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DYNAMIC TRACK-SOIL INTERACTION – CALCULATIONS AND MEASUREMENTS ABOUT SLAB AND BALLAST TRACKS

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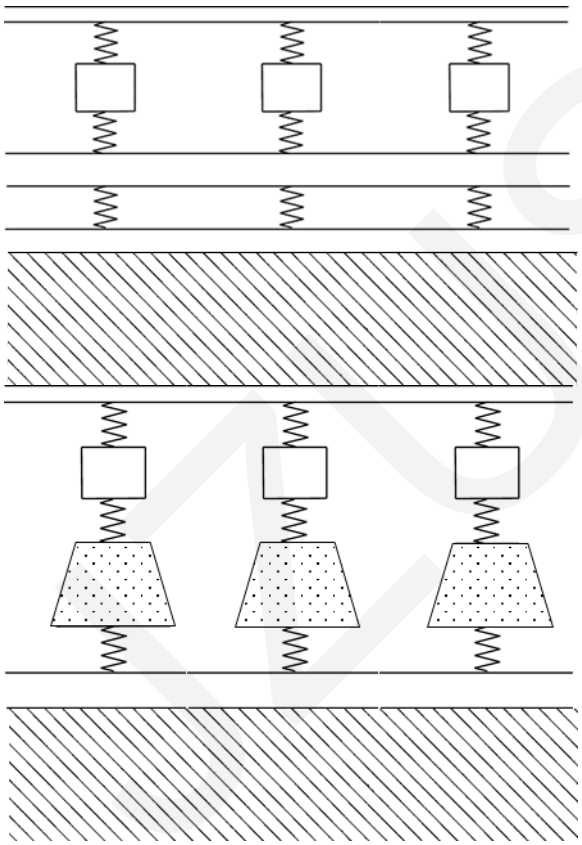
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Abstract: The dynamic behaviour of slab and ballast tracks has been investigated by measurements and calculations. Hammer impacts and train passages have been analysed. Measurements have been performed by geophones (velocity transducers) which have been time-integrated to displacements. The calculations are done in frequency-wavenumber domain for multi-beam-on-continuous soil models. The characteristics of the different tracks and track elements have been established in theory and experiment. The frequency-dependent compliances (displacement transfer functions) show clear rail-on-rail-pad resonances or highly damped track-soil resonances. Compared to the rail and sleeper, the track slab has much lower amplitudes. The slab track has usually the highest rail amplitudes due to soft rail pads.

Abstract continued: The train passage yields track displacements which are a superposition of the axle loads from the two neighbouring axles of a bogie and from the two bogies of two neighbouring carriages. This global behaviour is characteristic for the track slab of the slab track whereas the rails of the slab and the ballast track behave more local with only one bogie of influence. The measurements agree very well with the theory of the continuous soil in case of the six measured slab tracks and acceptably well for the six measured ballast tracks. The measurements allow to find appropriate model parameters and to check the models, for example the Winkler model of the soil has been found less appropriate as it reacts more locally.

Key words: Slab track, Ballast track, Train passage, Hammer impact, Track-soil interaction.

Fig. 1 Multi-beam-on-soil model for a) a slab track and b) a ballast track.

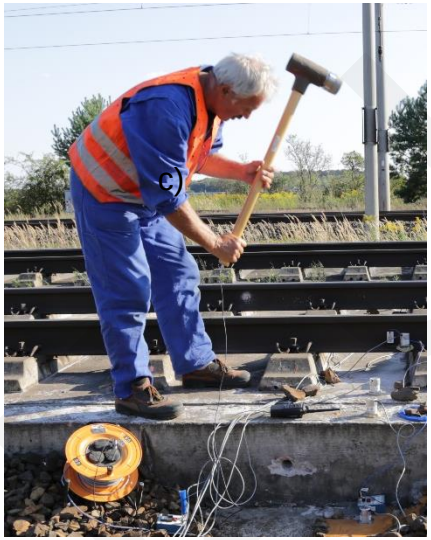


rail
rail pad
sleeper
sleeper pad
track slab
slab mat
base plate
soil

rail
rail pad
sleeper
sleeper pad
ballast
ballast mat
base plate
soil

Fig. 2 Measurements of the dynamic track behaviour due to a) hammer impacts and b, c) train passages.

a)



b)



c)



