Repair of Crane Girder using CFRP
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Introduction and background

In recent years, crane girders using rivets has reached their fatigue life in many factories. To repair these crane girders a new method was necessary.
This leaded to a new Reinforcement and repairment method of a crane girder using Friction-type Sandwiching device (Pitagrip) and a CFRP plate

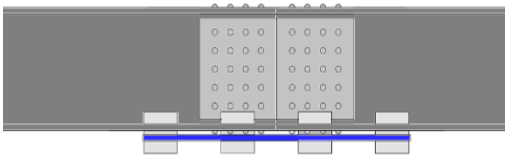


figure 1: Reinforcement and repairment of a crane girder using Friction-type Sandwiching device

Objectives and research flow

The friction-type joint device is mainly used to tighten steel, so the main objective of this research is to gather data about the reinforcement effect of the friction-type sandwiching device on a riveted crane girder
By carrying out both Tensile and Bending experiments we can collect data about this new reinforcement method.

Trough shear test experiments the sliding resistance of CFRP can be obtained.
Also, confirm the load that can be borne by the members sandwiched between the pita grips and finally decide the number of Pitagrip needed for reinforcement
In other hand, through bending tests the stress distribution in the cross section and the effective cross section of the reinforced section can be confirmed. Furthermore, verify the validity of the required pitch for the friction joint sandwiching device.

The tensile test parameters are:

1. Thickness of the CFRP
2. Presence of Seam in the CFRP
3. Presence of Rough Surface

After carrying out 12 tests, a fourth parameter was included

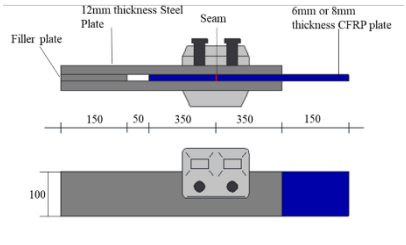


figure 2: tensile test experiments specimens drawing

4. Introduced axial force

This to confirm the relation between introduced axial and the break mode of the CFRP

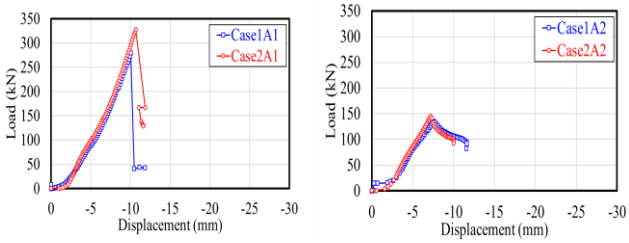
The bending test parameters are:

1. Thickness of the CFRP
2. Distance Between each Pitagrip

A third parameter was added after two experiments to confirm if the stress distribution on the CFRP could be improved

3. Additional Reinforcement on the CFRP.

Experiment results and Conclusion



(a) ***(b)***

Figure 3 (a) 8mm thickness specimen vs 6mm thickness specimen ***(b)*** Specimens with presence of seam

Regarding of Tensile test experiments, we can conclude:
the thicker the CFRP plate is, the proof stress increased. But specimens lost their resistance with the presence of seam.
100% maximum axial force improved the strength but destroyed CFRP as shown below.

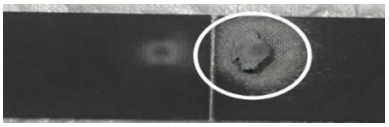


Figure 4: damage on the CFRP with 100% introduced axial force

After carrying out 12 tensile experiments, 15 experiments were added to confirm the fourth parameter included after.
Reducing the axial force introduced on the Pitagrip, the CFRP was not destroyed but the CFRP only slipped from the pita grip without damaging its surface.

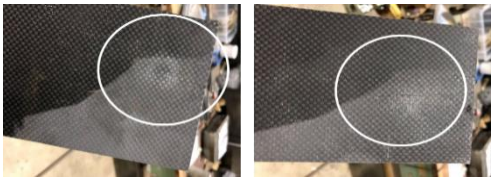
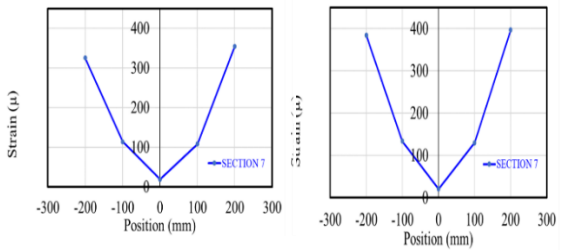
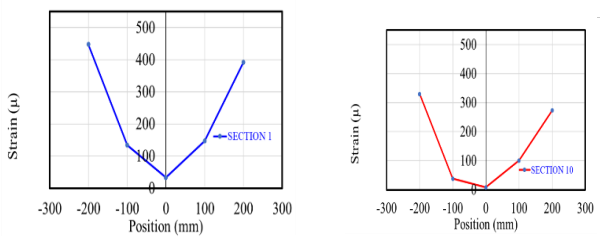


Figure 5: damage on the CFRP with 64% introduced axial force

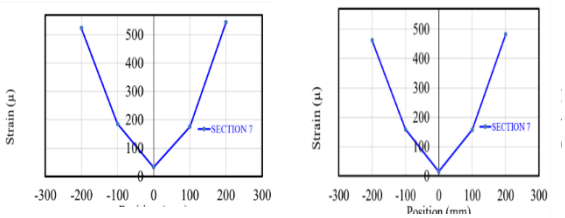


(a) ***(b)***



(c)

Figure 6: (a) 6mm thickness specimen stress distribution ***(b)*** 8 mm Specimens stress distribution ***(c)*** Additional Reinforcement specimens stress distribution



(a) ***(b)***

Figure 7: (a) 300mm pitch specimen stress distribution ***(b)*** 900mm pitch Specimens stress distribution

Regarding to bending tests, the strain is not uniformly generated in the cross section. The reinforcement effect is only perceptible near the Pitagrip.
the reinforcement effect is reduced as the pitch becomes bigger, the objective of avoiding a loss in the reinforcing effect could not be achieved after increasing the distance between each device.

REFERENCES

M.Contreras Daniel REINFORCEMENT OF STEEL STRUCTURE JOINTS UNDER COMPRESSION FORCES BY USING CARBON FIBER POLYMERS (CFRP), 2019

T. Taguchi, T. Kamiya, Y. HAGA, EXPERIMENTAL STUDY ON FRICTION-TYPE JOINT FOR SANDWICHING STEEL PLATE, Steel construction Engineering, Vol.23 No. 90, (in Japanese) 2016