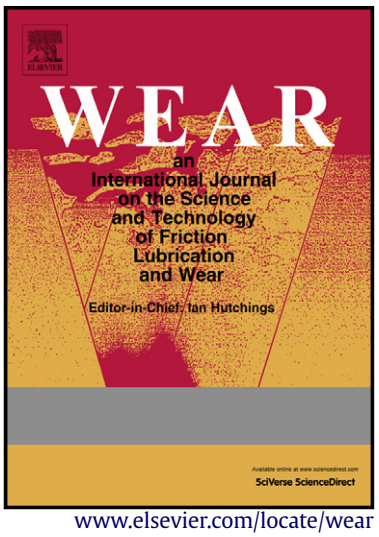

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Nirmal Kumar Mandal

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Plastic ratchetting of railhead material in the vicinity of insulated rail joints with wheel and thermal loads

Nirmal Kumar Mandal
Central Queensland University
Centre for Railway Engineering,
Rockhampton 4702,
Australia

ABSTRACT

A detailed finite element analysis (FEA) was carried out to present a stress analysis of an insulated rail joint IRJ considering a wheel load on the IRJ producing stresses above the shakedown limit of the rail material. A 5 mm endpost thickness is considered at the discontinuity in the rail steel which is required to form the 6 bolt IRJ. In addition, an axial pressure load of 165 MPa was also considered on the rail faces at the discontinuity in the form of compression (buckling) and tension (pull-apart). A modified Hertzian contact pressure distribution is considered in this simulation. 100 cycles of dynamic wheel load of 174 kN were applied to the rail top materials in the vicinity of the IRJ.

Residual stress and plastic strain, equivalent plastic strain and permanent deformation of railhead material in the vicinity of IRJ are presented. The strain data depict damage of endpost materials and ratchetting failure of rail ends due to vertical wheel load and axial thermal load. The ratchetting failure modes follow the established trend of decay in the ratchetting rate in successive wheel load cycles. The size of the plastic zone in the railhead materials is also identified.

Key words: Thermal load; wheel-rail contact; shakedown theory; elastic-plastic material behaviour; ratcheting damage and sub-surface plastic zone

Corresponding Author: Nirmal Kumar Mandal, Tel: +617 4923 2064, Fax: +617 4930 6984, E-mail: n.mandal@cqu.edu.au