Fig. 3 Measurements of train passages rail and slab different sites



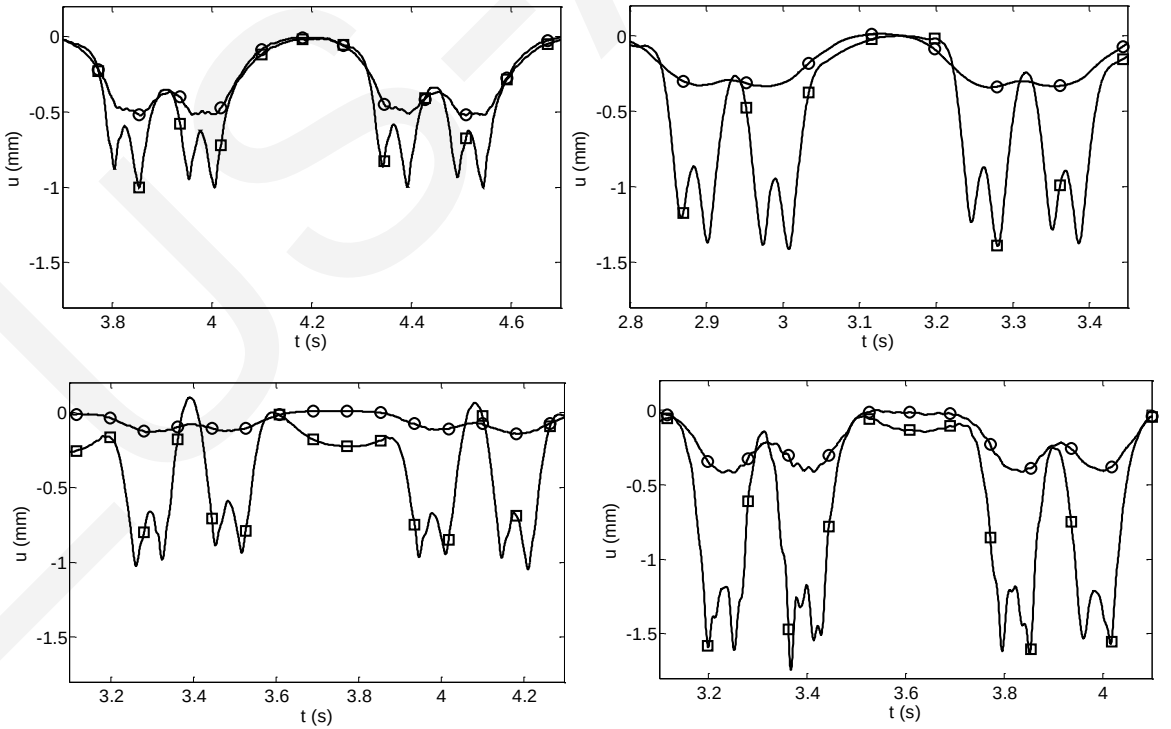
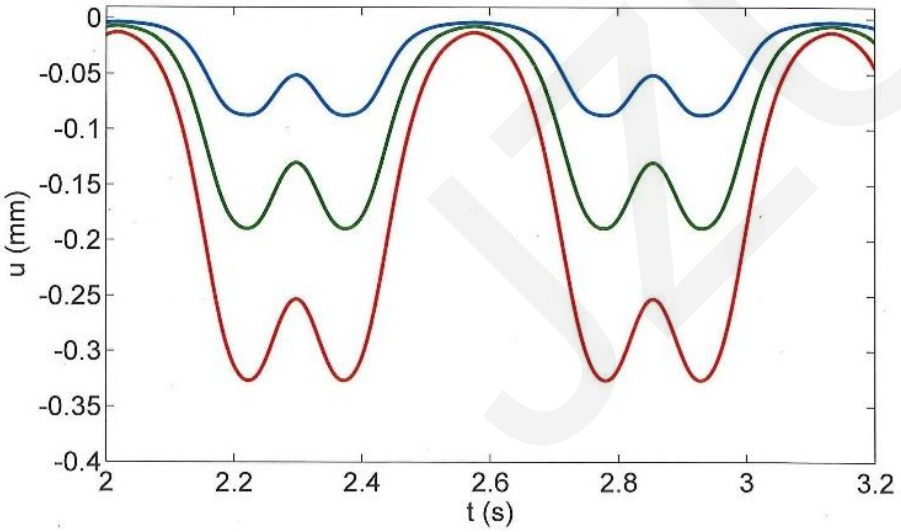


