2024 European Light Rail Congress

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Rockdelta

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VIBRATIONAL IMPACT OF URBAN RAIL INFRASTRUCTURES

Attenuation results with resilient stone wool mats

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Rockdelta® by Lapinus

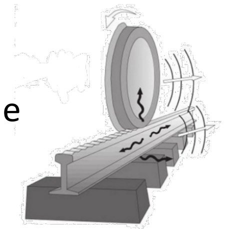
AC Ingenieros

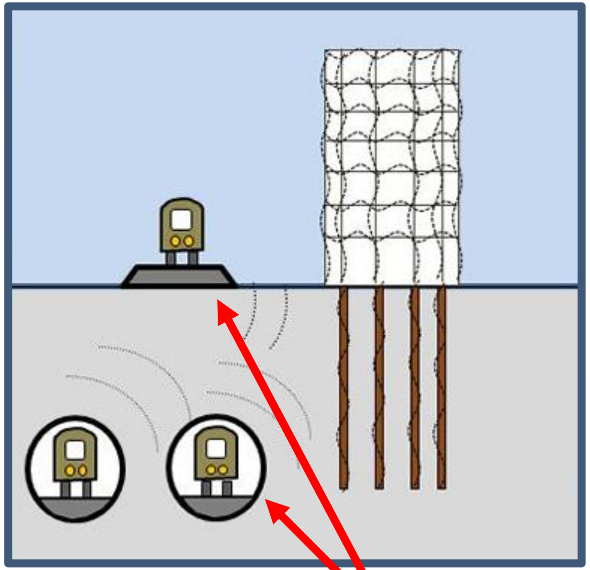
mainspring

TOPICS

1. Vibrational impact causes and effects
2. Stonewool resilient mitigations
3. Vibration transmission and modelling
4. Experimental results

RAILWAYS – A SOURCE OF VIBRATIONS



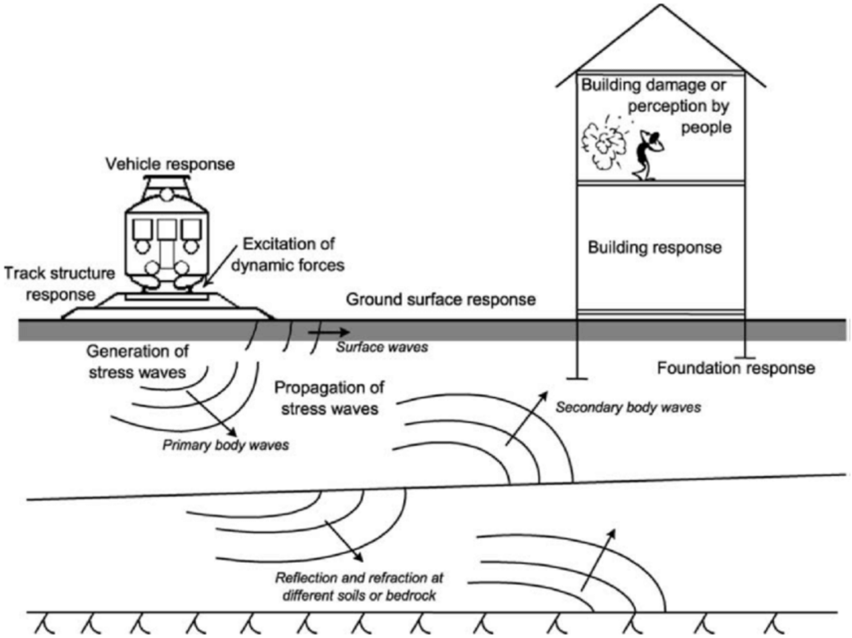


- Vibrations are inherent to all traditional railway systems due to the wheel and the rail interaction
- Vibrations can be transmitted through the ground and can be perceived as vibrations or re-radiated noise
- In contrast to audible sound, vibrations have the biggest impact at low frequencies (between 1 and 200 Hz)
- When not properly controlled, vibrations can lead to human discomfort, high precision equipment inaccuracy and in extreme cases, building masonry damage

It has been proven that the best way of isolating vibrations is by acting at the source = The track

RAILWAYS – A SOURCE OF VIBRATIONS

WHICH ELEMENTS OF THE SURROUNDING ENVIRONMENT INFLUENCE THE VIBRATIONS PATH?



