



# SPEED OF FREIGHT TRAINS IN TRACK JUNCTIONS

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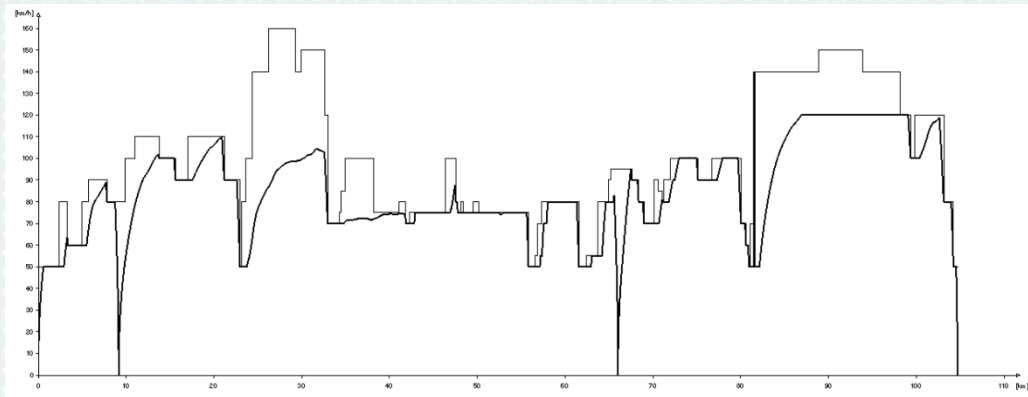
28<sup>th</sup> May 2025

# Motivation

- Designing the heads of stations for the highest possible operational speed
- Is such optimization practically applicable?
- Influence of railway signalling systems
- Introduction of the European Train Control System (ETCS)

# Research Objective

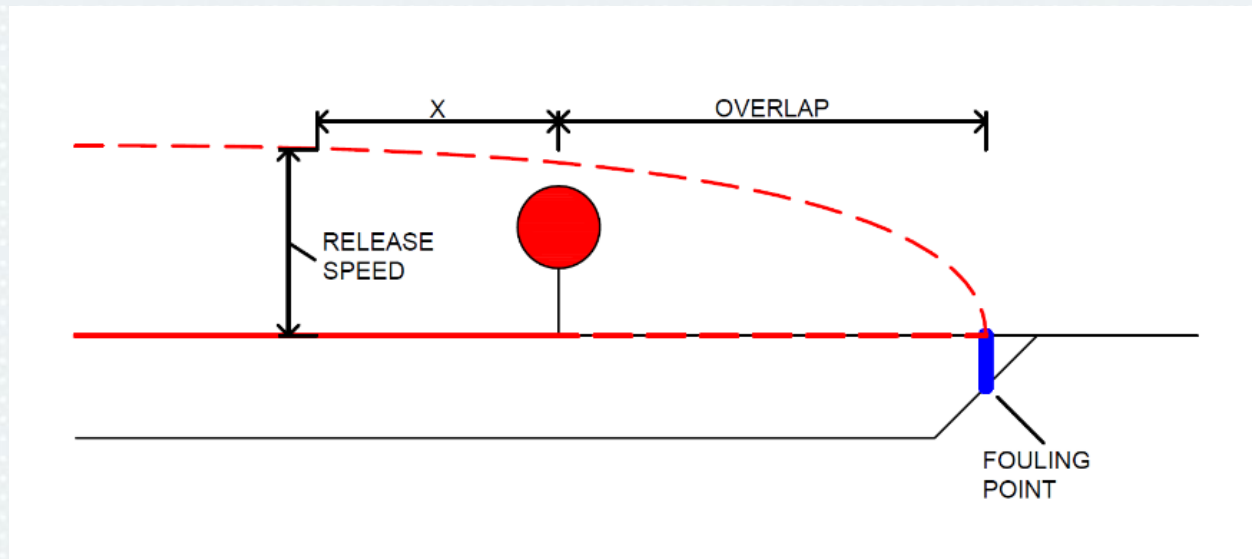
- To analyze train speed behavior in railway stations
  - To conduct speed measurements of freight trains
  - To perform simulation-based analyses
  - To compare empirical and simulation results
  - To provide recommendations for station design