Fig. 4 Calculation of train passages different soils and different slabs



ICE train with two bogies per carriage

v_s = 150, 200, 300 m/s
t_P = 0.45 m



t_P = 0.15, 0.3, 0.45 m
v_s = 150 m/s

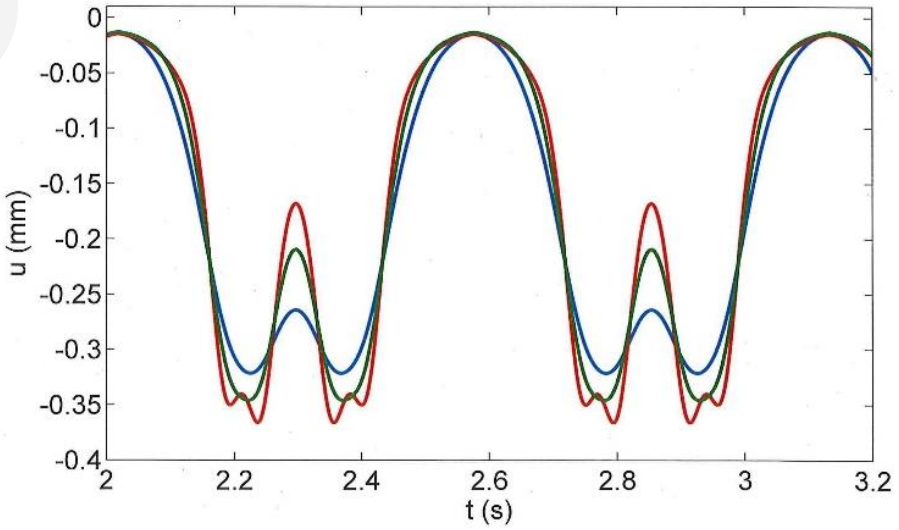
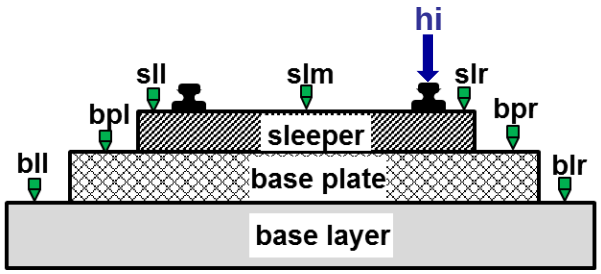
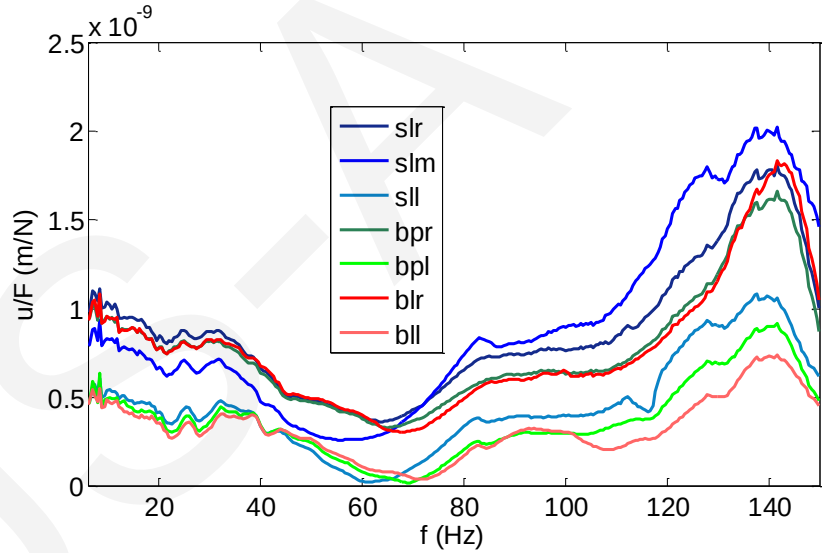


