



Journal of Zhejiang University-SCIENCE A  
(Applied Physics & Engineering)  
ISSN 1673-565X (Print); ISSN 1862-1775 (Online)  
www.jzus.zju.edu.cn; link.springer.com  
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## Mitigation of high-speed trains vibrations by expanded polystyrene blocks in railway embankments

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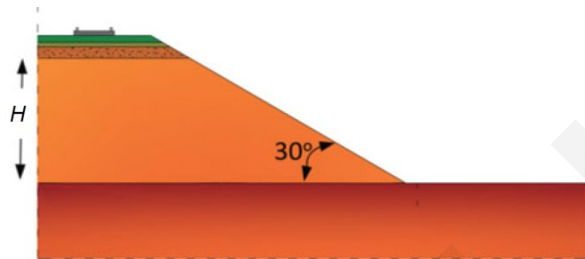
Keywords: High-speed railways (HSR); High-speed trains (HST); Traffic-induced vibrations; Mitigation measures; Expanded polystyrene (EPS)

Cite this as: Alexandros Lyratzakis, Yiannis Tsompanakis, Prodromos N. Psarropoulos, 2021. Mitigation of high-speed trains vibrations by expanded polystyrene blocks in railway embankments. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 22(1):6-20. <https://doi.org/10.1631/jzus.A1900680>

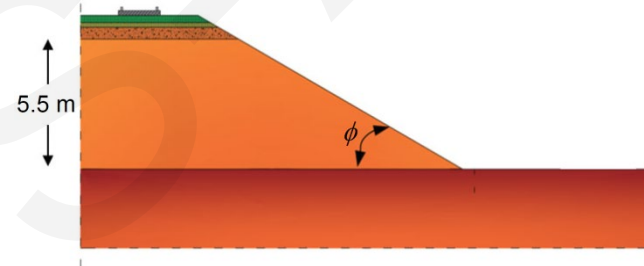
# PURPOSE OF THE STUDY

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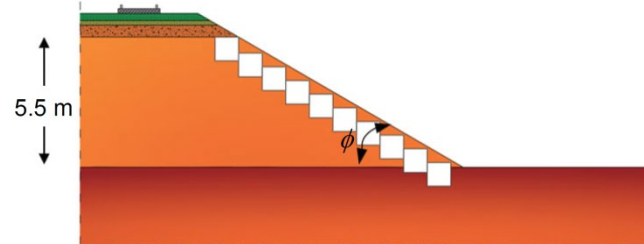
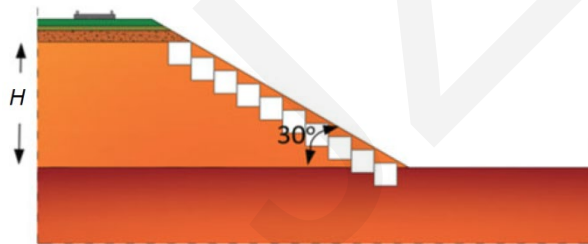
IMPACT OF EMBANKMENT HEIGHT ON HST-INDUCED VIBRATIONS



IMPACT OF EMBANKMENT INCLINATION ON HST-INDUCED VIBRATIONS



IMPLEMENTATION OF EPS BLOCKS ON THE EMBANKMENT SLOPE IN ORDER TO REDUCE VIBRATION LEVELS



# CASE STUDY

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- Examined HST: Thalys
- Passing speed: 284 km/h
- Welded UIC-60 rails
- Classical ballasted track
- Track components:  
ballast, subballast,  
subgrade.