*Author: Ing. Jan Valehrach, Ph. D.*

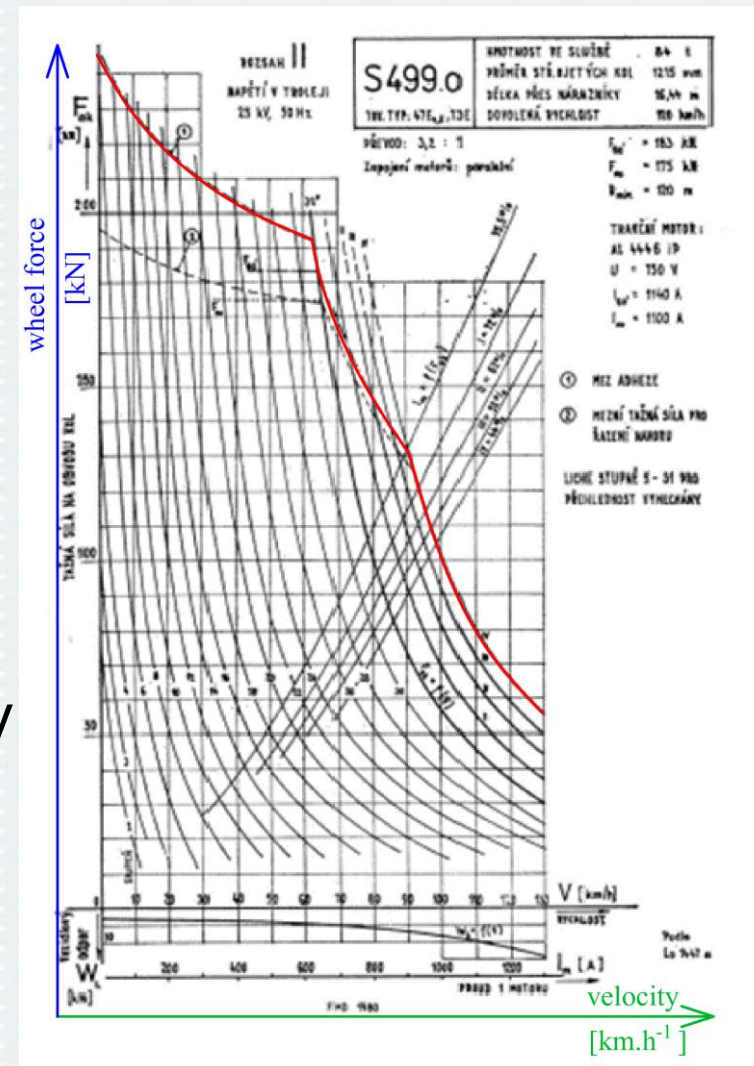
# Theoretical Background

- Signalling systems:
  - Speed signalling system in the Czech Republic
  - International approaches and comparison
  - Implementation and principles of ETCS
    - Concepts of overlap and release speed



# Train dynamics

- Acceleration and braking processes
  - Traction characteristics
  - Braking characteristics and constraints
  - Physical limitations
  - Brake system functionality





# Speed Measurement Methodology

- Using hand-held radar devices
  - Simple setup, high flexibility
  - Lower data volume, requires on-site personnel
- Preferred measurement locations:
  - Freight trains: marshalling yards
- Alternative approach:
  - Installation of permanent measurement equipment



