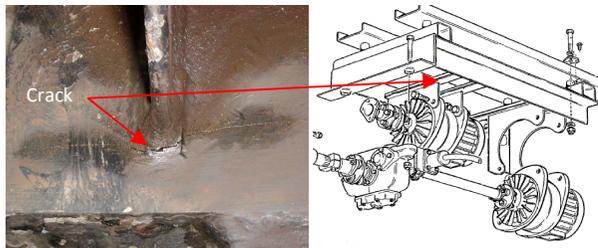


Case Study - Fatigue of Alternator Mounting Frame -

The Problem

Arriva Trains, Wales, experienced 11 alternator frame failures over a period of 10 years.

The fleet of class 150/2 trains operating on the GB rail network used alternators to provide an auxiliary electrical supply. The alternators were mounted on fabricated steel frame which had developed cracks in the main cross member over a period of time. Although no catastrophic failures had occurred; the failures discovered had the potential to develop further unless corrective action was taken.



Unbalance in the alternator rotation was assumed to produce cyclic stress at the welded joint which over long periods could cause fatigue fracture.

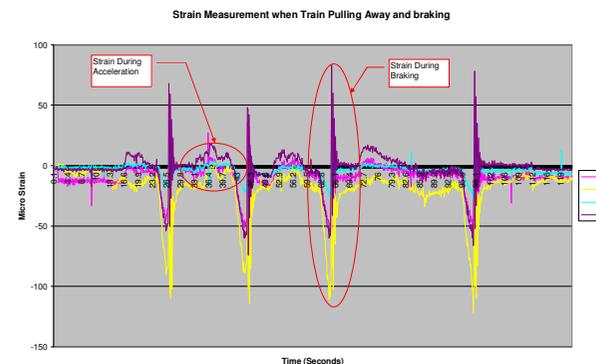
Live, in situ strain gauge based tests were required to confirm this hypothesis and recommendations based on the results provided.

The Measurement

Based on the fracture characteristics, the orientation and location of maximum stress was identified and strain gauges fitted.



Strain gauge data showed that train acceleration produced stresses an order of magnitude greater than those caused by the vibration resulting from unbalance in the alternator rotation. The braking system was found to produce stresses a further order above those caused by acceleration.



The Solution

Together with Arriva engineers, it was possible to estimate the train lifetime cycle braking profile. By using the material S/N curves, it was determined that fatigue would not occur at the stress levels measured.

A portion of the alternator mount was removed and cuts made in the welded fillet. Strain gauge monitoring allowed the resulting stress relaxation to be evaluated.



Residual stress in the weld was found to account for 90% of the total stress experienced by the mount. The fatigue life corresponding to the total stress closely matched the predicted number of braking cycles required for fatigue to occur in trains in service. Stress relieving the welded joints was recommended to alleviate the failure problem.