ROCKDELTA SOLUTIONS – STONEWOOL MATS

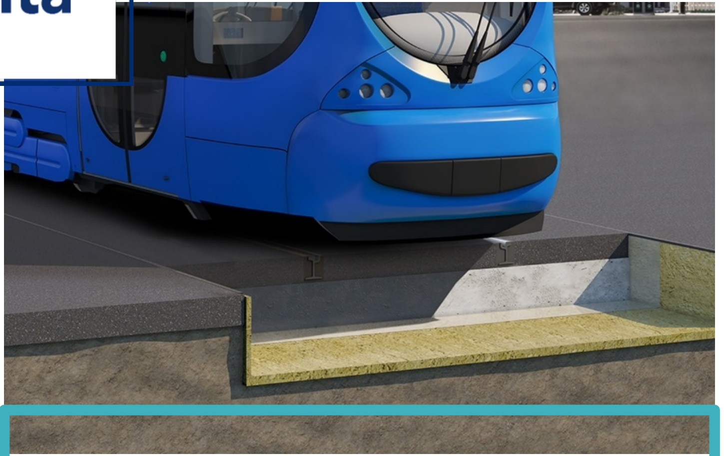
Track design

- Mass
- Resilient elements

Rockdelta®

by Lapinus

Rockdelta RB for ballasted tracks

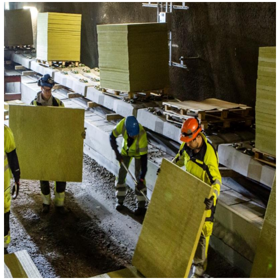


Rockdelta RX for ballastless tracks

ROCKDELTA SOLUTIONS – STONEWOOL MATS

Vibro-acoustic capabilities
Effectively reduces vibration and noise

Water properties
Resistant to water



Robustness
Performs consistently under any conditions

Installation and storage
Efficient and simple

Fire resistance
Protects construction environment from fire

Aesthetics
Can be used with all track top finishes

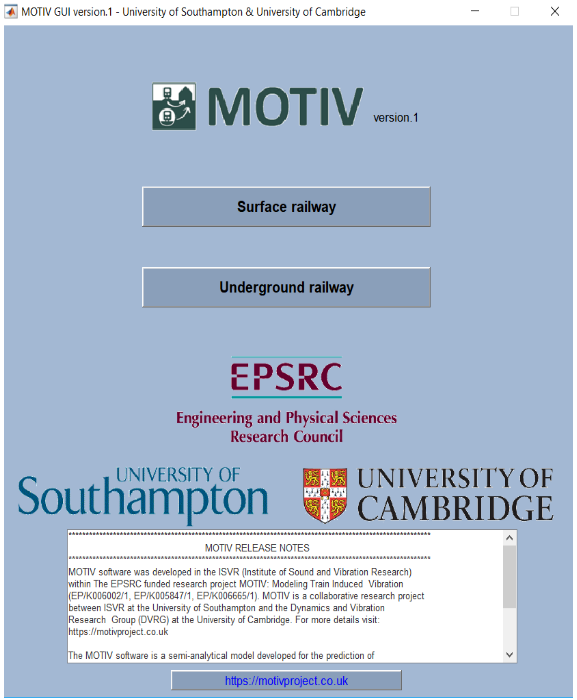
Thermal properties
Insulates against frost heaves and heat loads

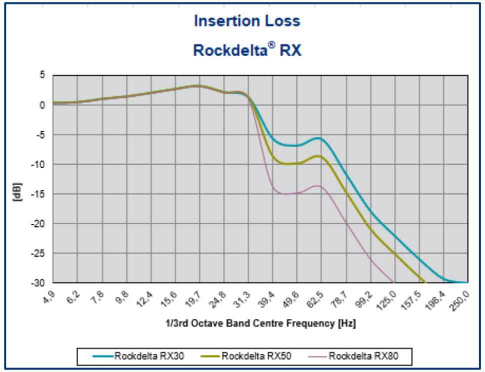
Circularity
Natural product for a circular economy

