CONSIDERATIONS REGARDING THE FRETTING PHENOMENON USING LEAF SPRINGS

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Abstract. *The fretting phenomenon represents particulary and complex form of wear who is; generaly, and/or weary of fretting who is produced on the load contact in a relative oscialatory movement lay small amplitude.A simultaneoustly applied tangential force and normal into contact appears a adhesion force*

Keywords: fretting, oscillatory motion, elastic blade

1. INTRODUCTION

Fretting is now fully identified as a small amplitude oscillatory motion which induces a harmonic tangential force between two surfaces in contact. It is related to three main loadings i.e. fretting-wear, fretting-fatigue and fretting corrosion.

The main parameters were reported to be amplitude displacement, normal load, frequency, surface roughness and morphology, and residual stresses. More recently fretting has been discussed using the third-body concept and using the means of the velocity accommodation mechanisms introduced by Godet et al.[1,2]

Fretting regimes were first mapped by Vingsbo. In a similar way, three fretting regimes will be considered: stick regime, slip regime and mixed regime. The mixed regime was made up of initial gross slip followed by partial slip condition after a few hundred cycles. Obviously the partial slip transition develops the highest stress levels which can induce fatigue crack nucleation depending on the fatigue properties of the two contacting first bodies. Therefore prediction of the frontier between partial slip and gross slip is required.

The type of surface damage that occurs in fretting contact depends on the magnitude of the surface normal and tangential tractions. In existing fretting models the relative displacement is assumed to be accommodated mainly micro slip in the contact surface.

2. EXPERIMENTAL MEANS

For the study of the fretting phenomenon in case of elastics assemblages spring slides with multiple sheets, I used the experimental stall from fig.1. .[3]
The stall permits testing for one slide and for spring slides with multiple sheets, too.

2.1. Description of the stall

The elastic blade is assembled on the rigid support, using the upper plate with screws. It oscillates because of the rod and crank eccentric mechanism. This mechanism is actioned by the electrical engine, assuring the necessary conditions for the fretting phenomenon to take place. The contact is charged with the assistance of 4 screws through the agency of some helical springs and through the agency of some radial-axial bearings with conic rolls. The helical springs beforehand standard permit a charge with a normal and known force, the presence of the radial-axial bearings assuring the discharge of friction between the screw and the superior plate.

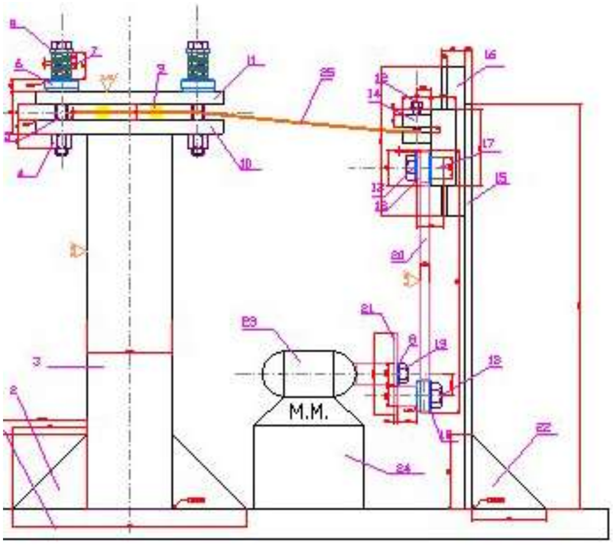

Fig.1. Experimental stall

Fig.2. The system eccentricity

The stall can be used for the testing at fretting of some couples by different materials. This stall can be adapted for study of the lamellar springs with many sheets.

The blades used in experiments have 560x56x2 mm and are realized by spring steel having hardness 55 HRC.

The rod-crank mechanism permits a displacement at the end (extremity) of the 20 mm lamella and can modify this displace by changing of the system eccentricity (Fig.2). The system is actioned through the agency of electrical engine having revolution of 750 rot/min.

The experimental stand was used in order to study the wear state caused by the blade to blade contact, specific for leaf springs with multiple sheets, by a low-amplitude oscillatory motion. In this case I have studied the dependence of the fretting phenomenon of normal push force and a certain request length, obtaining for each case specific traces. At a variation of the push normal force between 200 and 250 N, the duration of exposure ranged between 40000 and 60000 stress cycles[4].

Traces of wear obtained from tests at a normal force of 250 N, reveal, as expected, an increase in the size of the used area, at an increased request length. Also, all traces of fretting wear tests were identified by the presence of "red powder", at the contact between the two blades.

