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FINITE ELEMENT LINEAR ELASTIC ANALYSIS OF INSULATED RAIL JOINT

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Abstract

Goal: The goal of this research is to investigate possible changes in insulated rail joint design in order to improve the performance of the insulated joint. ***Design approach*:** The finite element program ANSYS is used to model the insulating gap. The insulating gap is first meshed; the volume is meshed using two different shaped elements, tetrahedral and hexagonal. The hexagonal mesh is used on the region of interest i.e. the insulating gap and the steel surrounding it. Then the loads are applied; all the loads and displacements were applied to a point corresponding to the centre of the wheel. And then the contact model was used to simulate normal contact between the rail and the wheel in the built in ANSYS with linear contact stiffness, four different material models were used for the insulating joint i.e. linear elastic, hyper-elastic, built in ANSYS material model and custom model. The study focuses on three major parts: The first part was to compare hyper elastic Neo-Hookean and linear elastic material models for the insulating layer in the joint. Investigating the effects of increasing the stiffness of the insulating material was performed in the second part. And third part was, effect of having an inclined insulating joint was analyzed. Four different inclination angles θ, were tested ranging from 0^0(no inclination) to 60^0. ***Findings*:** The first part simulation result showed that the difference between the two material models is small. The maximum displacements for different young's modulus are almost identical. Second part investigation showed that increased stiffness decreases the plastic deformation in the steel. However when increasing the stiffness the interfacial shear stress increases. This will promote failure of the glue that ties insulation and rail together. And the third showed that by increasing the angle the plastic deformation in the steel on both sides of the insulating layer increased under pure rolling conditions. Inclination did not seem to cause any significant changes in interfacial shear stresses. ***Future scope***: The simulations are carried for static and quasi-static (i.e. acceleration and momentum are not accounted.) and the speed is limited to 80kmph. Hence the simulations can be carried out for speed more than 80kmph.

Keywords: Insulating rail joint, plastic deformation, hyper-elastic material, low-cycle fatigue inclined joint.