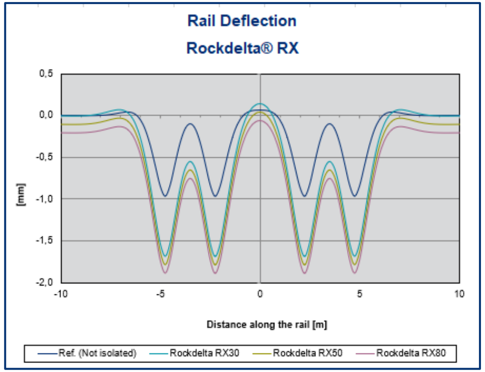
PREDICTION MODELS

MOTIV is a semi-analytical model for predicting ground vibration from surface and underground trains, including the effects of the track structure, vehicle type and ground properties.

MOTIV also calculates the Insertion Loss and the expected rail deflection by the use of elastic elements in track.







EXPERIMENTAL RESULTS: BREST TRAMWAY

The Brest tramway is located in Brest which is a port city of Brittany in north-western France.

It's a 14.3-kilometre line consisting of a 28-stop, two-branch.

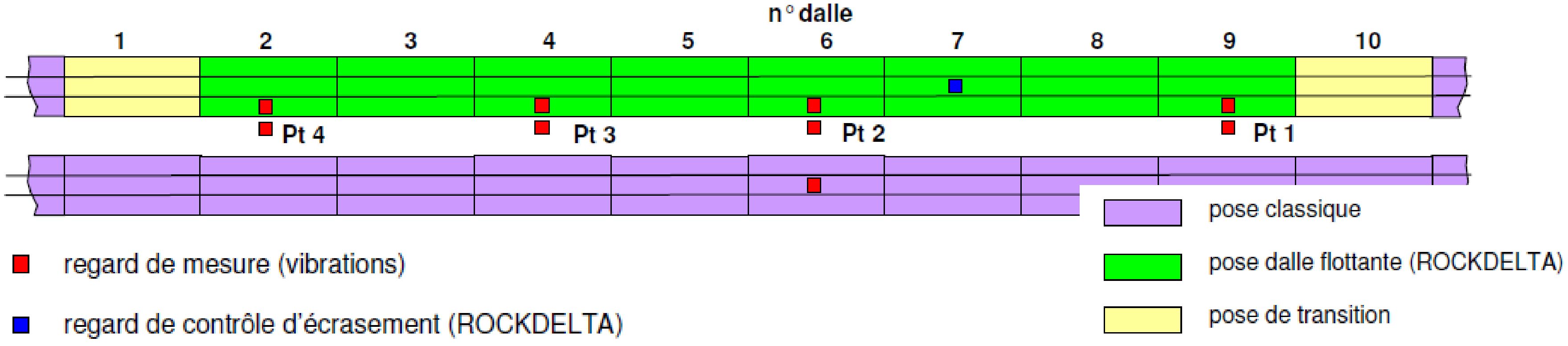
Construction work on the platform began in early 2010 and the system began service on 23 June 2012.

VIBRATIONAL MEASUREMENTS

The purpose of the measurements which have been carried out is to validate the technical ability of RockDelta anti-vibration mats to achieve the required vibration attenuation.

The test area is located between PK 11090 and PK 12050 (route de Gouesnou, in BREST).

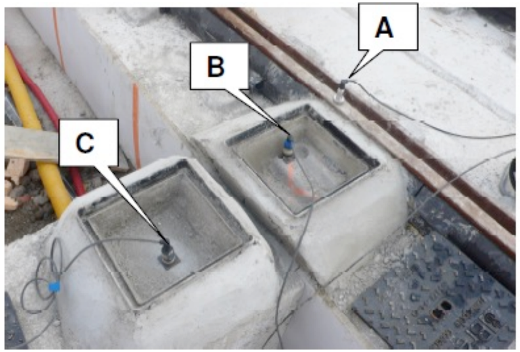
The tested section is equipped with RockDelta product type "RockXolid 50", thickness 50mm, with drainage channels.