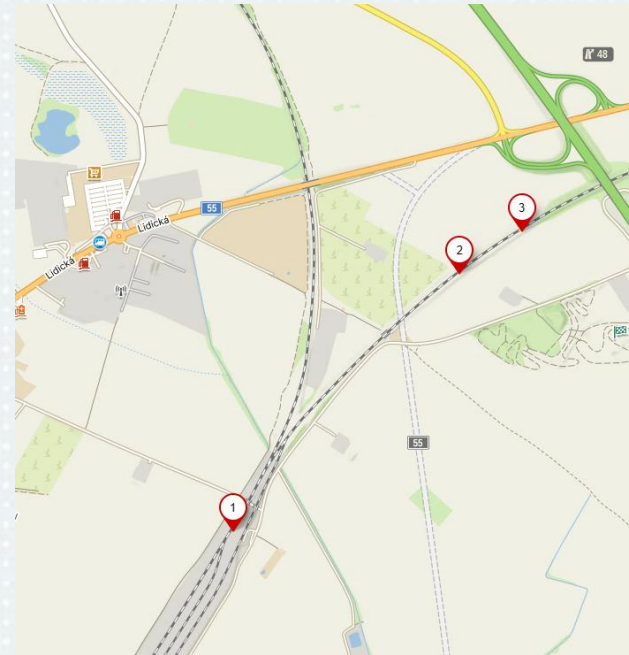
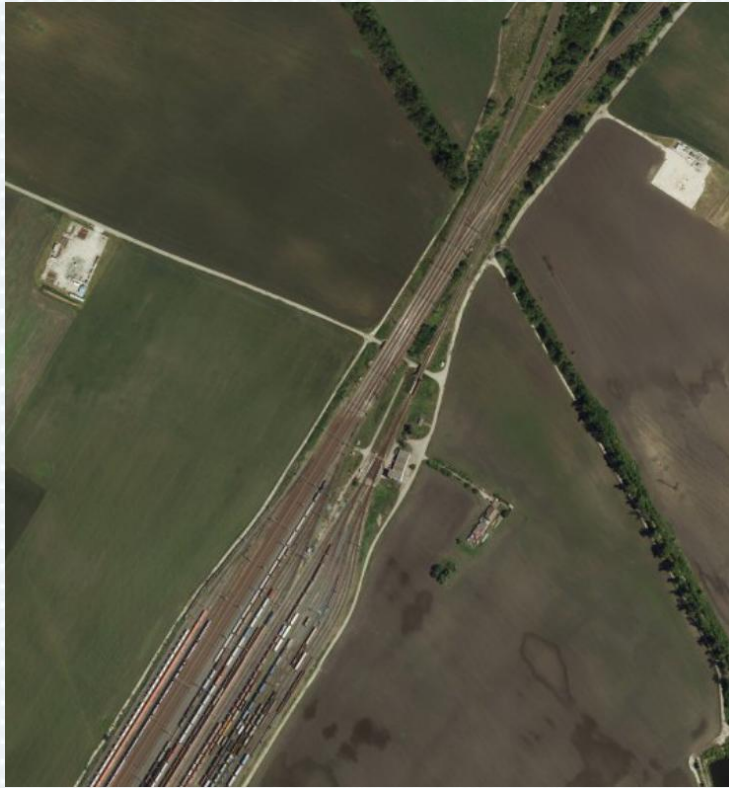
# Site Selection Criteria

- Should be located on a line with heavy freight traffic
- Accelerate from zero initial speed
- Heads of the groups of marshalling yards should allow for high speeds



