NONIs - Development of an Optimized and Sustainable Insulation Joint System

Michael Höfler and Ferdinand Pospischil
Institute of Railway Infrastructure Design

Project NONIs focusses on the systematic analysis of the current insulation joint system, and development of a new and more robust solution while taking into account sustainability aspects. The approach consist of three parts, simulation, track measurements and the design of new components. After completion of the projects first year, first simulations, as well as two measurements were performed.

Introduction

With the target network 2025+, the Austrian Federal Railways, together with the State of Austria, are making a clear commitment in the fight against the climate crisis in the overall transport plan. However, the basis for this is an efficient infrastructure. A massive increase in train kilometers in the coming years requires at the same time a low-maintenance infrastructure that can cope with the increasing loads. In order for trains to run, today's signaling system needs block sections that are monitored by track circuits, e.g. to generate track occupancy messages from vehicles on the track. These block sections are separated from neighboring sections by insulating joints, which allows for finer subdivision. The Austrian Federal Railways currently have around 33,000 of these insulating joints installed in their track network. The service life of the insulated joints in Class A tracks is currently around 8 to 12 years, in places only one to two years, depending on the local load. Despite the half-yearly inspection intervals, they are very susceptible to faults and are one of the main causes of delays, accounting for 42 % of all track faults (excluding points). There are various approaches to improve the susceptibility of insulated joints to faults, but so far there is no systematic overall approach.

