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RIVAS Training Workshop: "Reducing railway induced ground vibration by interventions on the transmission path", Berlin, 23 May 2013

# Mitigation of vibration by sheet piling walls

## Results of vibration measurements.

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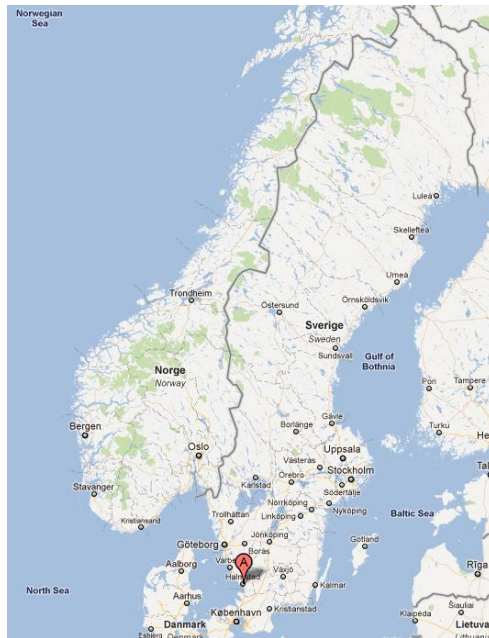


- Introduction
  - Furet test site
  - Sheet pile wall
- Vibration measurements
  - Train passages
  - RSMV

# Introduction

- Furet

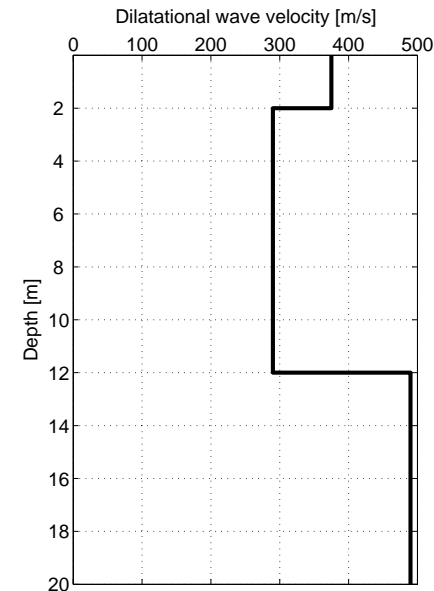
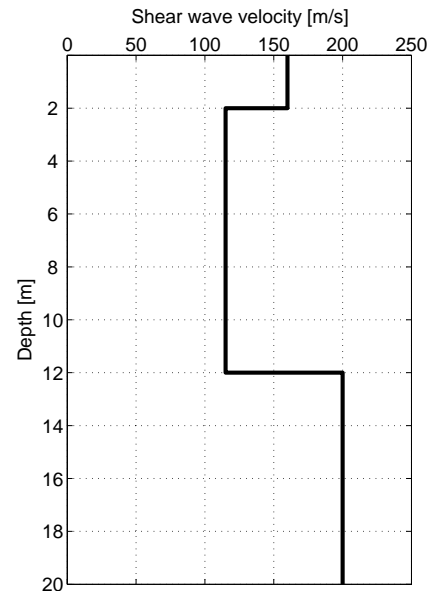
- Located in southwest of Sweden (Halmstad) along the West Coast Line between Gothenburg and Lund
- Vibration problems in houses nearby (4 – 5 Hz)