VIBRATION MEASUREMENTS

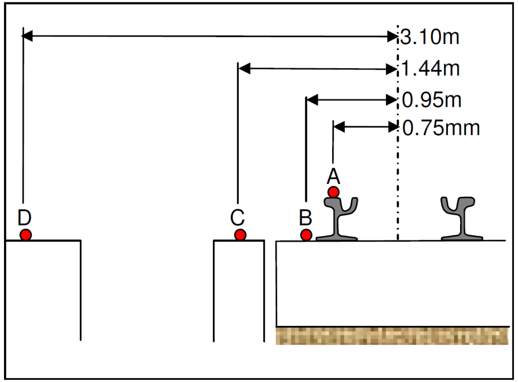
To perform the measurements, the following equipment has been used:

- Impact hammer;
- 3 PCB2 accelerometers;
- 1 calibrator;
- 1 acquisition and processing system.



The quantity measured is the "transmission" loss.
The measurement method used first requires determining the transfer mobilities at the different points.
To do this, three sensors are used:

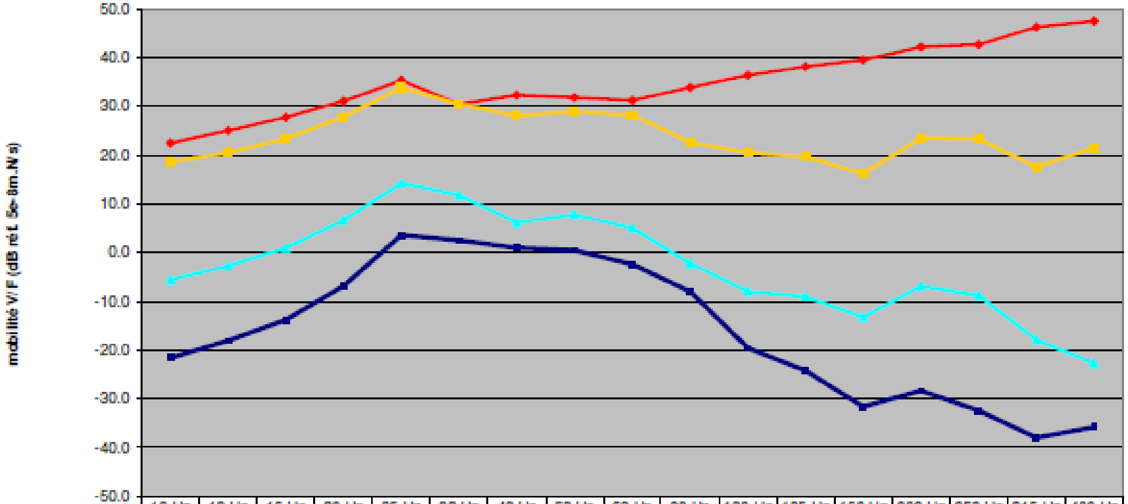
- sensor A: on the rail, in line with the excitation point;
- sensor B: on the floating slab, at the edge of the vertical joint;
- sensor C: outside the floating slab, at the edge of the vertical joint (close to point C);



In some cases, an additional sensor is also used:

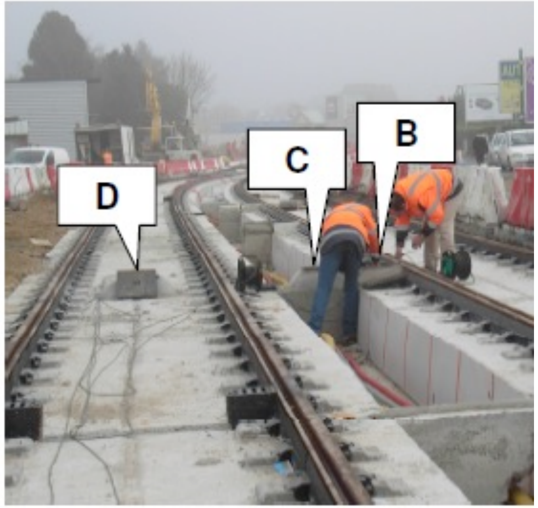
- sensor D: outside the floating slab, 3m from the axis of the track (this point may, for practical reasons, in some cases has been impossible to measure)