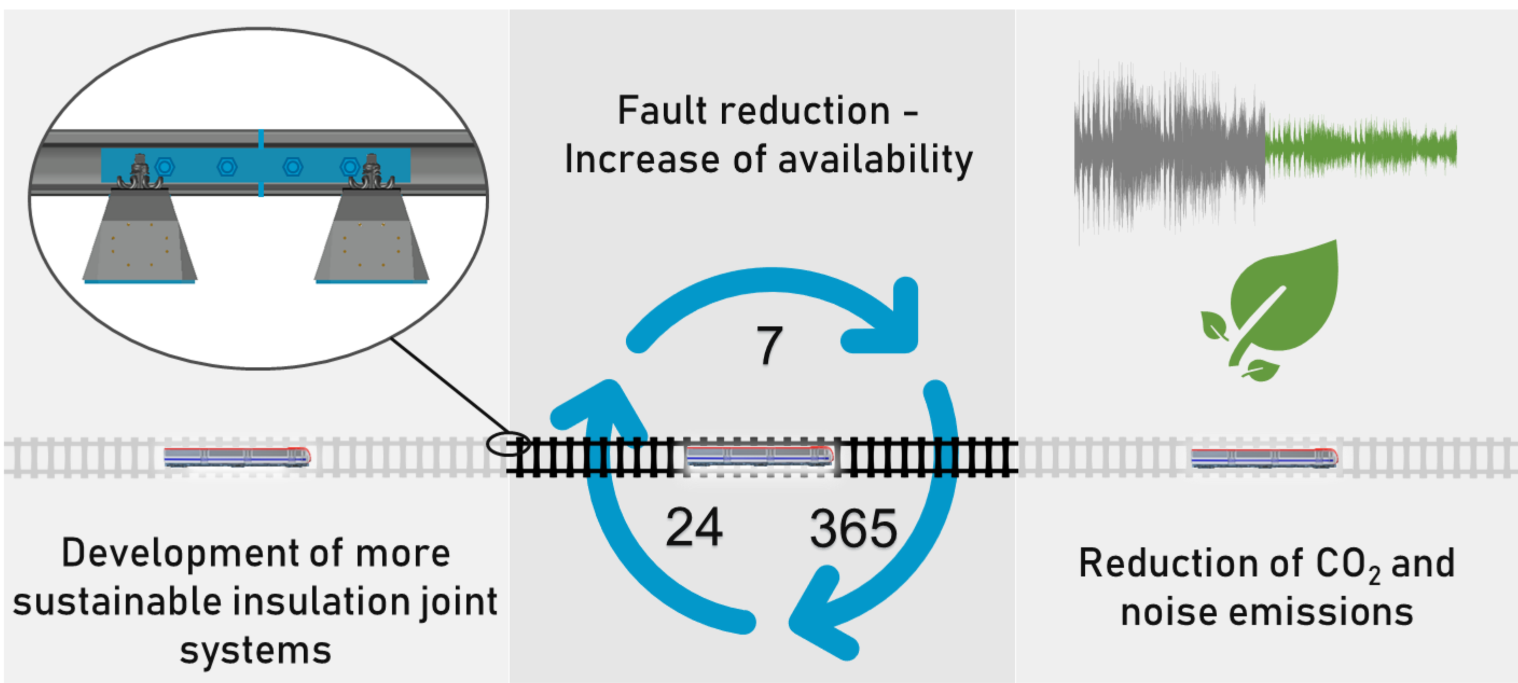

Fig.1: Focus areas of the project

The aim of this project is to develop a systematic approach ranging from the design of the joints, taking into account the local permanent way, to the alignment parameters and the structural design of the insulated joints. The main objective of the project is to develop sustainable isolated joint systems through new designs and/or materials in order to increase the availability of the infrastructure. The project aims to increase the availability of the infrastructure through new designs and/or materials by reducing disruptions, thus contributing to the reduction of CO_2 emissions by extending the service life and to the reduction of noise emissions by improving the quality of the insulated rail joint system.

