TRACK-BRIDGE INTERACTION FOR STEEL RAILWAY BRIDGES

APPLICANT: JOÓ DÁNIEL LÁSZLÓ

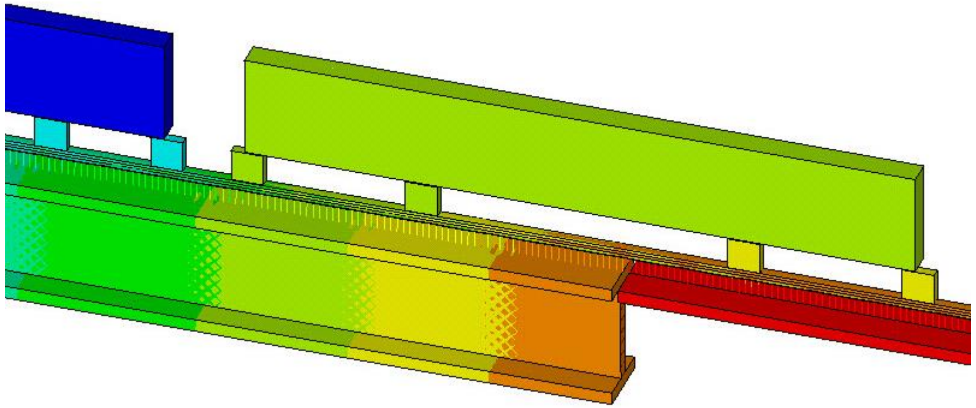
CONSULTANT: DR. KÖVESDI BALÁZS GÉZA / JOSEF FINK

