Noise and Vibration Fundamentals
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TRACK 21
Railway Track for the 21st Century

Noise and vibration

Initial Objectives

1. To **measure the dynamic stiffness** of track structure layers (ballast in various conditions; also the effects of sleeper pads, ballast mats and rail pads).
2. To assess the implications of different sleeper/ballast/ sub-base combinations on **noise and vibration** using appropriate numerical models.
3. To study track support **stiffness variation** as a mechanism for vibration generation.

Noise and vibration

Additional Objectives (since start of project)

4 Quantify wheel and rail **roughness** and **track decay rates** typical of UK track. Carry out field measurements for **validation** of noise and vibration models.

5 Develop new **time domain FE** vehicle/track models to study critical velocity and distribution of loads through the track.

6 Provide input data of noise and vibration performance of **interventions** to WA6 (modelling)

Objective 1: dynamic stiffness measurements

Achieved:

- Test rig developed and commissioned
- Measurements of NR ballast, modified gradations, USPs

Conclusions:

- Dynamic stiffness depends strongly preload; weakly on frequency; also on depth.
- Low internal damping.
- Little difference between gradations.

To do:

- Rail pads (Aug).
- Reinforced ballast? (←WA2)

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Objective 2a: implications of different sleeper/ ballast/sub-base combinations for noise

Achieved:

- Measurements of effect of sleeper type
- Ballast absorption tests underway
- BEM modelling and scale model tests

Conclusions:

- Main parameter for noise is ballast *absorption* rather than stiffness.

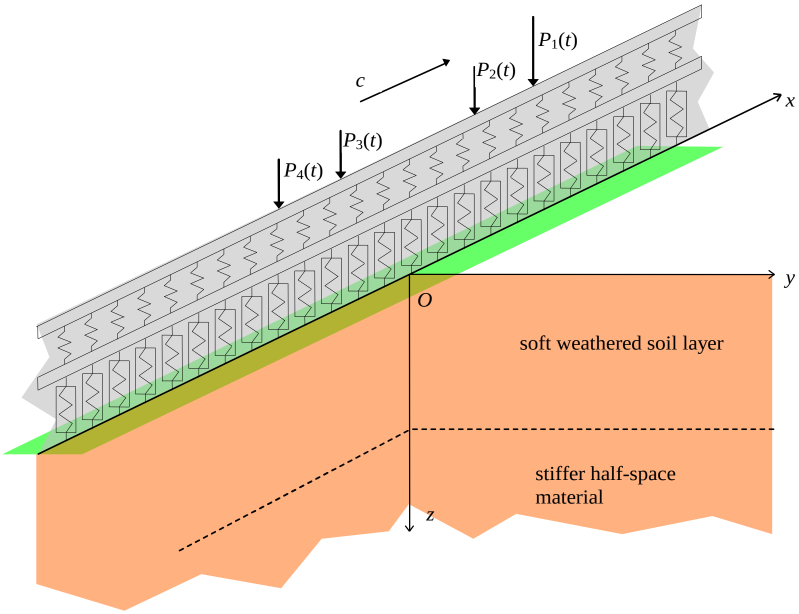
To do:

- Further ballast absorption tests and modelling
- Model effect of sleeper type and USPs on noise
- Absorption of reinforced ballast? (←WA2)
- Implications of new track design for noise (←WA5)

Objective 2b: effects of different sleeper/ballast/sub-base combinations on vibration

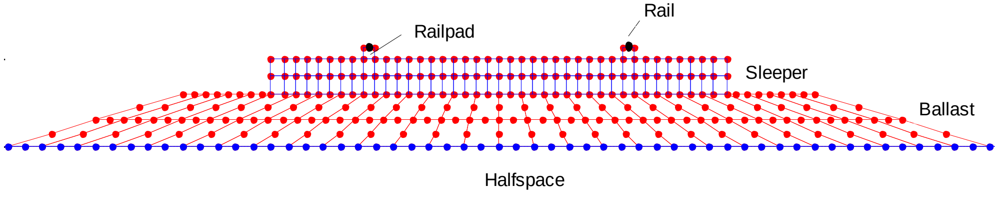
Achieved:

- Models available (further development in MOTIV)
- Field tests for validating vibration models (5 sites)



Conclusions:

- Soil type more important than ballast stiffness.



To do:

- Modelling using results from lab and field testing
- Implications of new track design for vibration (←WA5)

Objective 3: track support stiffness variation

Not a major focus

Achieved: Models developed in previous PhD (paper in review)

To do: Need for input data (possible use of RCA system?)

Objective 4a: wheel/rail roughness and track decay rates

What is typical UK situation?

Achieved:

- Wheel roughness device developed
- 2 sets of wheels measured; third underway at Siemens
- Rail roughness and TDR measured at >5 sites

Conclusions:

- UK roughness generally low.
- TDR depends on pad stiffness and temperature.