VIBRATION ATTENUATION RESULTS

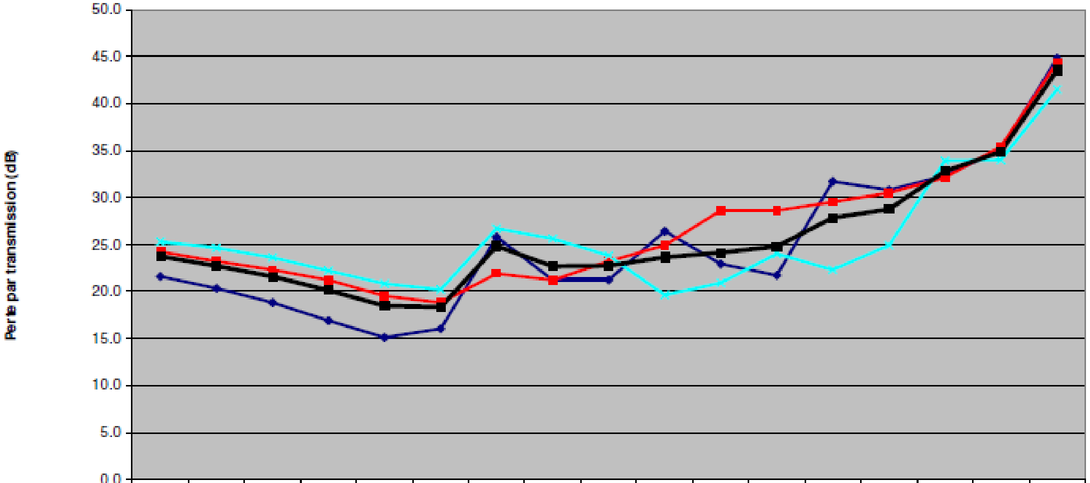


	10 Hz	13 Hz	16 Hz	20 Hz	25 Hz	32 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz
Pt.2 (A/F)	22.5	25.1	27.8	31.2	35.4	30.5	32.4	31.9	31.3	33.9	36.5	38.2	39.6	42.3	42.8	46.3	47.6
Pt.2 (B/F)	18.6	20.6	23.4	27.9	33.9	30.5	28.1	29.0	28.3	22.7	20.6	19.7	16.2	23.5	23.4	17.6	21.6
Pt.2 (C/F)	-5.6	-2.7	1.0	6.7	14.3	11.8	6.2	7.8	5.1	-2.2	-8.0	-9.0	-13.3	-6.9	-8.8	-17.9	-22.7
Pt.2 (D/F)	-21.6	-18.1	-13.8	-6.8	3.6	2.5	1.0	0.5	-2.4	-8.0	-19.6	-24.2	-31.6	-28.4	-32.4	-38.0	-35.8

Fréquence centrale de tiers d'octave (Hz)



VIBRATION ATTENUATION RESULTS



	10 Hz	13 Hz	16 Hz	20 Hz	25 Hz	32 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz
Pt.1	21.6	20.3	18.8	16.9	15.1	16.0	25.8	21.2	21.2	26.4	22.9	21.7	31.7	30.8	32.3	35.1	44.8
Pt.2	24.2	23.2	22.3	21.2	19.5	18.8	21.9	21.2	23.2	24.9	28.6	28.6	29.5	30.5	32.1	35.4	44.3
Pt.3	25.3	24.6	23.6	22.2	20.8	20.2	26.7	25.6	23.8	19.6	20.9	24.0	22.3	24.9	33.9	34.0	41.5
moyenne	23.7	22.7	21.6	20.1	18.5	18.3	24.8	22.7	22.7	23.6	24.1	24.8	27.8	28.7	32.8	34.8	43.5

Fréquence centrale de tiers d'octave (Hz)

The various results presented show that the transmission loss measured at the three or four selected sites complies with the usual requirements of project managers and track-laying companies, i.e. 20 dB minimum for third octaves above 50 Hz.

These results were obtained while the coating was absent, which is slightly detrimental.

Finally, the design of the test area, with integrated manholes, will make it possible to carry out the same tests with Rolling Stock and thus confirm the good results obtained.

Questions?

THANK YOU!

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