The marks obtained for 250 N and 40000 cycles are shown in Figure 3 for the same normal force and for 50,000 to 60,000 cycles traces obtained are given in Figure 4 and 5.

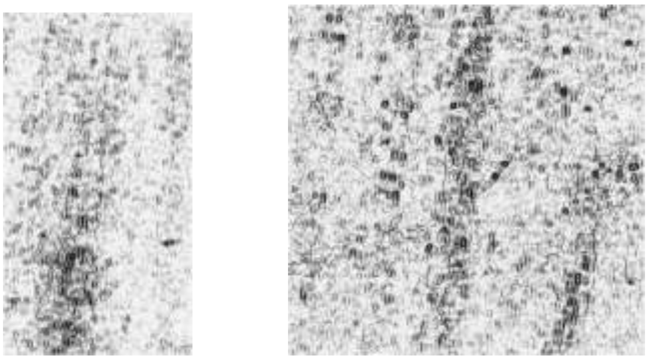

Fig.3.a Traces of wear F = 250N, Nc = 40,000 cycles - upper blade

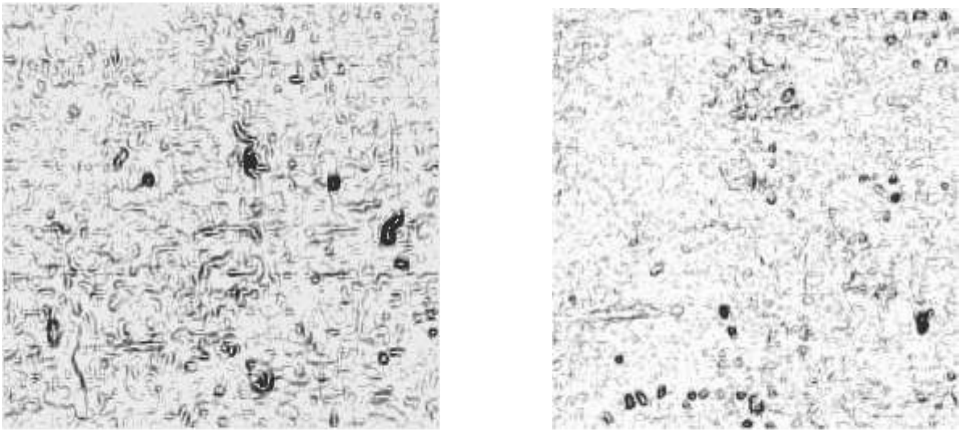

Fig.3.b Traces of wear F = 250N, Nc = 40,000 cycles - lower blade

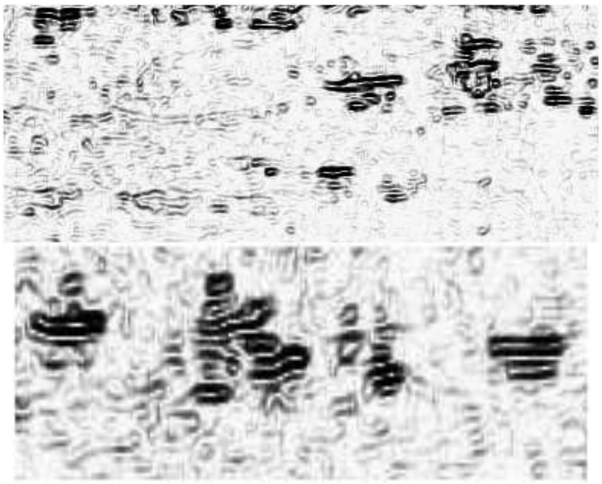

Fig.4.a Traces of wear F = 250N, Nc = 50,000 cycles - upper blade

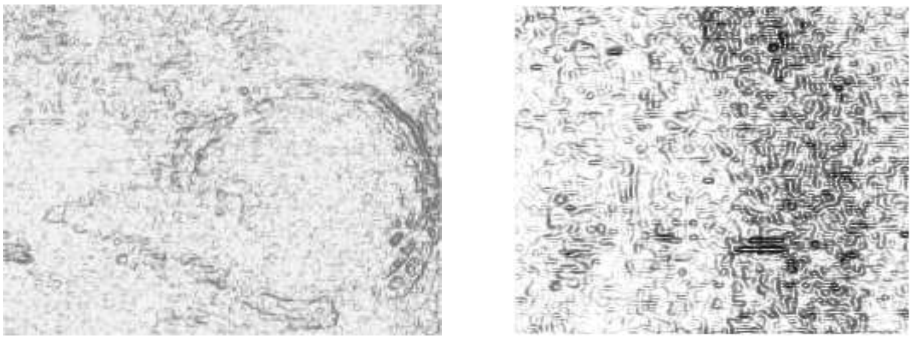

Fig.4.b Traces of wear F = 250N, Nc = 50,000 cycles - lower blade

Fig.5.a Traces of wear F = 250N, Nc = 60,000 cycles - upper blade

Fig.5.b Traces of wear F = 250N, Nc = 60,000 cycles - lower blade

The marks obtained for 200 N and 40000 cycles are given in Figure 6 for the same normal force and for 50,000 to 60,000 cycles traces obtained are given in Figure 7 and 8.