INSTITUTION: BUDAPESTI MŰSZAKI ÉS GAZDASÁGTUDOMÁNYI EGYETEM

FACULTY: ÉPÍTŐMÉRNÖKI KAR – HIDAK ÉS SZERKEZETEK TANSZÉK

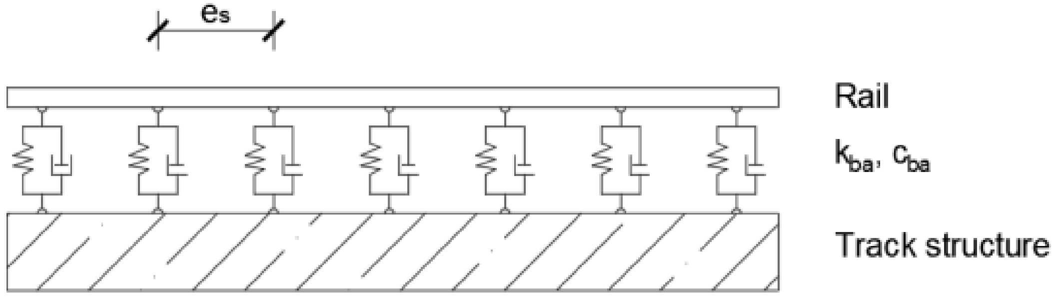
E-MAIL: JOO.DANI96@GMAIL.COM

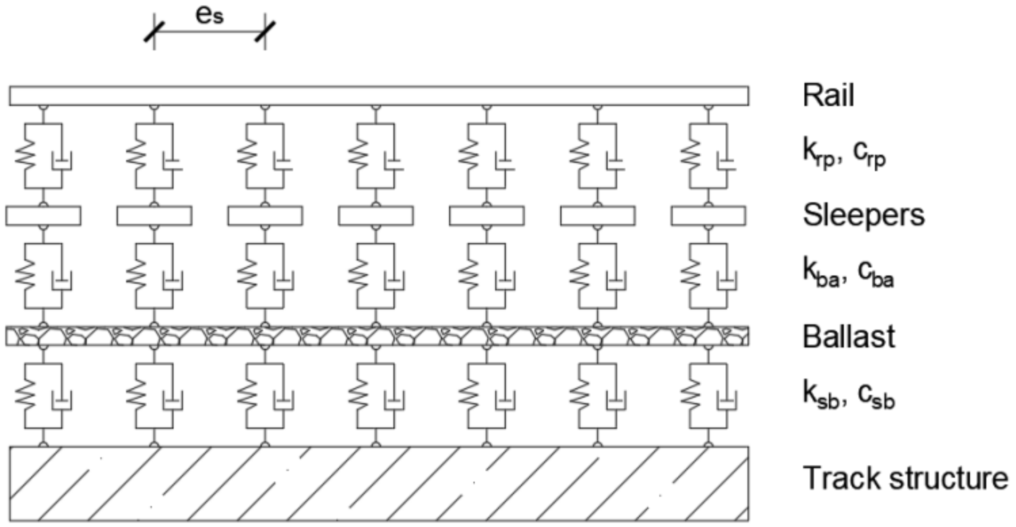
PHONE: +36 30 248 2400



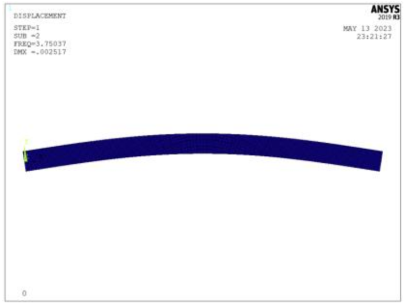
PROJECT OBJECTIVE

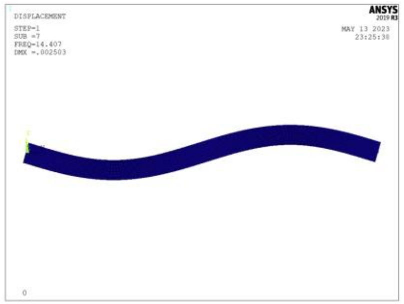
- The aim of the thesis was to investigate the damping potential of using ballast track for bridges, as a large percentage of our train paths were built using this method, but the current Eurocode does not currently consider the potential positive effect of this.
- If the effect of attenuation is significant, a large percentage of our tracks could continue to be used intact.