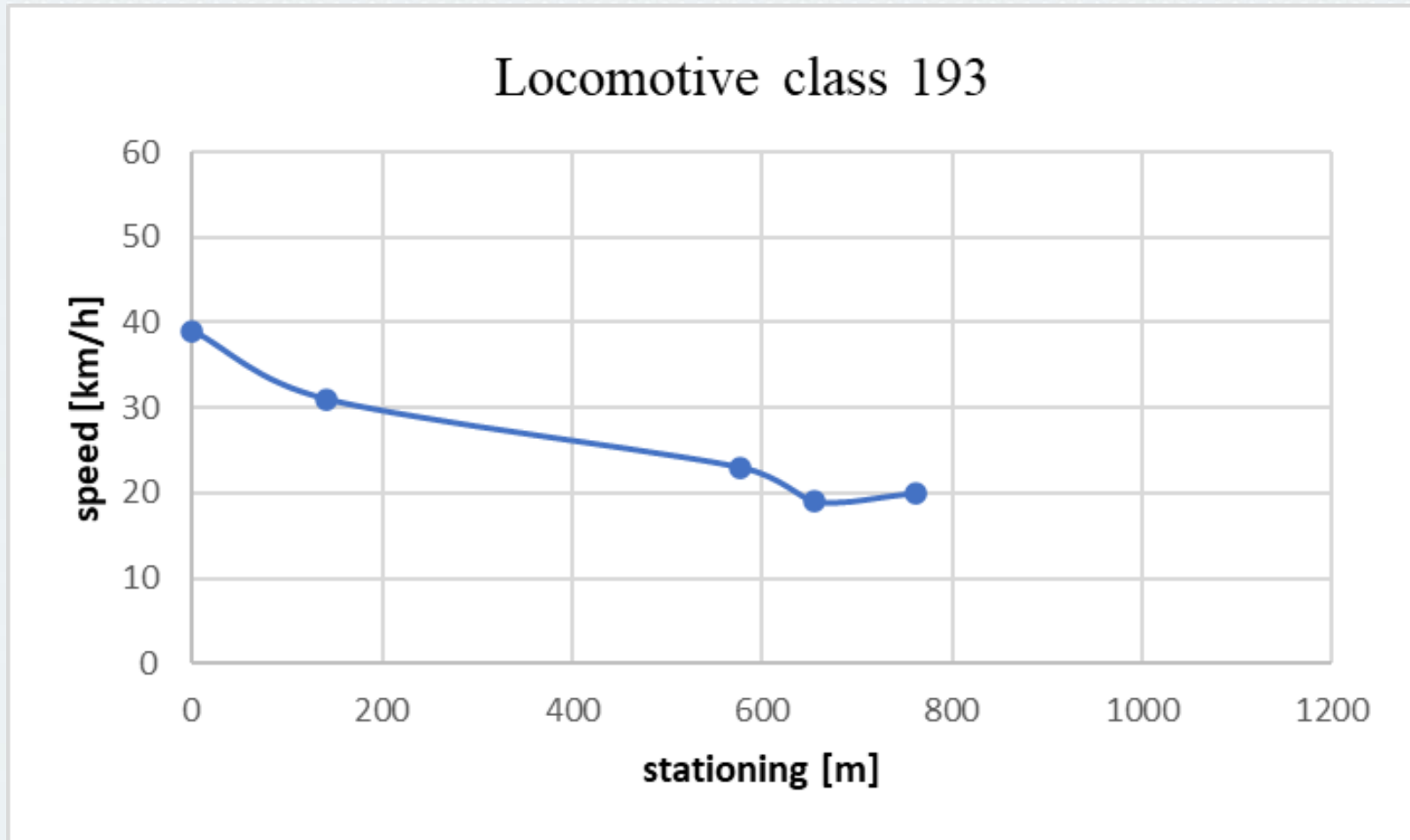
# Selected Location

- Freight trains:
  - Břeclav-přednádraží