# Introduction

- Dynamic soil characteristics

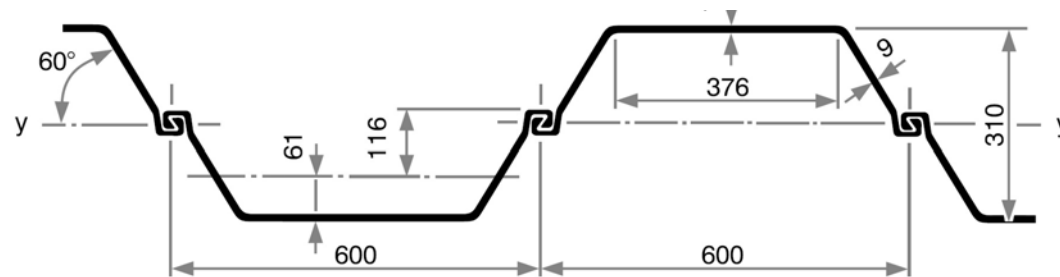
Layer	$h$ [m]	$C_s$ [m/s]	$C_p$ [m/s]	$\beta$ [-]	$\rho$ [kg/m <sup>3</sup> ]	$\nu$ [-]
1	2	154	375	0.025	1800	0.40
2	10	119	290	0.025	1850	0.40
3	$\infty$	200	490	0.025	1710	0.40



# Sheet pile wall

- VL 603-K profiles

- Depth of 12 m with every fourth pile extended to 18 m
- Distance from center of nearest track approximately 5.60 m



Mass	$m_w = 113.5 \text{ kg/m}^2$
Sectional area	$A_w = 144.8 \text{ cm}^2/\text{m}$
Moment of inertia	$I_w = 18900 \text{ cm}^4/\text{m}$
Width	$t_w = 0.310 \text{ m}$



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- Introduction
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  - Sheet pile wall
- **Vibration measurements**
  - Train passages
  - RSMV

# Vibration measurements

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- RIVAS measurement protocol
  - Vibration levels at adjacent track sections with (A) and without (B) mitigation measure
  - Vibration levels before and after installation of the mitigation measure



# Vibration measurements



- RIVAS measurement protocol
  - Vibration levels at adjacent track sections with (A) and without (B) mitigation measure
  - Vibration levels before and after installation of the mitigation measure
- Measurement line A
  - Geophones on sleepers
  - Geophones at 8 m, 16 m, 32 m and 64 m
  - Geophones at 8 m and 16 m at the opposite side of the track





# Vibration measurements

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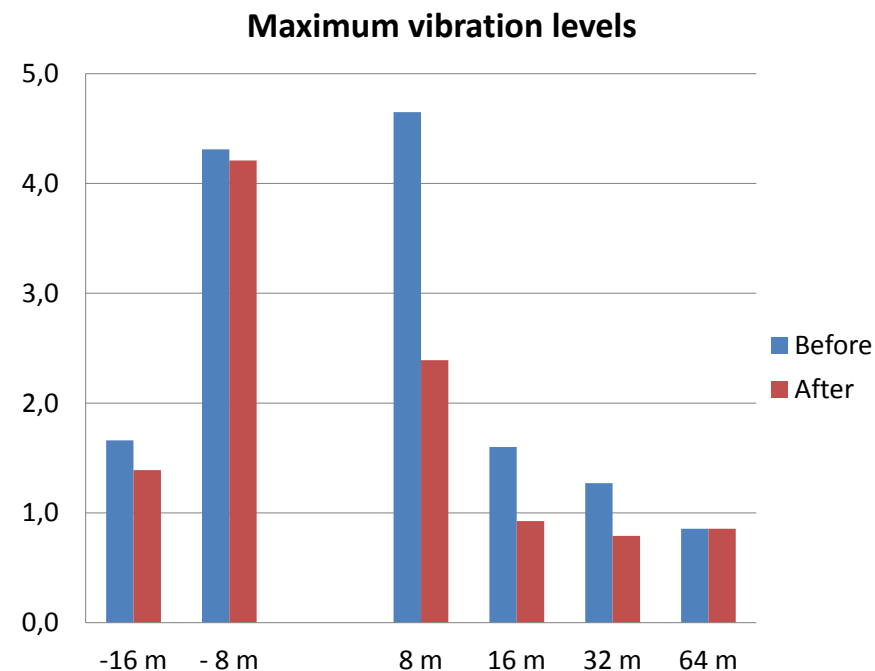
- RIVAS measurement protocol
  - Vibration levels at adjacent track sections with (A) and without (B) mitigation measure
  - Vibration levels before and after installation of the mitigation measure
- Measurement line B
  - Couple of hundred meters south of sheet piling wall
  - Geophones on sleepers
  - Geophones at 8 m and 16 m