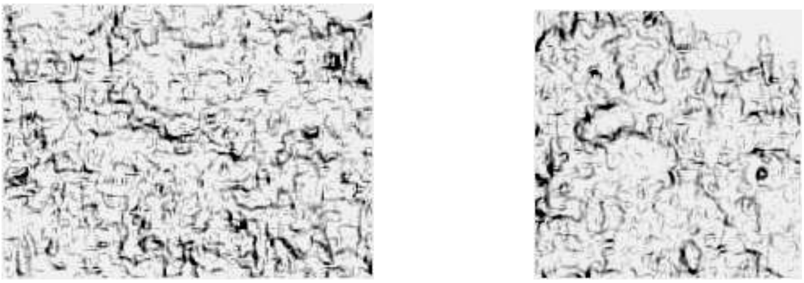

Fig.6. Traces of wear F = 200N, Nc = 40,000 cycles - upper blade

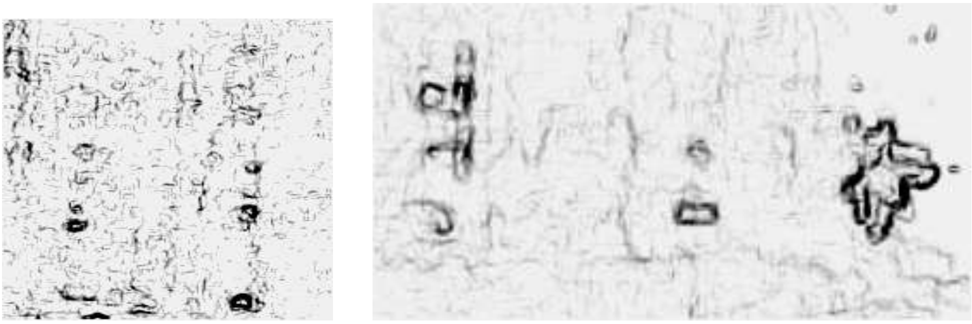

Fig.7.a Traces of wear F = 200N, Nc = 50,000 cycles - upper blade

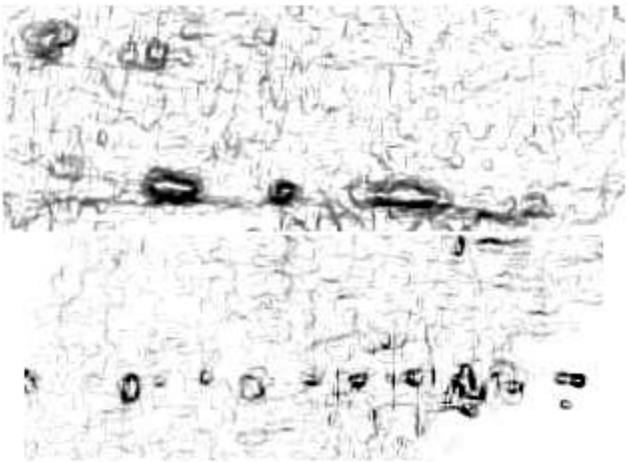

Fig.7.b Traces of wear F = 200N, Nc = 50,000 cycles - lower blade

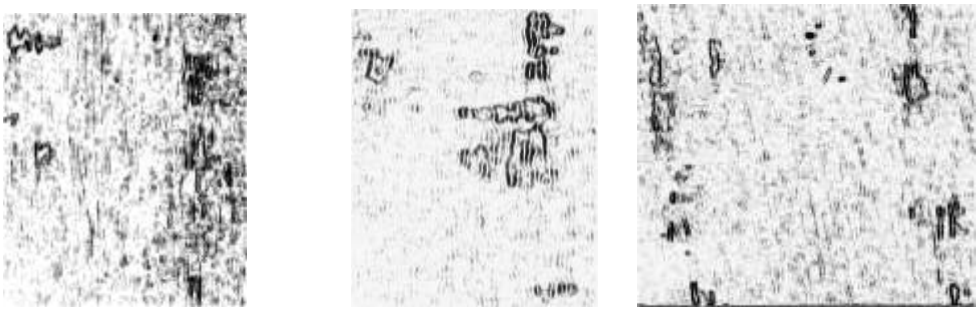

Fig.8.a Traces of wear F = 200N, Nc = 60,000 cycles - upper blade

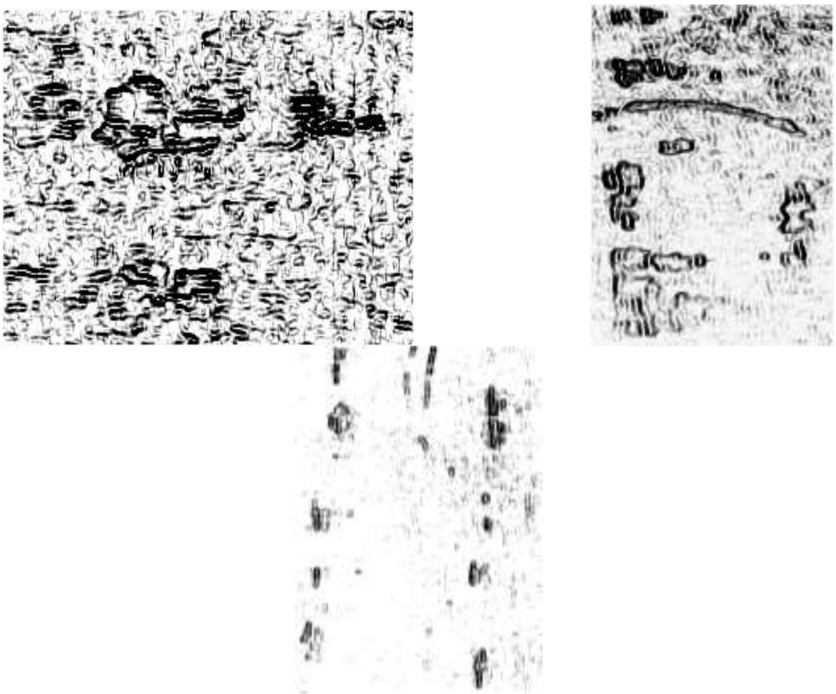

Fig.8.b Traces of wear F = 200N, Nc = 60,000 cycles - lower blade

For 40,000 cycles, the traces obtained are distinguished by small areas of adhesion between the two blades. These adhesion areas increased significantly between 50,000 and 60,000 cycles. At 60,000 cycles areas with much more "red powder" were found on the blade, which proves a proportional increase of the wear during application. For the same length request, we can see an increase in the wasted area, if the normal push force is higher.