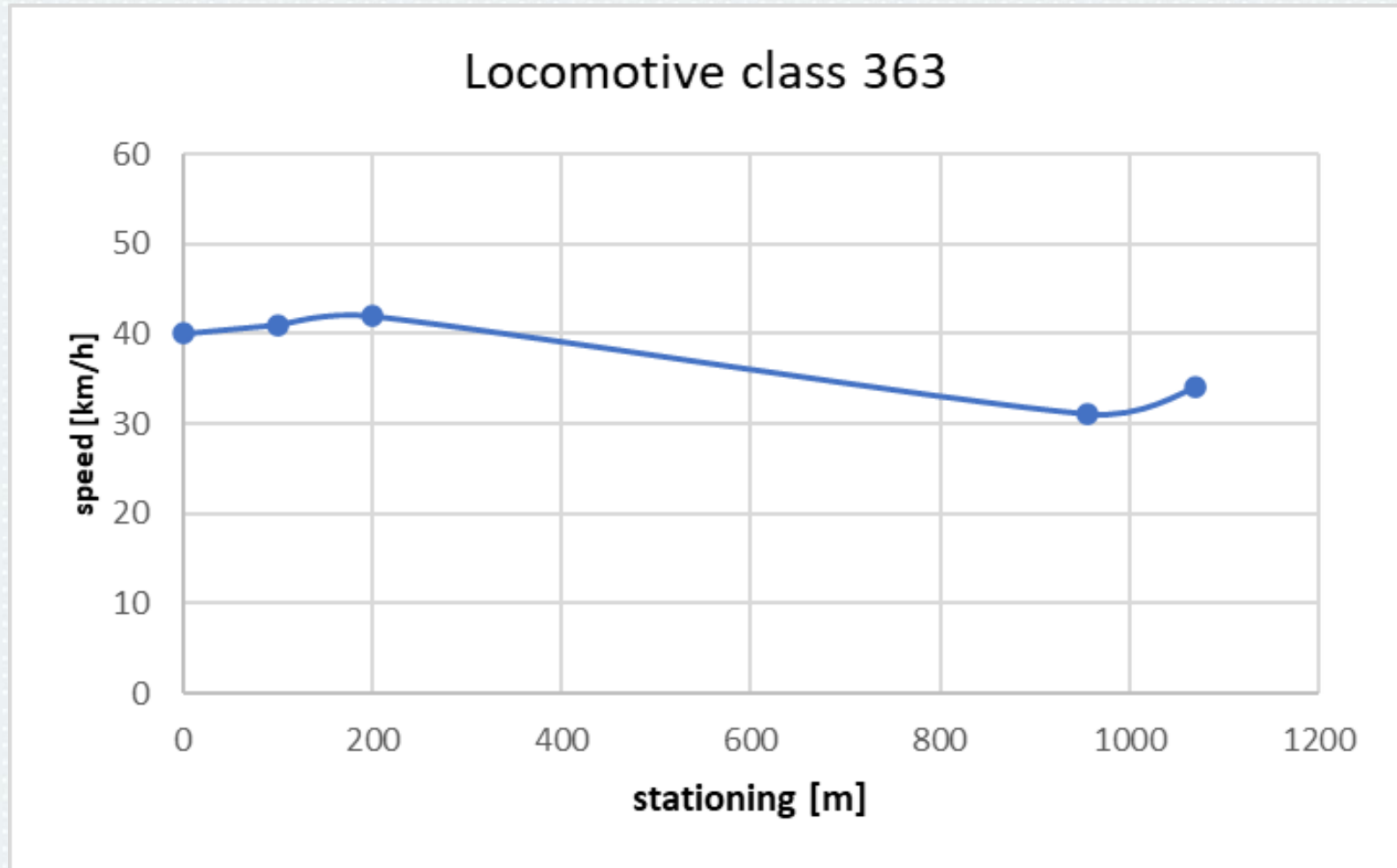


# Results



*Braking curve of a train with locomotive class 193,  
473 m long, 1825 t in weight.*

