Development of a fretting fatigue fixture

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I. Introduction

Fretting fatigue occurs when two bodies are in contact and at the same time repeatedly move relative to each other. The amplitude of the relative sliding motion is often in the order of micrometers.
This phenomenon occurs in mechanical systems. For example in the aviation industry where dovetail connections [1] and lap joints [2] are used to connect parts.

II. Basics of a fretting fatigue test

Fretting fatigue testing is commonly performed on coupon specimens (Figure 1). Fatigue specimens are used in combination with two intenders (pads) that are pre-stressed against the fatigue specimen.

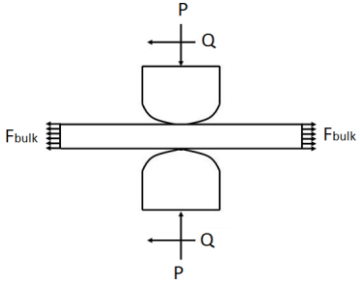

Figure 1. Coupon scale fretting fatigue testing

The load F_{bulk} is an alternating fatigue load that can be applied by a standard tensile tester.

The normal load P is applied by means of a fretting fixture and the tangential load Q is a result of the interacting forces and the compliance of the test rig.

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III. Advanced fretting fatigue fixtures

During fretting fatigue, wear occurs and particles (debris) are produced in the contact area. These debris will either be trapped in the contact area or evacuated out of it. The normal distance between the fatigue specimen and the pads will change by this modified geometry. However the normal force should not be affected by this changing geometry.

A. Movable fretting fatigue fixtures

Fretting fixtures are commonly floating or suspended on the base frame. Low weight and symmetry are necessary so that the specimen is not additionally loaded by the fixture.

Axial springs and drawbars or a proving ring (circular spring) satisfy these preconditions, but lack the ability to control the normal force. Even keeping the normal force constant is impossible due to debris.

B. Fixed fretting fatigue fixture

A newly designed fretting fatigue fixture at Labo Soete will be fixed onto the base frame. Hereby a heavy hydraulic actuator can be used in a closed-loop system, leading to a controllable normal force during experiments.

Acknowledgements

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References

[1] Kermanpur, A., et al., *Failure analysis of Ti6Al4V gas turbine compressor blades.* Engineering Failure Analysis, 2008. **15**(8)

[2] Wagle, S. et al., *Ultrasonic detection of fretting fatigue damage at bolt joints of aluminum alloy plates.* IJF, 2009. **31**(8-9)