# Vibration measurements



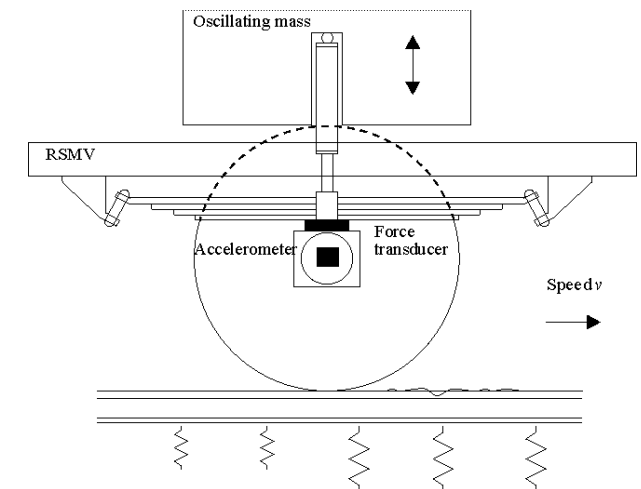
- During train passages

- Significant reduction in vertical vibration levels at 8 m, 16 m, 32 m
- Effectiveness is higher closer to the wall: maximum levels reduced by 50% at 8 m, by 30% at 32 m, no reduction at 64 m
- No increase in vibration levels at other side of track



# Vibration measurements

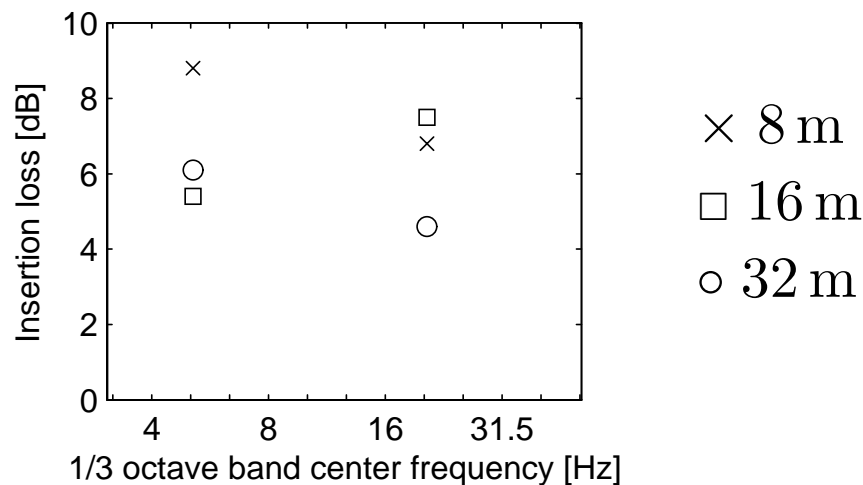
- Rolling Stiffness Measurement Vehicle (RSMV)
  - Stationary excitation of the track
  - Excitation duration 30 s at each operating frequency (3 Hz, 4 Hz, 5 Hz, 6 Hz, 7 Hz, 8 Hz, 9 Hz, 10 Hz, 15 Hz, 20 Hz)



# Vibration measurements



- Rolling Stiffness Measurement Vehicle (RSMV)
  - Stationary excitation of the track
  - Excitation duration 30 s at each operating frequency (3 Hz, 4 Hz, 5 Hz, 6 Hz, 7 Hz, 8 Hz, 9 Hz, 10 Hz, 15 Hz, 20 Hz)
  - Insertion loss  $IL_z = 20 \log_{10} \frac{|\hat{v}^{\text{ref}}|}{|\hat{v}|}$



# Thank you for your attention

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