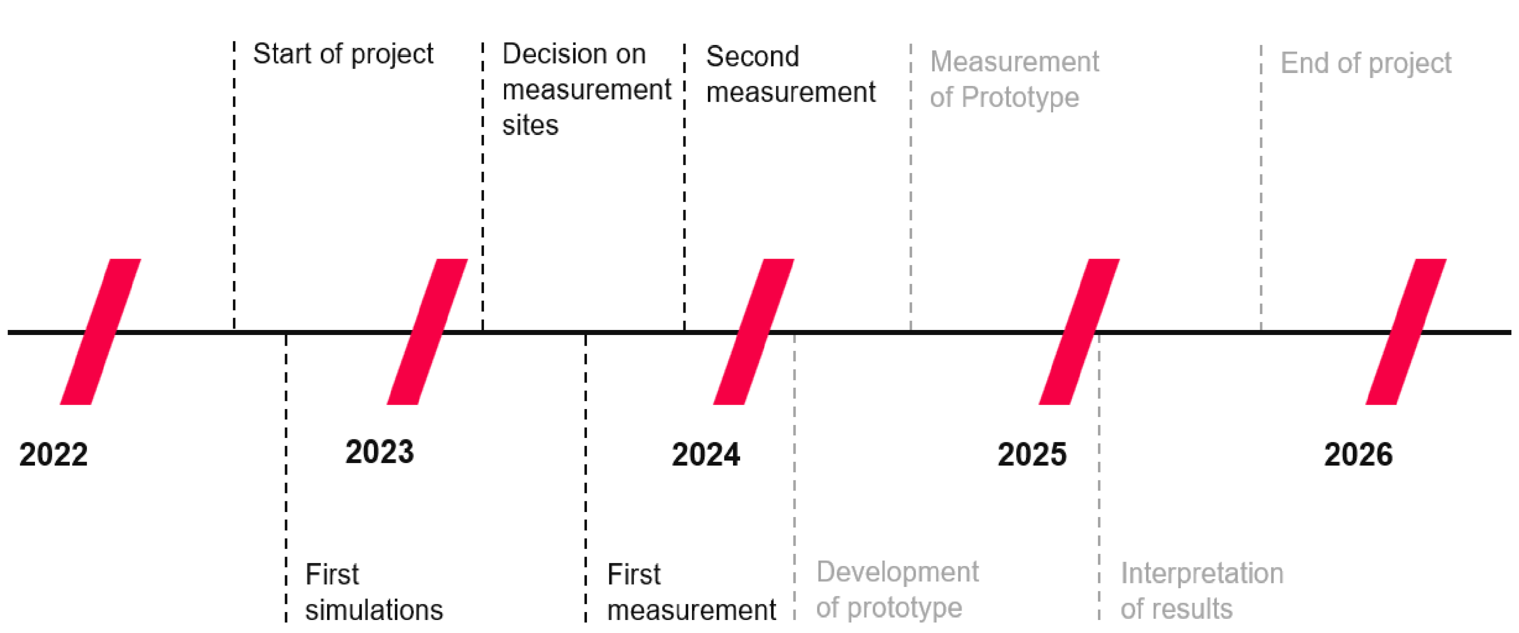

Fig.2: Project milestones

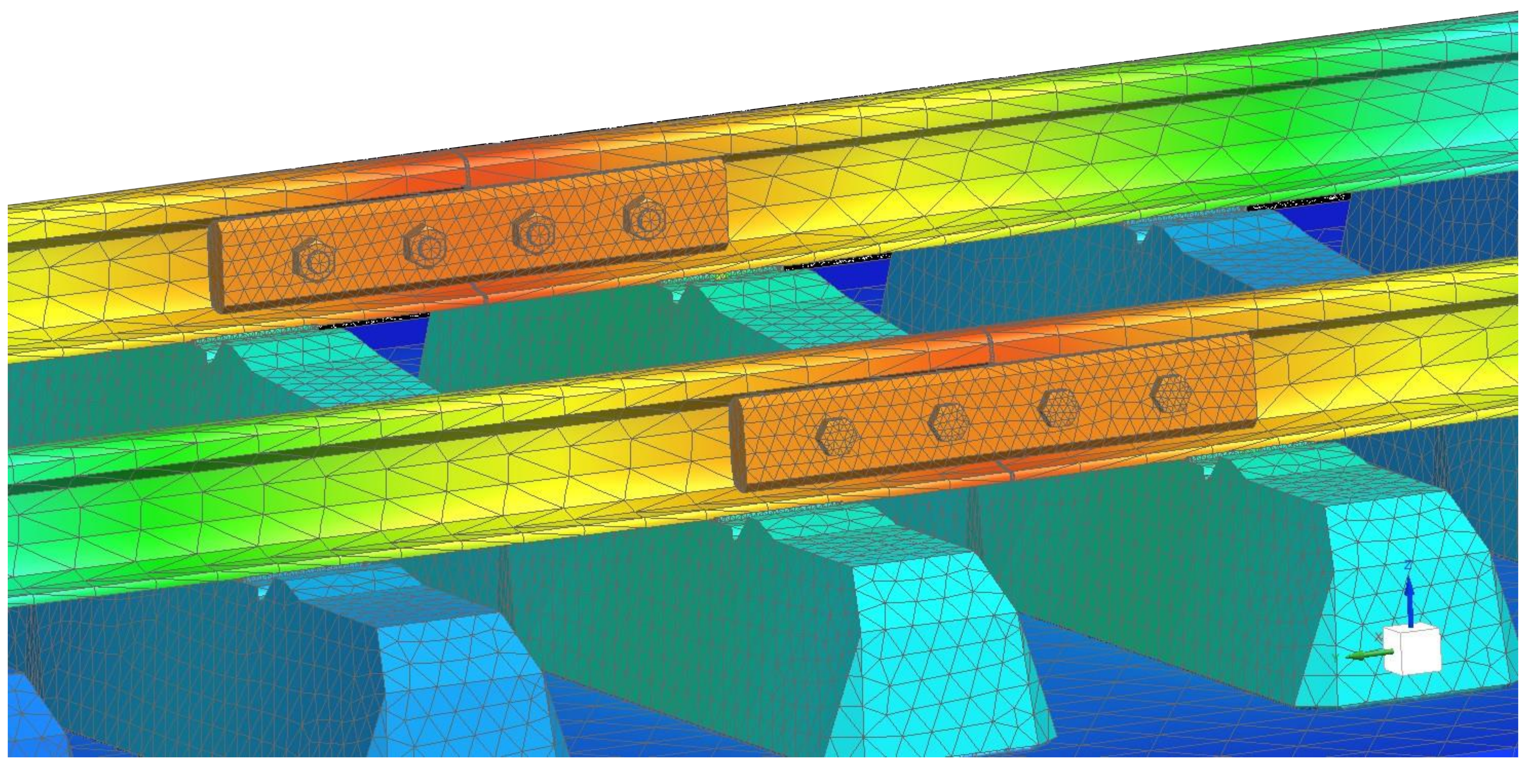

Fig.3: Deformation caused by a vertical load on the rail

Simulation

Using Finite-Element-Simulation Software, a model was developed to analyse the displacements, forces, and stresses caused by the passing wheelsets. This virtual model of the insulated rail joint system consists of a ballast track with padded concrete sleepers, rail pads, the insulating layer between the rails and the fishplates holding the joint together. Correct Materials were assigned to the CAD-Models, to replicate their physical behaviour. Boundary conditions were used to fix the start and endpoints of the rails, as well as the base of the ballast bed. Contact between the bodies was established to account for interactions between them.

Fig.4: First measurement site in Lower Austria

Measurements

To generate the data necessary for the validation of the simulation model, as well as to examine the current system, measurements were carried out. After analysis of all insulated rail joints in Austria, carried out by the Institute of Railway Engineering and Transport Economy, two suitable locations were found, both on the western high speed line. The measuring equipment consist of linear and shear strain gauges, to record the stresses and forces inside the rail and fishplates. Laser displacement sensors were used to measure the movements of the sleepers and rails. The measurements will be repeated with the newly developed prototype, to record the difference.

September 2023

TU Graz – *Institute of Railway Infrastructure Design*
8010 Graz, Inffeldgasse 25E/II, Austria, Tel.: +43 316 873-35081
rid@tugraz.at, rid.tugraz.at