ABSTRACT OF PAPER

Title of Paper *(limited to 15 words in CAPITALS):*

ESTIMATION OF RAIL WEAR LIMITS USING FINITE ELEMENT ANALYSIS AND FRACTURE MECHANICS

Authors *(including presenting author and full name)***:**

Iman Salehi[1], Peter Mutton[1], Darrien Welsby[1], Nick Petticrew[2] and Clinton Crump[2]

Company of Affiliation:

[1]Institute of Railway Technology, Monash University
[2]Australian Rail Track Corporation (ARTC)

Presenting Author:

Iman Salehi

Nominated Theme:

Track and Structures

Abstract *(max 350 words)***:**

There are several different criteria and conditions track designers and railway operators consider when investigating the limits for safe operation of worn rails. The determination of wear limits is based on the rail strength to ensure the worn section can support the applied loads without failure. Among such criteria are those based on the permanent plastic deformation of the entire rail section, the limit for elastic behaviour of the section, the fatigue strength of the rail material and the criteria based on the non-propagation of specific defects or cracks which might be present at different regions of the rail. The reliability of each criterion primarily depends on whether it correctly addresses the failure modes that occurs in service.

Of these, the fatigue strength of the material is widely used as the basis for rail selection, particularly in new track construction. However, for existing operations results based purely on fatigue strength are not representative of actual rail defect or failure modes. Hence, a more appropriate methodology may include criteria based on the non-propagation of the relevant defect types.

Traditionally, calculations of wear limit have involved analytical representation of the selected criterion based on simplified track models, idealized rail section, wear profiles and estimated loading conditions. For the criteria based on non-propagation of specific defects using fracture mechanics, rail defects or cracks are also simplified with crack models in idealized geometries that have defined mathematical descriptions.

In this paper finite element analysis is utilised to overcome some of the limitations of the analytical methods by implementing more accurate models of rail track with discrete supports and bi-axial elastic foundations, realistic rail sections and wear profiles which more closely represent the wheel/rail contact conditions. Recent advances in commercial finite element packages have also substantially facilitated fracture mechanics analysis with more realistic models of the cracks and the medium in which they are located.

To demonstrate this approach the process for the calculation of wear limit using finite element analysis based on fatigue strength of the rail/weld section and non-propagation of the most prevalent defect/crack in the railway under study is explained.