Soil profile and  
embankment

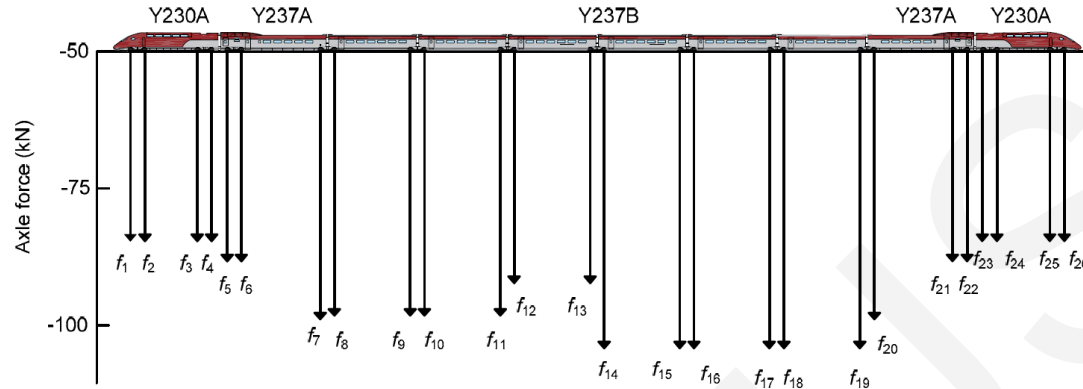


Site north-east of  
Brafte, Belgium



# FINITE-ELEMENT MODEL

## THALYS STATIC AXLE FORCES



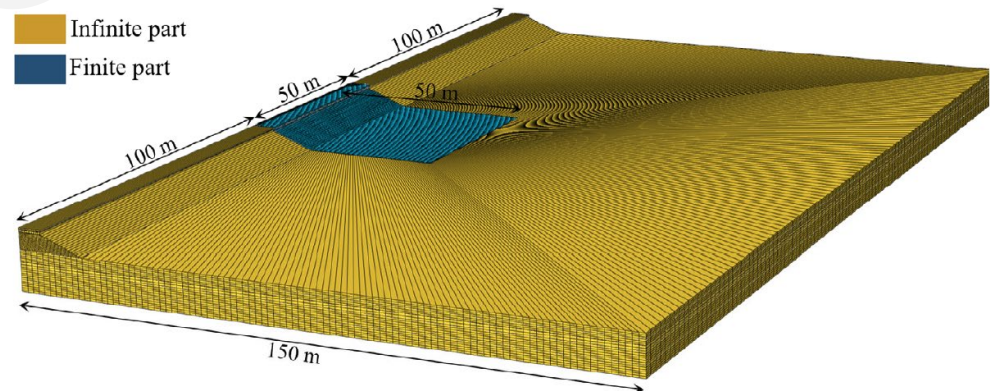
Modeling of HST's axle forces

↓  
Fortran Vdload subroutine

Modeling of the track and soil components

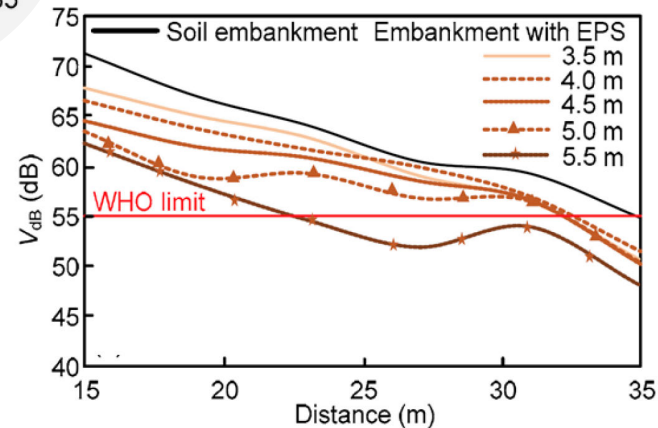
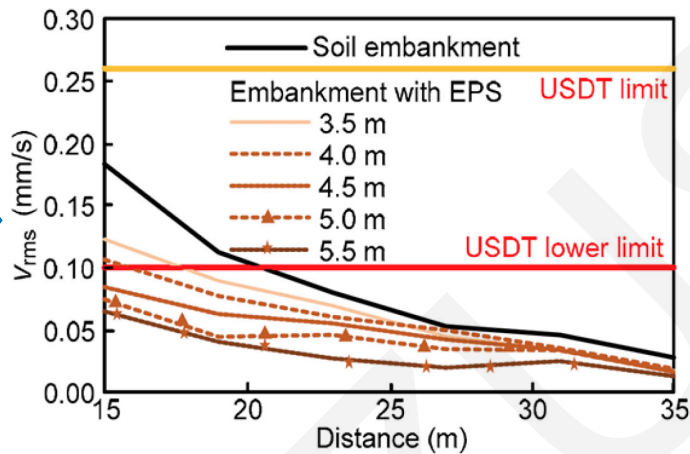
↓  
ABAQUS Explicit