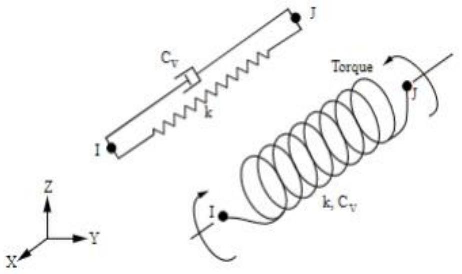


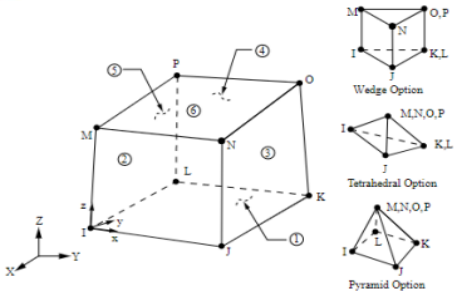
MODEL STRUCTURE, DISCRETISATION

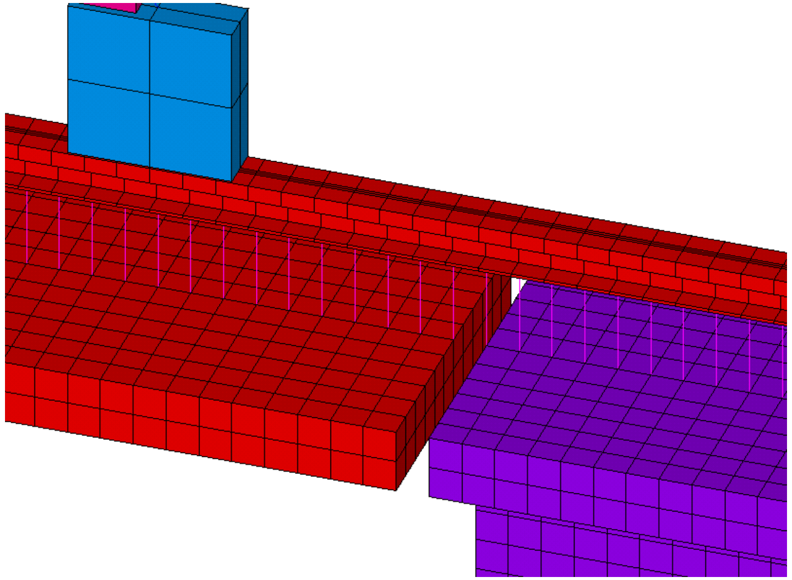


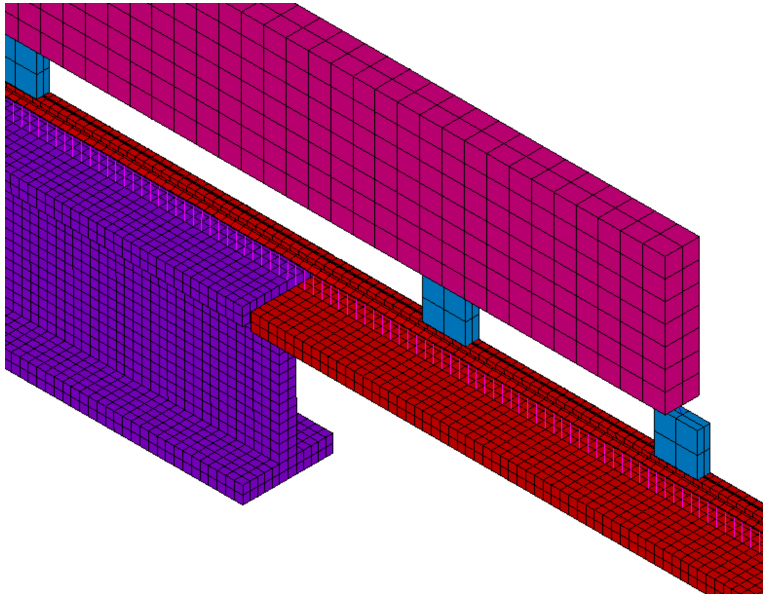


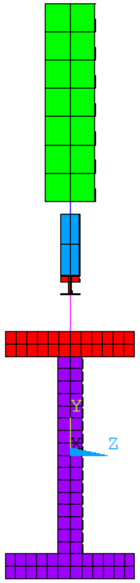
- Using real Swedish Skidträsk bridge data for model validation. (Modal Analysis) Use of half cross-section to speed up the calculation.
- Track, rails, bridge and wagons and their wheels were modelled with 3D body elements.SOLID164 for the LS Dyna dynamic model.
- Train and wheels connected with COMBI165 element. Modelling of the ballasted bed with COMBI165 element with damping and stiffness calculated in meters per unit length. - Continuum model10cm finite element size





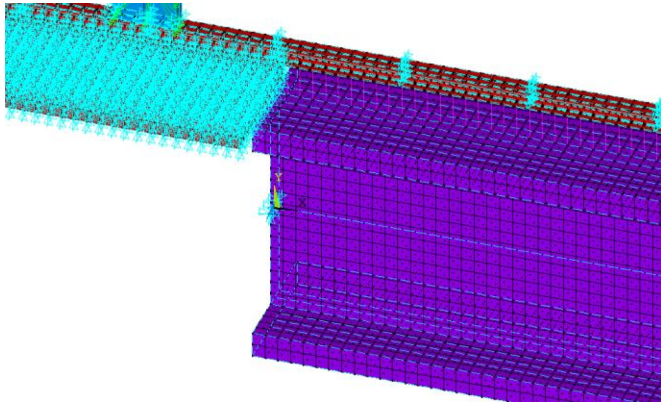


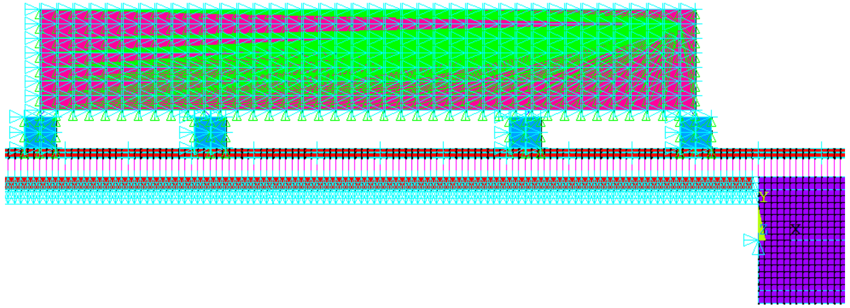


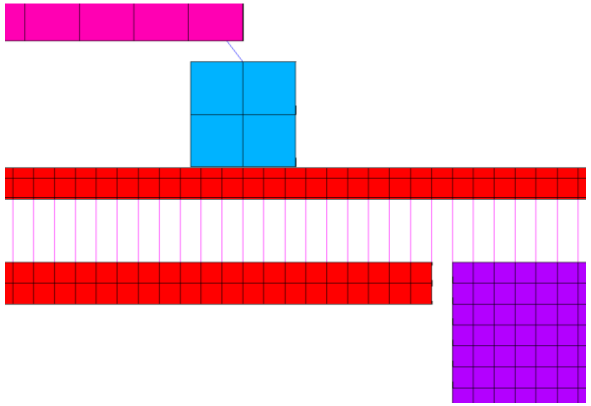


TYPE OF CALCULATION, APPLIED LOAD AND BOUNDARY CONDITIONS

- Ansys LS-Dyna dynamic explicit time history calculation with Ansys APDL input code.
- Ansys LS-Dyna solves the equations of motion using a modified central differential method with time integration.
- Loading in two steps: first, only the self-weight is applied to the structure, then the test waits for the stable state with higher structural damping. In the second stage, the dynamic motion of the train applies the load with less structural damping.
- Fixed supports at the ends of the bridge and on the approach road. Lateral supports against buckling and rotation on bridge and rail (per meter, like a sleeper) beams. Applied CP to the wheels and carriages one by one to rule out deformation.