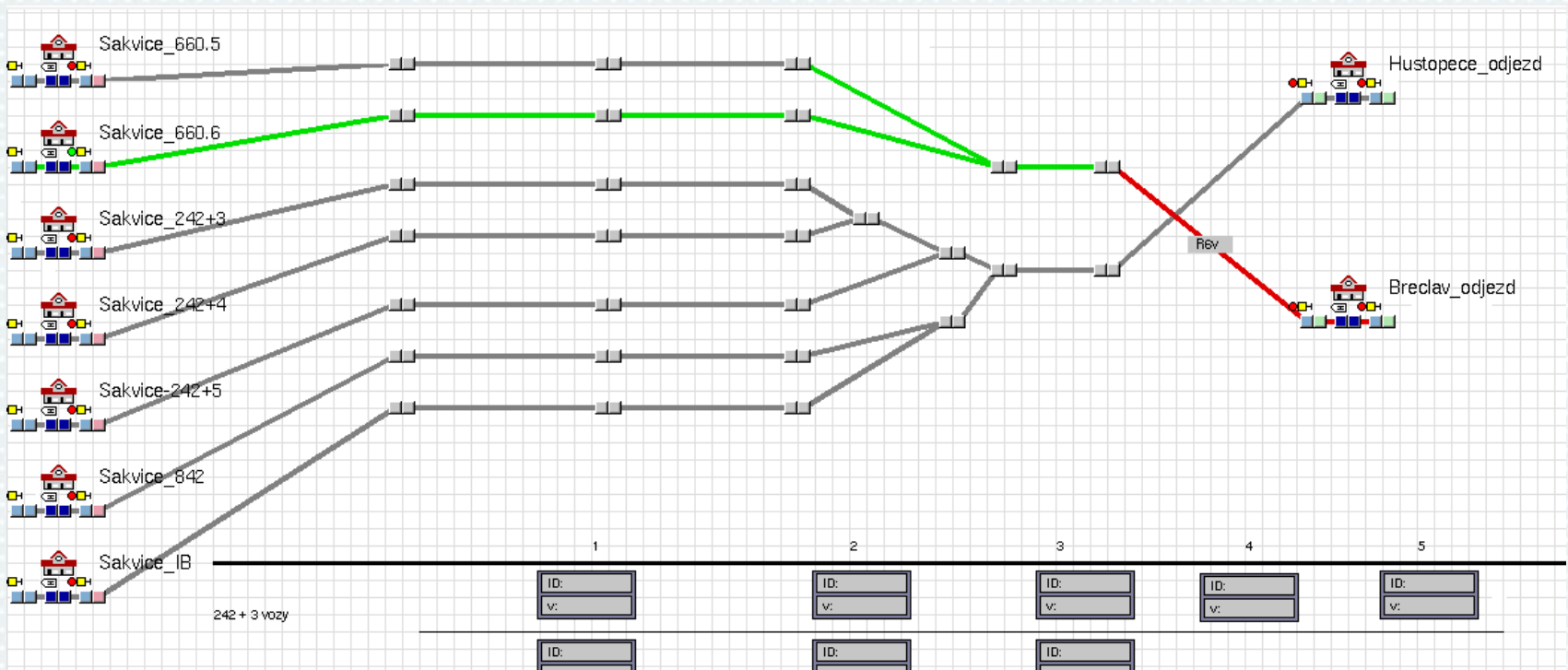
# Results



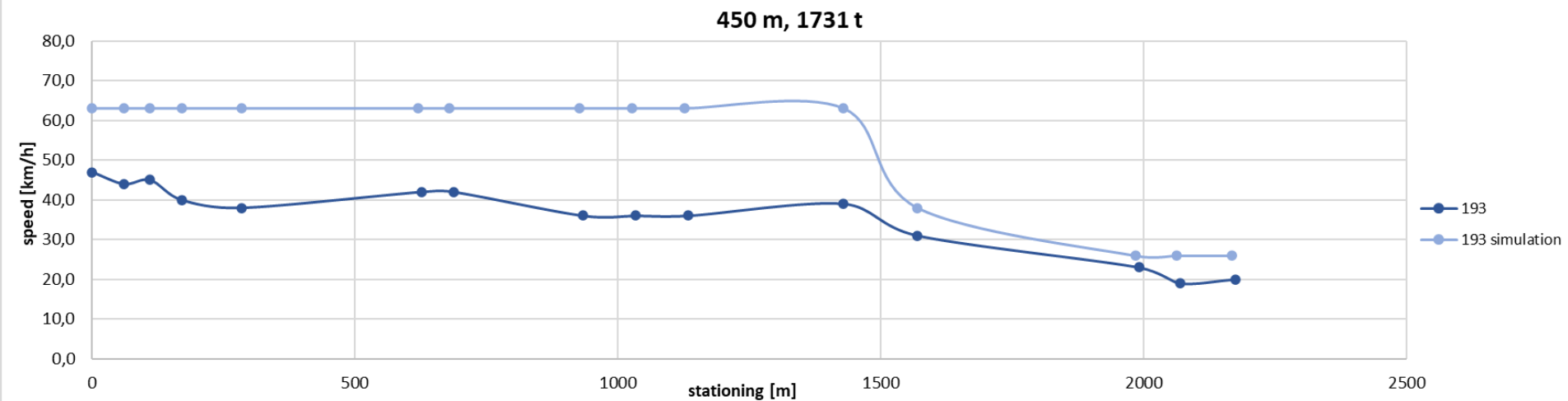
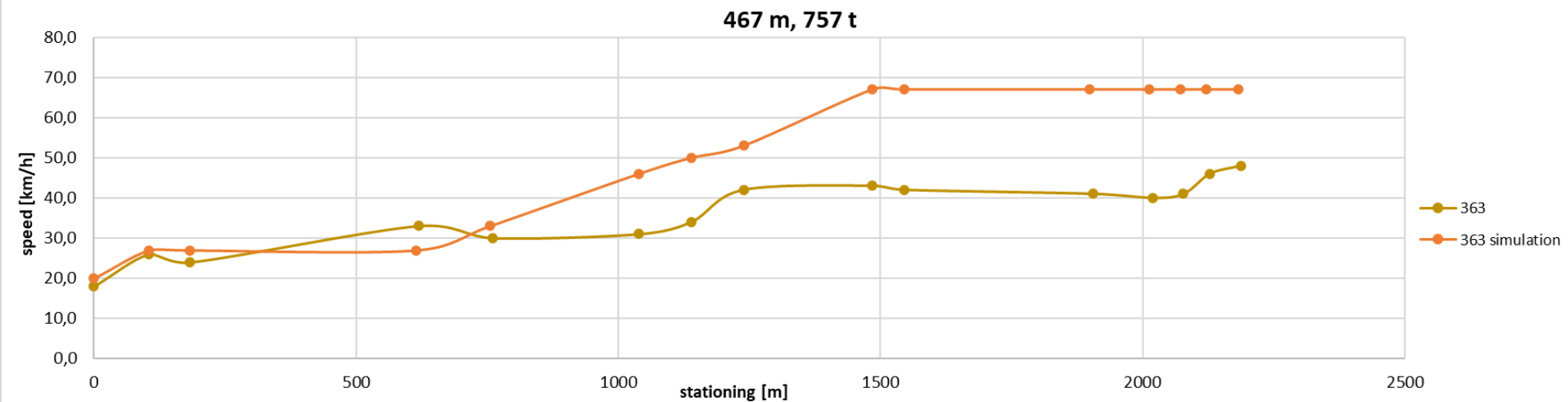
*Acceleration curve of a train with locomotive class 363  
in a neutral section, 563 m long, 1217 t in weight.*

