

Publication : Stress analysis of inserted rail joints

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| Abstract / summary: | <p>There are two types of Insulated rail joints (IRJs) in the railway track: inserted and glued. The IRJs in the track are significant components in relation to integrity and safety of rail signalling operations. Because of low values of vertical bending rigidity of IRJs, cyclical dynamic wheel loading forces increase significantly at IRJs, thus accelerating material degradation and damage of their components such as rail ends, endposts, joint bars, etc. As a result, relatively free rail ends are created at IRJs that further amplify dynamic wheel load impacts. Only limited literature are available addressing the free end of rail effects at IRJs targeting stress distributions in the vicinity of the rail joints. To understand clearly the delamination process of inserted endpost IRJs and the damage of the endpost and rail end material, a thorough analysis targeting the modes of failure of both glued and inserted IRJs and subsequent damage of the railhead material is necessary to find ways to improve the joint's life. In this paper, a 3D finite element analysis (FEA) is carried out to assess damage when the endpost is either initially installed loosely ("inserted" rather than "glued") in between the ends of the rail at the IRJ or becomes a loose fit due to plastic delamination of a glued joint, or when a gap is created between the rail and endpost due to pull-apart problems as the rails contract longitudinally in winter. Both 5mm and 10mm gaps (inserted endpost IRJs) are considered, using a peak vertical pressure load of 2500MPa applied at one rail end. This peak load ensures a ratchetting</p> |

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| | <p>failure mode of the rail end material. Plastic deformations and stress distributions in the vicinity of inserted IRJs are quantified using FEA data and compared with that of the glued IRJs (5mm and 10mm endpost thicknesses) to show the free end of rail effects. Residual stress and strain distributions indicate the damage of the railhead material. The progressive damage of the railhead material at the rail ends can be quantified by equivalent plastic strain (PEEQ). The free end of rail effects can be further illustrated by comparing PEEQ for inserted and glued IRJs. The railhead material of 5mm and 10mm inserted endpost IRJs is more sensitive to permanent deformation compared to that of the corresponding glued IRJs. Therefore, inserted IRJs pose an increased potential threat to rail operations in relation to damage of railhead and endpost materials and premature failure of IRJs.</p> |
| Keywords: | insulated rail joints (IRJs); free end; endpost; glued joint; inserted endpost |
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