MSC-PROJECT ON CONTACT FATIGUE

A MODEL FOR THE INITIAL PROPAGATION OF "STUD" DEFECTS IN RAILS

Local surface cracks are a major problem on several railway systems worldwide. Research has found that these defects can be divided into (at least) two categories. If it becomes more generally accepted that this is the case, it has significant implications for track maintenance. A surface defect of "squat" type should be treated with urgency because it can develop into a rail break, but there is currently no case in which a rail break is known to have developed from a "stud" defect.

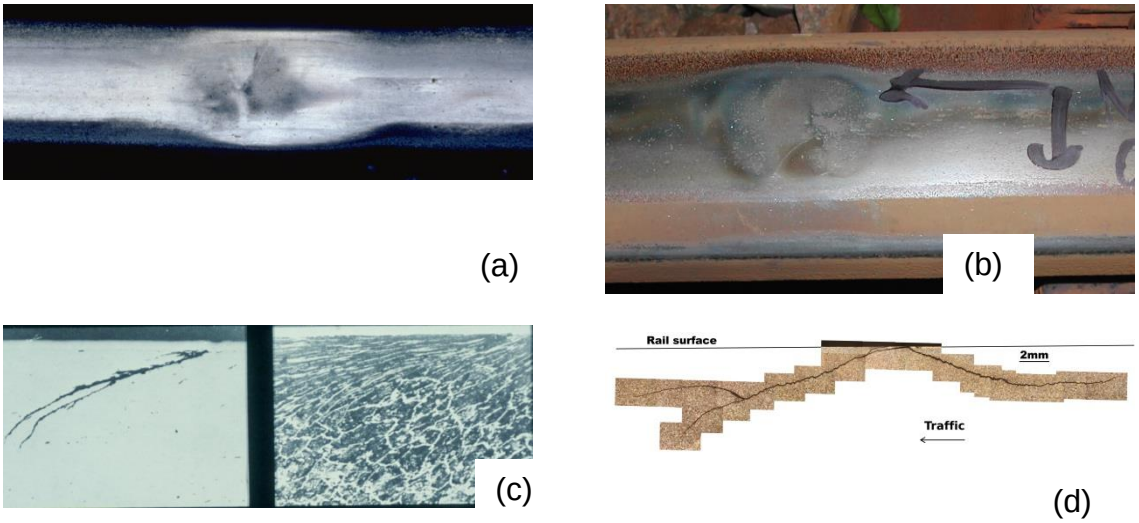

Figure 1 Squat on left (from above and cross-section); stud on right (from above and cross-section)

Although it was first proposed that studs were a different defect from squats more than a decade ago, an understanding of stud development is in its infancy. The intention of this project is to examine crack propagation from surface defects to aid in that understanding.

A characteristic of studs is the inverted U-shaped crack mouth (Figure 1(b)). This typically develops, as shown in Figure 1(b), under the action of lateral forces on the rail, pulling the rail surface towards the gauge corner.

A simple model to examine the initial development of a stud is illustrated in Figure 2. The contact area can be considered as circular or line contact. The normal contact stress (or pressure) is given by Hertzian equations. Friction is assumed to be saturated, so the tangential contact stress is $\tau = \mu p$, where p is the contact pressure and μ the coefficient of friction. It is assumed that there is a small crack of depth ka and length ba tangential to the edge of the contact area. The tangential contact force, and therefore also the tangential contact stress, can initially be presumed to act normal to the longitudinal crack (i.e. transverse to the longitudinal axis of the rail).

Development of the crack would be examined as the contact force traverses over the crack.

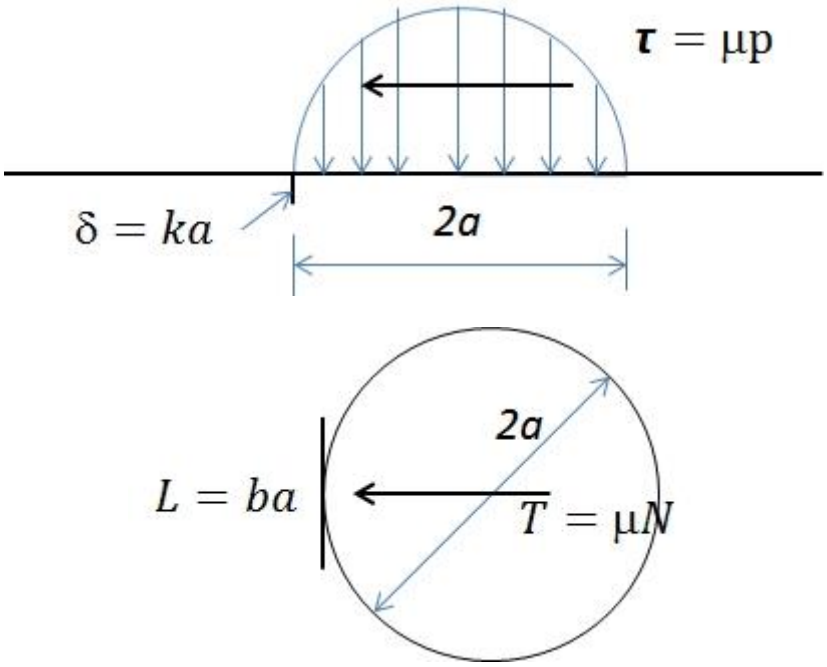

Figure 2 Basic model to examine development of a stud from an initial vertical crack on the edge of the contact

To aid in the study, there exists a number of studies in the literature. Further, numerical (FE) simulations will be carried out. The load evolution of the crack will be studied in relation to estimated direction of growth and crack growth rate.

To further aid, the work will be given access to field data on crack appearance and the pertinent loading conditions.

Examiner: Anders Ekberg, anders.ekberg@chalmers.se, M2, Dynamics/CHARMEC

Supervision: Elena Kabo, elena.kabo@chalmers.se, M2, Dynamics/CHARMEC
Dr Stuart Grassie, RailMeasurement Ltd