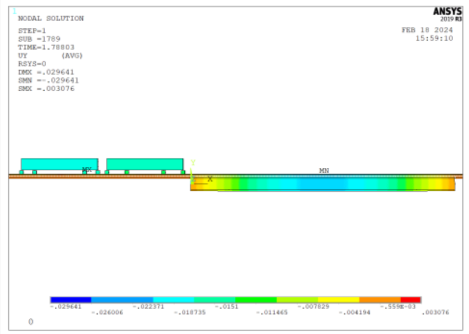




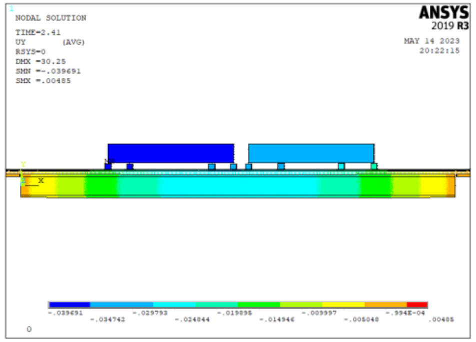
RESULTS AND EVALUATION

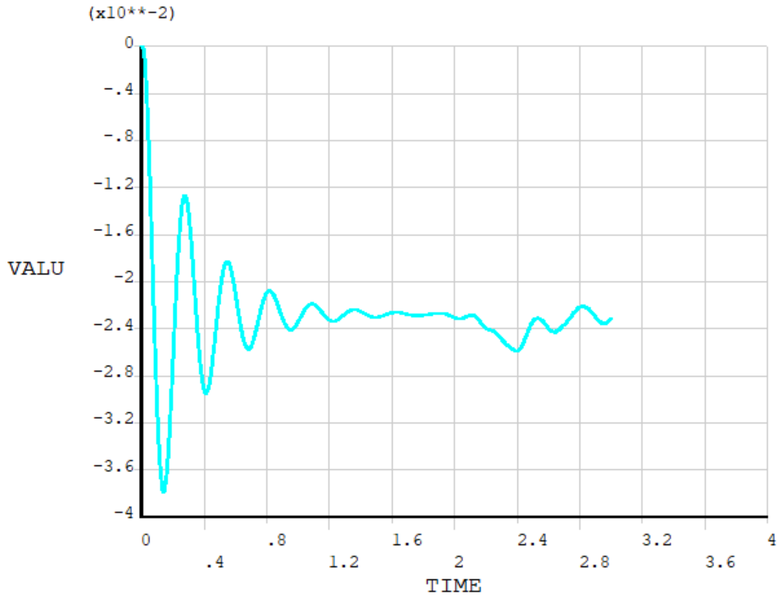
- As a parametric study, I investigated the effect of different bridge bedding parameters on the deflection of the structure at different speeds. Velocity and acceleration calculated with Matlab as the derivative of deflection.

