EXPERIMENTAL STUDY ON FRICTIONAL SHEAR RESISTANCE OF HIGH STRENGTH BOLT CONNECTION WITH CORROSION

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The FBG sensors were adopt to monitor clamping force of frictional high strength bolt connection with corrosion, furthermore, study the frictional shear strength of connection

BACKGROUND

Friction high strength bolt connections are widely used in steel structures for connecting components. The bearing capacity of the friction high strength bolt connection is positively related to the bolt clamping forces and the slip coefficient.

Traditionally the torque wrench is used to control the clamping force. **The measurement error of the torque wrench can as high as 50%. In recent years,** the acoustoelastic effect based methods are employed to detect the clamping force.

Fig. 1 Corroded high strength bolt connection

Moreover, many severely corroded high strength bolts connections were observed in steel structures in long-term service as shown in Fig. 1. The steel corrosion of the high strength bolt connection may cause the clamping force decrease, change the slip coefficient of high strength bolt connections and hence influence the bearing capacity. However, the variation in the **clamping force of the bolts has rarely been precisely monitored in the steel corrosion process.** The influence of the decreased bolt clamping force, which may be induced by steel corrosion, on the frictional shear strength of the high-strength bolt fitting has not been fully investigated.

KEYWORDS High-strength stud bolt connection, Corrosion, Bolt clamping force, Shear resistance

METHOD

1. The **fiber bragg grating (FBG) sensor** is used for measuring the clamping force.
2. The clamping force decrease of each high strength bolt after finally screwed was monitored for analysis of the clamping force decrease.
3. The experiments of accelerate steel corrosion and the shear resistant of the high strength connections were conducted for **quantitatively investigate the corrosion effect on the clamp force and frictional shear strength** of the high strength bolt connection.

Fig. 2 FBG sensor installation for measuring clamping force

RESULT

1. Clamping force decreases rapidly in the first 2 hour, the clamping force decreases very slow after 5 hours and the clamping force is almost no change from the 7th day to the 21st day. **The average and standard deviation of the final clamping forces of bolts are 20.7% and 11.4% respectively** as shown in Fig. 3.
2. After corrosion, **the clamping force reduction ratios are from 1.7% to 4.5%** as shown in Fig.4.
3. **The slip load and the slip coefficient of high strength bolt connection increases** as the corrosion depth increasing within the average corrosion depth of cover plate is 1.02 mm as shown in Fig. 5 and Fig. 6.

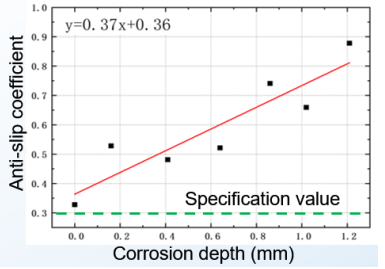

Fig. 5. Anti-slip load of corrosion high strength bolt connection

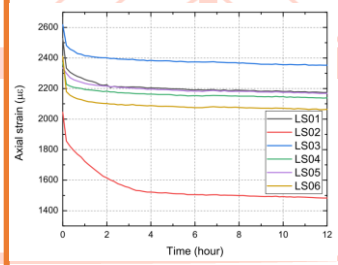

Fig. 3. Bolt relaxation after final tighten

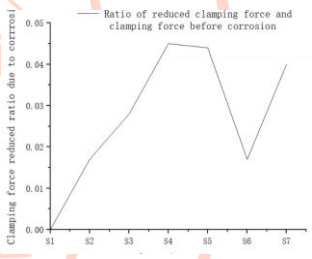

Fig. 4. Bolt relaxation ratio after corrosion

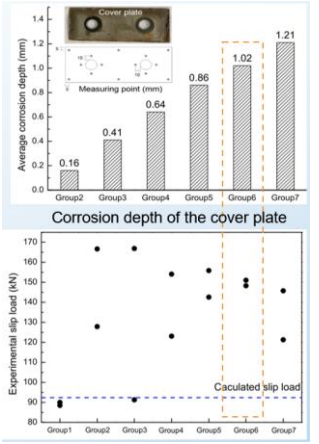

Fig. 6. Slip loads of corrosion high strength bolt connection

SUMMARY

1. The clamping forces were significantly decreased after finally screwed and the reduction ratio is greater than 10% which set by Chinese specification.
2. Although clamping forces were reduced because of corrosion, but the slip coefficients of high strength bolt connection are enhanced. In addition, the slip loads of the high strength bolt connection are generally larger than those of high strength bolt connection without corrosion. It can be concluded within 1.2 mm of average corrosion depth of cover plate, **the corroded high strength bolt connection still have sufficient frictional shear strength.**