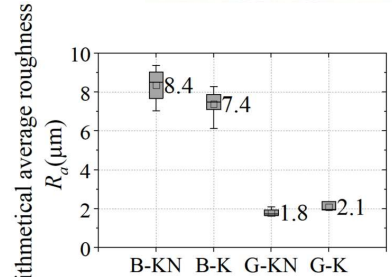


Fig. 6 Surface roughness

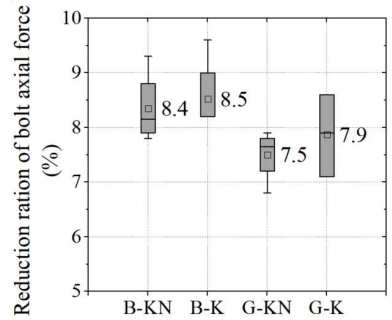


Fig. 7 Bolt axial force Reduction

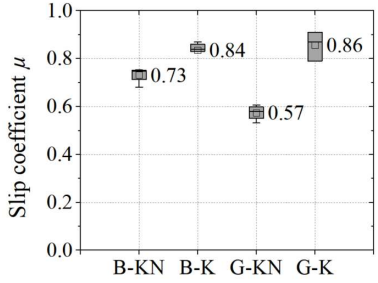


Fig. 9 Comparison of slip coefficients

SUMMARY

1. Blast and grinder treatments achieved different surface roughness levels, with average *Ra* of 7.9 μm and 2.0 μm, respectively.
2. Higher surface roughness led to higher slip coefficients without 1-month hygrothermal environment, and curing with a 1-month hygrothermal environment can enhanced the slip coefficients of the two types specimen.