The marks obtained were taken with a video camera and were subsequently processed on the computer. Examples of fretting wear are presented in fig. 9,10,11.

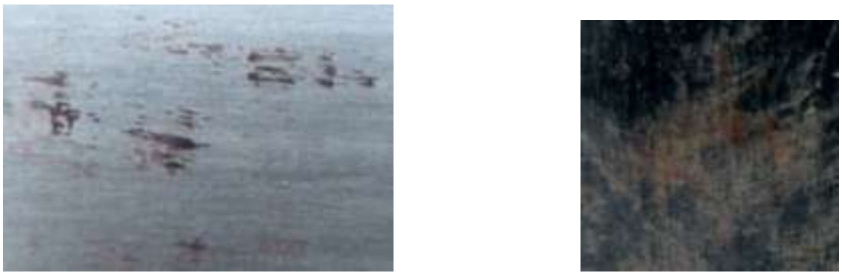

Fig.9 Traces of fretting for a normal load of 250 N and 50000 load cycles

Fig.10 Traces of fretting for a normal load of 250N and 60000 load cycles

Fig.11. Traces of fretting for a normal load of 200 N and 50000 load cycles

CONCLUSION

The experimental stall supports experimental tries for the study of fretting. We can determine the different size of the fretting areas and we can compare them with the theoretical results.

We can identify the presence of "red powder" on the blades subjected to fretting and also we can see a wear increase, proportional with the length of the request. For the same length request, we can see an increase in the wasted area, if the normal push force is higher.

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