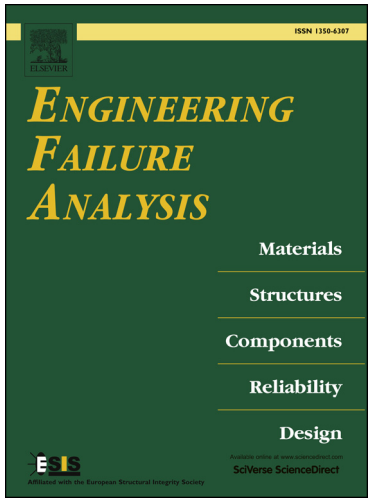

Failure of discontinuous railhead edges due to plastic strain accumulation

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Failure of discontinuous railhead edges due to plastic strain accumulation

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Abstract

Railhead is perhaps the highest stressed civil infrastructure due to the passage of heavily loaded wheels through a very small contact patch. The stresses at the contact patch cause yielding of the railhead material and wear. Many theories exist for the prediction of these mechanisms of continuous rails; this process in the discontinuous rails is relatively sparingly researched. Discontinuous railhead edges fail due to accumulating excessive plastic strains. Significant safety concern is widely reported as these edges form part of Insulated Rail Joints (IRJs) in the signalling track circuitry. Since Hertzian contact is not valid at a discontinuous edge, 3D finite Element (3DFE) models of wheel contact at a railhead edge have been used in this research. Elastic-plastic material properties of the head hardened rail steel have been experimentally determined through uniaxial monotonic tension tests and incorporated into a FE model of a cylindrical specimen subject to cyclic tension loading. The parameters required for the Chaboche kinematic hardening model have been determined from the stabilised hysteresis loops of the cyclic load simulation and implemented into the 3DFE model. The 3DFE predictions of the plastic strain accumulation in the vicinity of the wheel contact at discontinuous railhead edges are shown to be affected by the contact due to passage of wheels rather than the magnitude of the loads the wheels carry. Therefore to eliminate this failure mechanism, modification to the contact patch is essential; reduction in wheel load cannot solve this problem.

Keywords: Edge failure; Strain analysis; Railway engineering; Finite element analysis.