

An Indian-Australian research partnership

## Project title

**Influence of Environmental Factors on Growth of Rolling Contact Fatigue Damage in Rails**

**Project number:** IMURA0096

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## Research Academy theme/s

1. Advanced computational engineering, simulation and manufacture
2. Infrastructure engineering

## The problem

Rolling contact fatigue (RCF) occurs in wheel-rail contact due to cumulative plastic deformation and cracking in the near-surface layers under the action of surface traction forces. Crack initiation occurs at the free surface, resulting in the typical damage shown in Figure 1. Sectioning through such damage reveals the crack growth morphology shown in Figure 2. Some forms of rolling contact fatigue damage may also propagate in the manner shown in Figure 3, increasing the probability of broken rail.



Figure 1: Surface appearance of rolling contact fatigue damage in rail



Figure 2: Longitudinal section through rolling contact fatigue cracks.

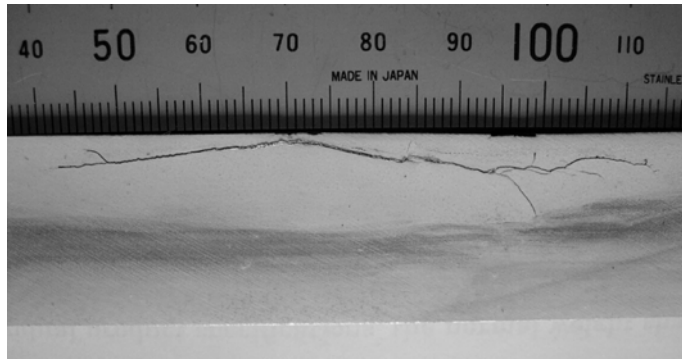


Figure 3: Longitudinal section through “squat” defect

The presence of surface-breaking cracks means that environmental factors such as the presence of moisture or other liquid contaminants may influence the crack propagation behaviour. Previous research into the growth behaviour of rolling contact fatigue cracks has assumed that the influence of contaminants such as moisture or lubricant is purely mechanical, for example by reducing crack face friction. However contaminants may also have an electrochemical effect, increasing the probability of mechanisms such as stress-corrosion cracking.

### **Project aims**

The objective of the project is to examine the sensitivity of fatigue crack growth behaviour in rail steels to environmental conditions, in particular those which may result in stress-corrosion cracking or similar mechanisms. It is envisaged that the following activities would be carried out:

- Literature review to gain a basis understanding of rolling contact fatigue behaviour, and influence of environmental factors on the crack growth mechanisms in steels
- Design and undertake an experimental program to examine the influence of environmental factors on crack growth behaviour in rail steels under Mode 1 loading conditions, taking into consideration the typical stress-time history in wheel-rail contact.

### **Expected outcomes**

This project should provide valuable insight into the influence of environmental factors on crack growth mechanisms in wheel-rail contact, and if successful, should form the basis on ongoing research. Aspects to be addressed in further would include:

- The influence of environmental factors on crack growth behaviour under Mode II/Mode III loading; and
- The influence of environmental factors on crack growth behaviour in plastically-deformed rail steel.

You'll be challenged in this project, which combines innovation with a need for the rigorous assessment of the test concepts. However, you'll gain tremendous insight to the railway industry and one of the most important issues in wheel-rail contact. You'll also work closely with the Monash-based Institute of Railway Technology, which is internationally-recognised for its expertise on wheel-rail contact and related topics.