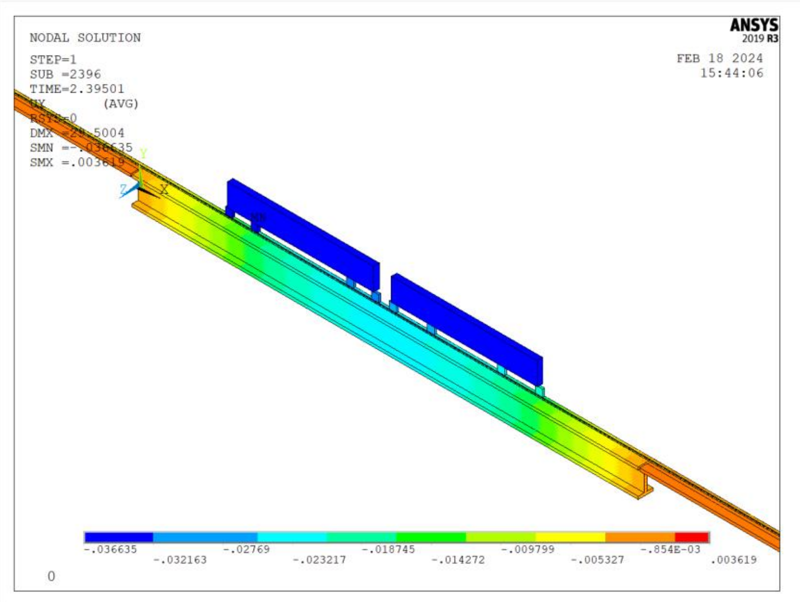
I. load step

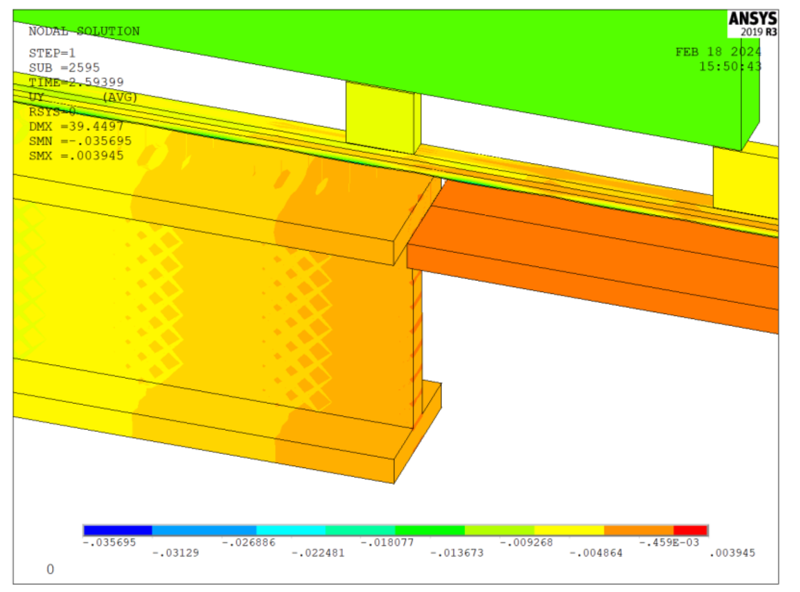


II. load step

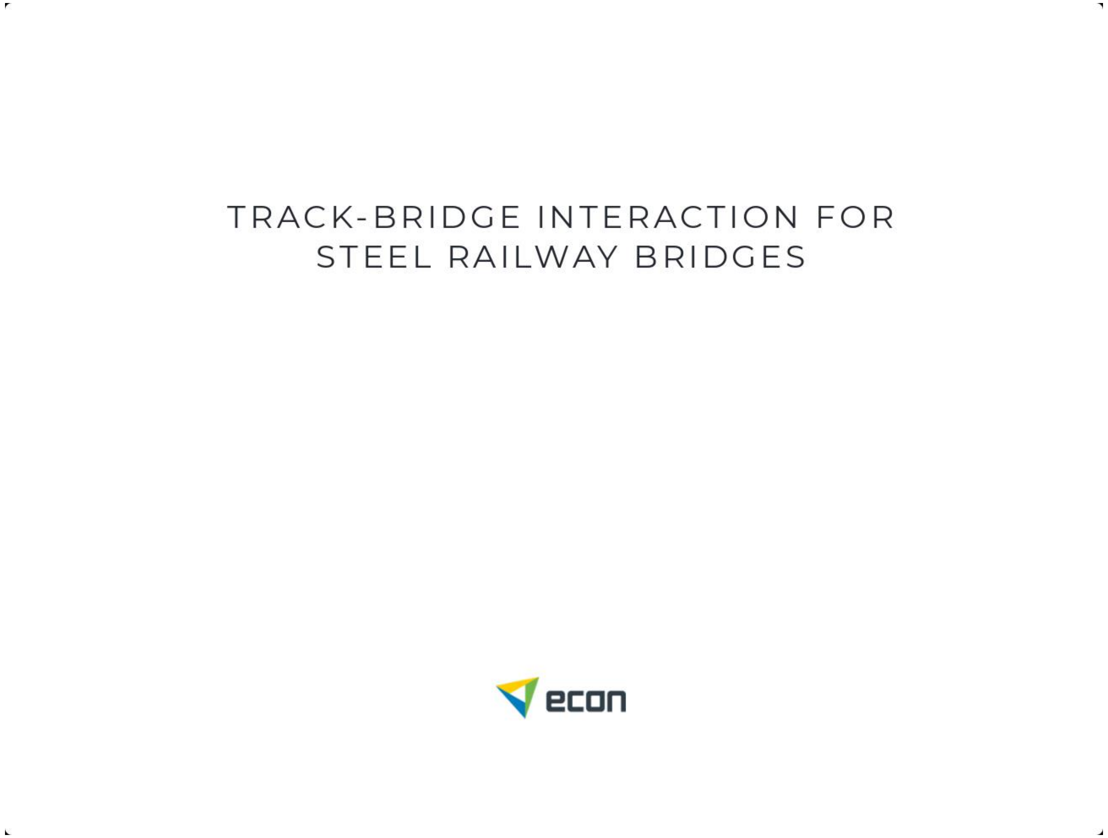


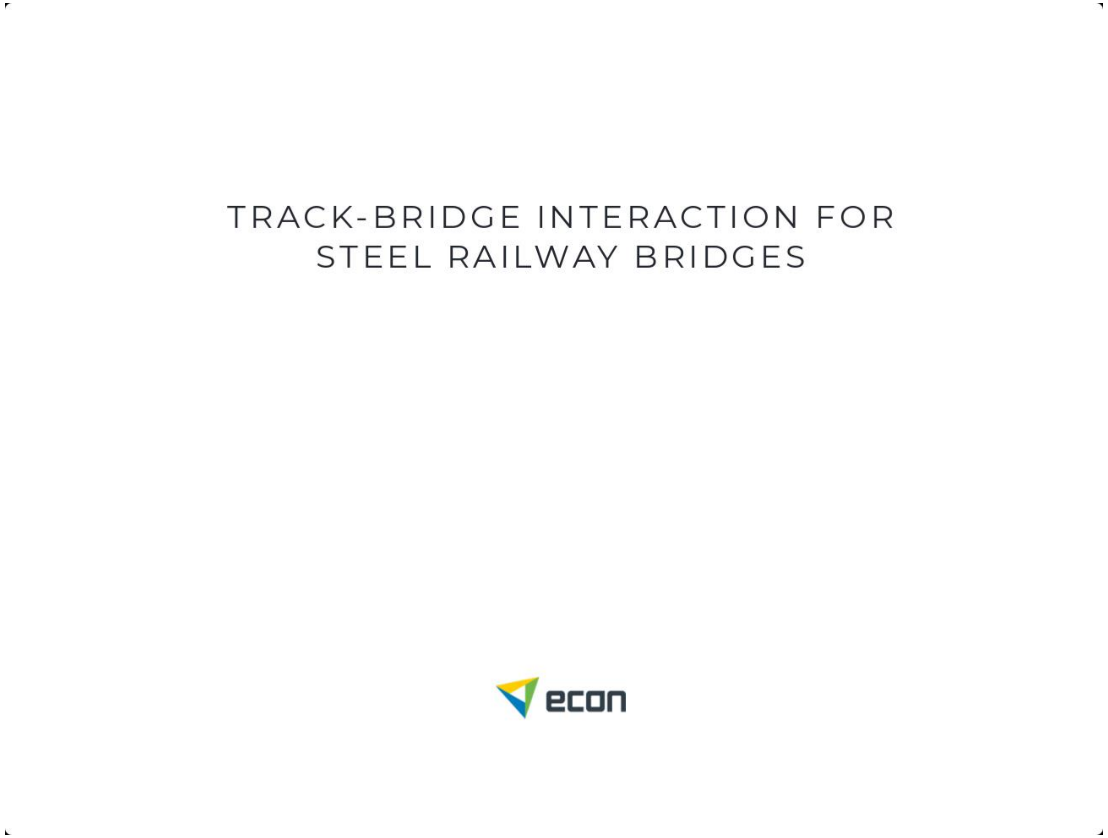






RESULTS AND EVALUATION





CONCLUSIONS

- At speeds of up to 180 km/h, there can be up to 22% variation in the deflection of the bridge mid-spans using different deck parameters.
- At 330 km/h there can be up to 13% variation. For the same calculations, the variation in the result is significant and it would be important to take into account the influence of the ballast and its exact parameters.
- The time step cannot be modified in the calculation. (wave path speed) Due to the length of the calculation time, additional implicit numerical calculations were used in the research. These more complex calculations have demonstrated that the inclusion of the VBI system and the bedding can result in a load bearing margin in our current structures.