Fig. 5 Measured transfer function of a slab track







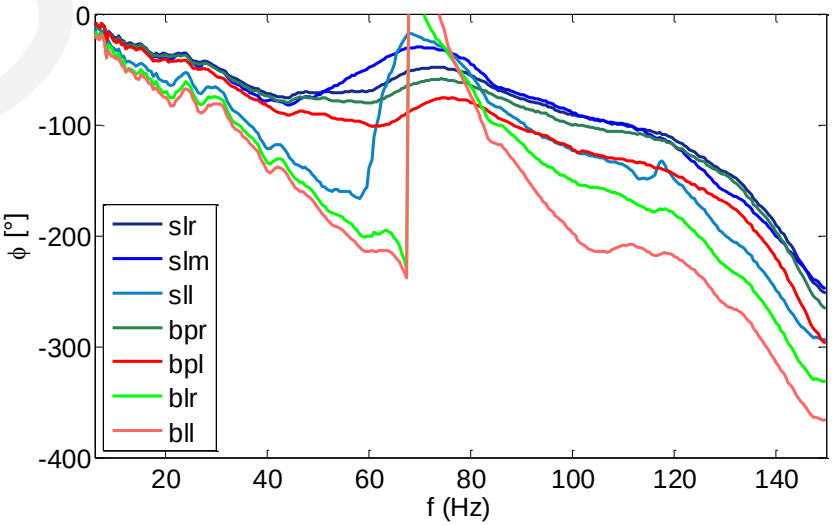
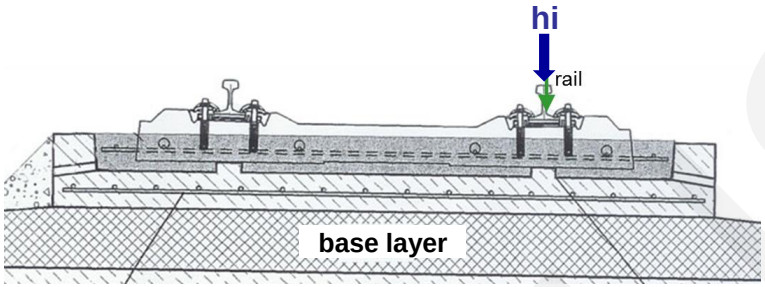
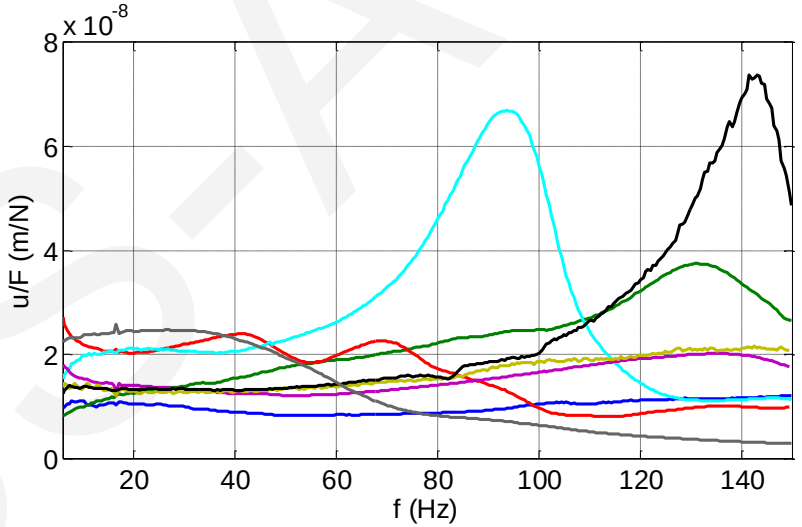
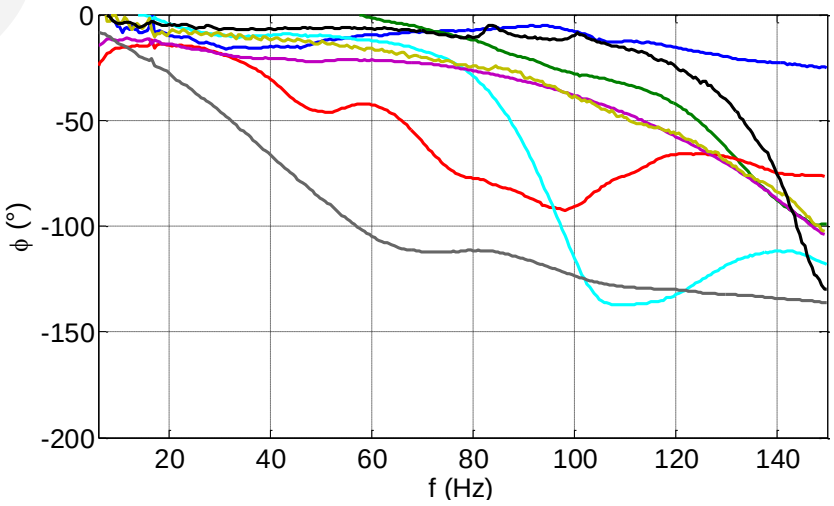


Fig. 6 Measured transfer functions of the rail at different tracks and sites







- site 1, slab track
- site 2, slab track
- site 5, asphalt track
- site 5, slab track with soft rail pads
- site 5, slab track
- site 3, slab track with stiff rail pads
- site 7, slab track
- site 7, ballast track