## 3D FINITE/INFINITE NUMERICAL MODEL



# RESULTS

## SOIL AND EPS-RETROFITTED EMBANKMENTS: VIBRATION LEVELS FOR VARIOUS HEIGHTS

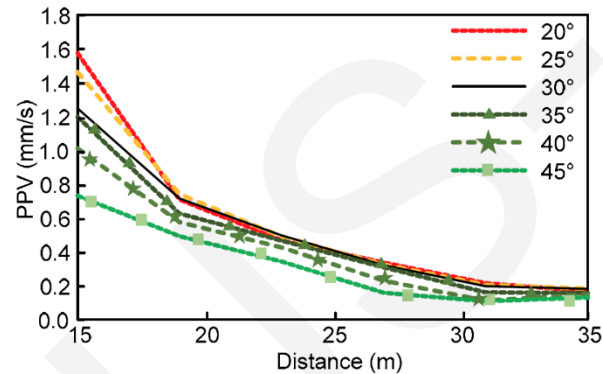


$V_{rms}$   
compared  
to USDT  
limits

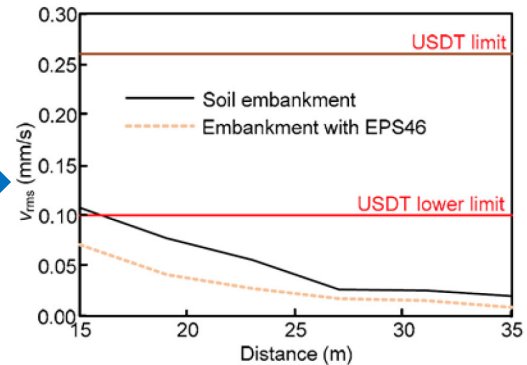
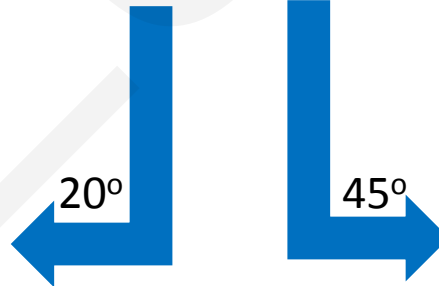
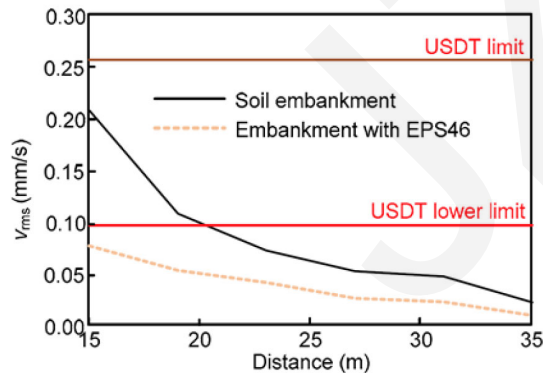
$V_{dB}$   
compared  
to WHO  
limit

# RESULTS

PPV ( $=\max |v(t)|$ ) OF THE SOIL EMBANKMENT FOR VARIOUS SLOPE INCLINATIONS



COMPARISON WITH EPS-RETROFITTED EMBANKMENT



# CONCLUDING REMARKS

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- In general, the implementation of EPS blocks contributes to the mitigation of the HST-induced vibrations.
- The embankment height has a minor impact on the HST-induced vibrations.
- The embankment slope inclination plays a more crucial role on vibration levels. A steeper slope leads to lower vibration levels.
- The application of EPS blocks leads to a reduction of  $v_{rms}$  values below the USDT limit for frequent HST passage.
- In addition, PPV values are lower than the DIN limit for the protection of nearby buildings and their residents.