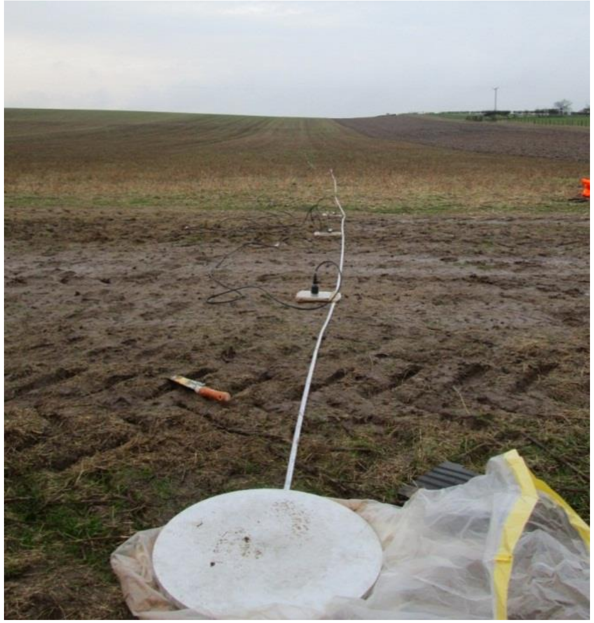
To do:

- Continue as opportunity arises

Objective 4b: field measurements for validation of models (noise and vibration)

Achieved:

- Measurements at Fishbourne, Romsey, Preston, Alnmouth, Banbury, Tamworth



Conclusions:

- No site is ideal!
- Have effect of rail pads, steel sleepers, USP (under switches), critical velocity site, train type

To do:

- Complete comparisons with models
- Further measurements as opportunity arises

Objective 5: time domain FE models

Achieved:

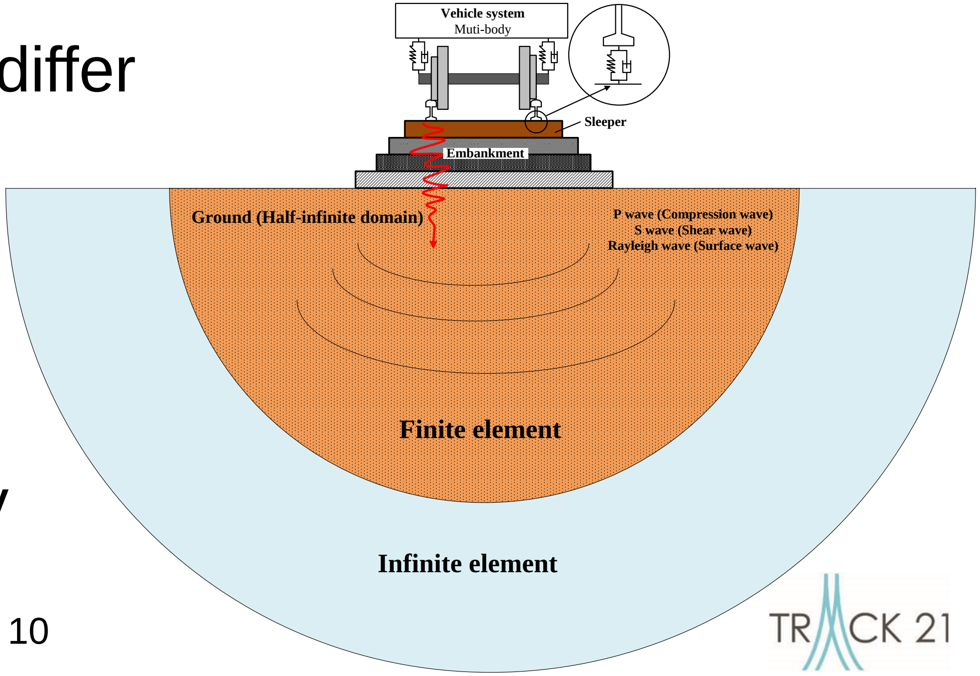
- Vehicle, track and ground models established and coupling method achieved
- Effect of model size, element size, infinite elements investigated

Conclusions:

- Results at critical velocity differ from steady state models

To do:

- Further work on effect of model size
- Introduce soil non-linearity



Objective 6: provide input data to WA6 (modelling)

Pulls together results from other work

Achieved:

- Field measurement of ground-borne vibration on crossings with and without USPs
- Noise measurements of effect of rail pad stiffness

Conclusions:

- Demonstration of (small) benefit of USPs
- Effect of rail pad stiffness and temperature quantified

To do:

- Quantify effect of other proposed interventions using detailed modelling (TWINS, TGV, etc) and results from laboratory and field measurements.

Thank you

Any questions?

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