# Simulation Environment

- Conducted using OpenTrack railway simulation software



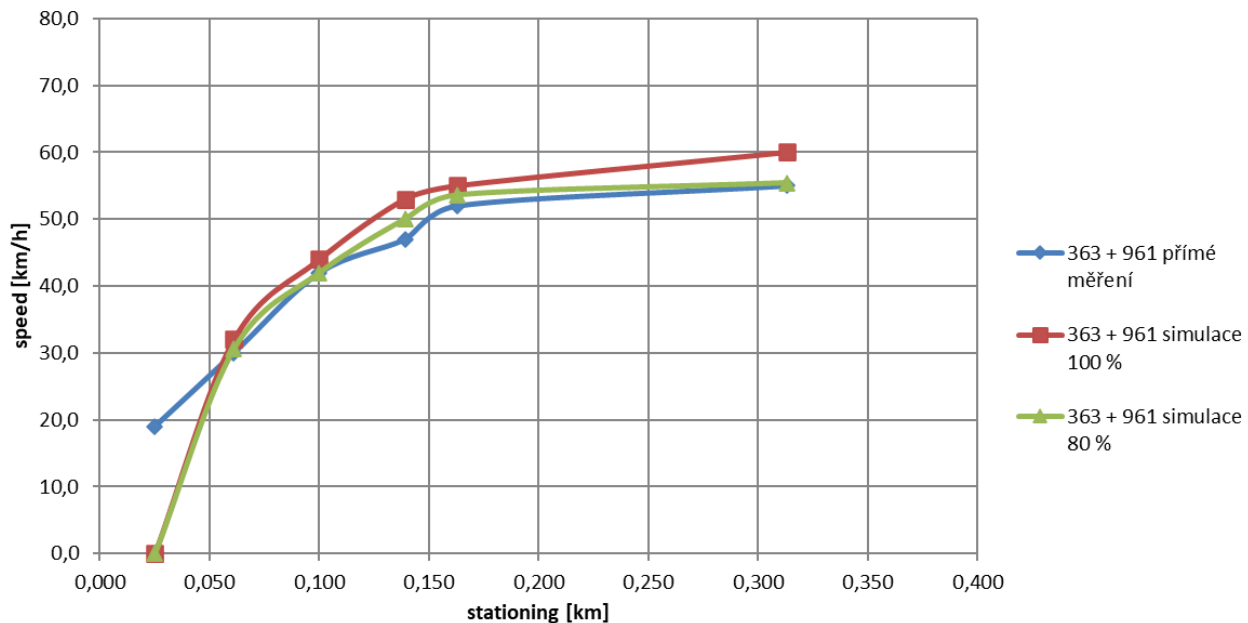
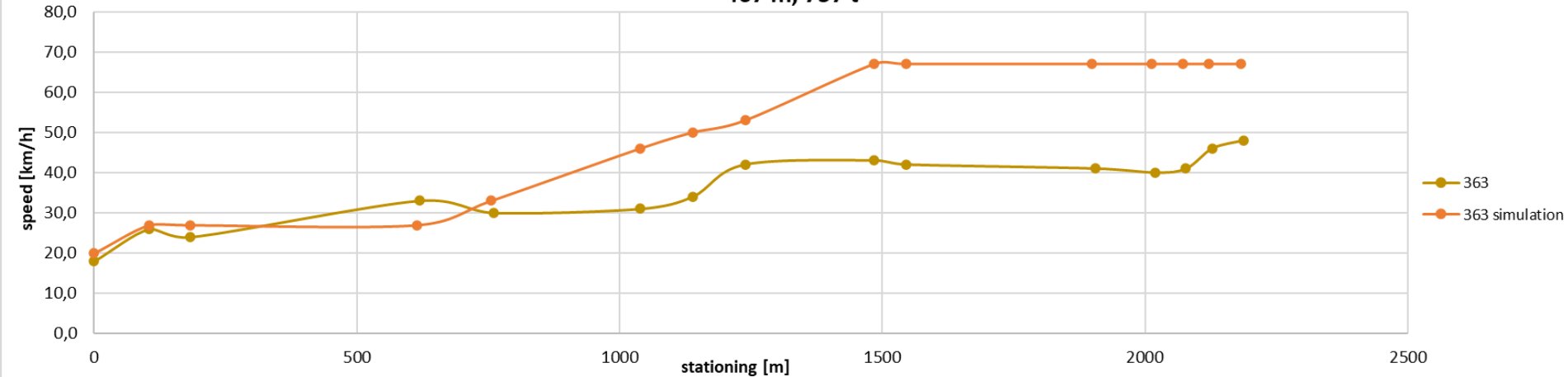
# Comparison





# Comparison

467 m, 757 t



# Outlook and Further Steps

- Finalization of freight train measurement campaign
- Consideration of additional sites for further study
- Evaluation of alternative measurement methods:
  - Fixed-speed measurement units
  - Onboard velocity logging
  - Internal vehicle monitoring systems
- Development of design recommendations for station approaches and junctions

**Thank you  
for your attention**

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