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Reduction of Vibration in a Station Building in South America

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ABSTRACT

Many railways stations across the world are arranged in such a way that the ticket offices and other passenger spaces are beneath the tracks of the trains running overhead. High noise levels cause significant problems with communication for ticket offices and for other commercial and information services.

This paper covers a case study in South America where a floating slab has been used to reduce the levels of vibration and structure-borne noise to significantly improve the acoustic conditions in the station.

1. INTRODUCTION

Grajau station in Sau Paolo is on Interlagos Line C. The entrance, ticket office and customer enquiry desk are located beneath the tracks and when trains ran overhead such high levels of noise and vibration were generated that communication was very difficult and working conditions extremely uncomfortable.

To remedy the problem a CDM floating slab track solution was used under the running track on one side of the platform. This paper describes the measurements taken and displays the results before and after the floating slab was installed.

Figure 1: *Grajau Station with a train approaching*

2. FST DESCRIPTION

A CDM floating concrete slab on discrete elastomer bearings was installed under the running tracks (see Figure 2):


Figure 2: *CDM Floating Slab*

The chosen solution consists of a 44m long floating slab track with discrete supported rail. The floating track bed is composed of prefabricated concrete formwork panels (U-shaped troughs) in which a continuous slab is poured on site.

This floating slab is supported by discrete resilient pads, made of CDM-RR (resin-bonded rubber) material and have an equivalent static stiffness of about 4.5 MN/m³ (for a slab width of 2,60 m) and an equivalent dynamic stiffness of 10.4 MN/m³. In longitudinal direction, there is a space of approximately 2,4m between the pads to allow air circulation and for the eventual installation of lifting jacks to inspect or replace the resilient pads.
This maintenance possibility was a specific request from the permanent way owner.

Outside the station area this slab track changes for a classic ballasted track. To cope with the difference in track stiffness between the 2 track types, a transition zone of 8m has been foreseen on both sides of the floating slab track. For the transition zones, a similar floating

track bed has been used, but the number of discrete elastomer bearings has been doubled to increase the stiffness and thus limit the stiffness jump.

3. MEASUREMENTS

Vibration measurements were taken in the following locations:

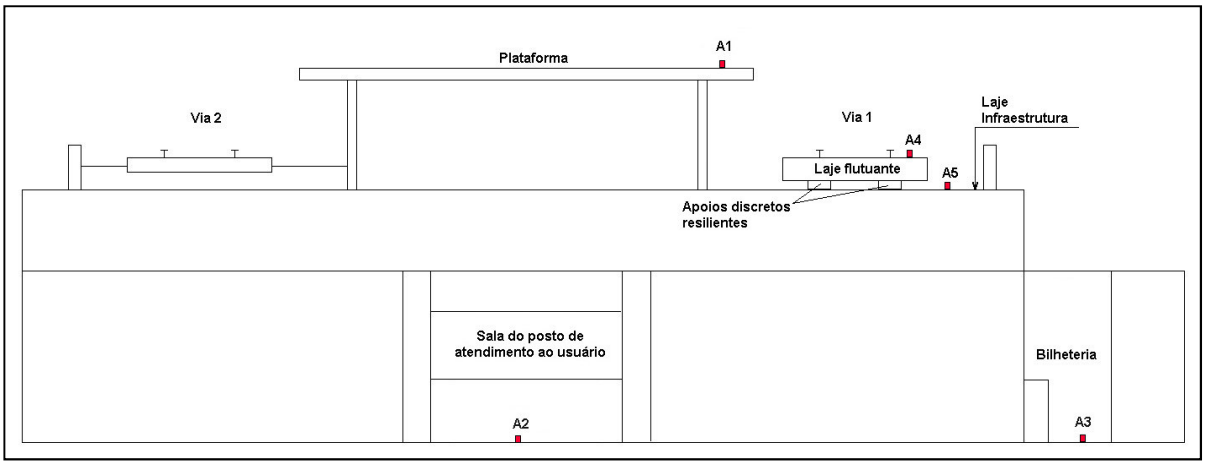

Figure 3: *Measurement Locations*
A1 – on the platform, A2 – customer enquiries desk, A3 – in the ticket office, A4 – on the CDM floating slab, A5 – on the slab infrastructure slab

Noise measurements were also taken in the ticket office and the customer enquiries desk.

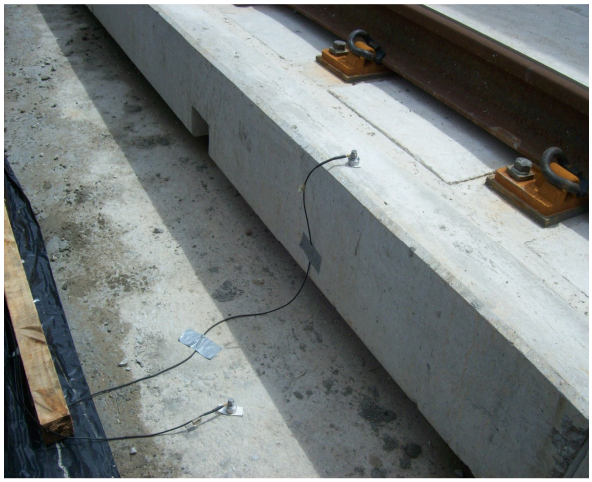

Figure 4: *Vibration Accelerometers on and off the CDM Floating Slab (A4 and A5)*

Figure 5: *Vibration Accelerometer on the Platform (A1)*

Figure 6: *Vibration Accelerometer on the Customer Enquiry Desk (A2)*

Figure 7: *Vibration Accelerometer in Ticket Office (A3)*

Following are the measured vibration spectra at each of the measurement locations:

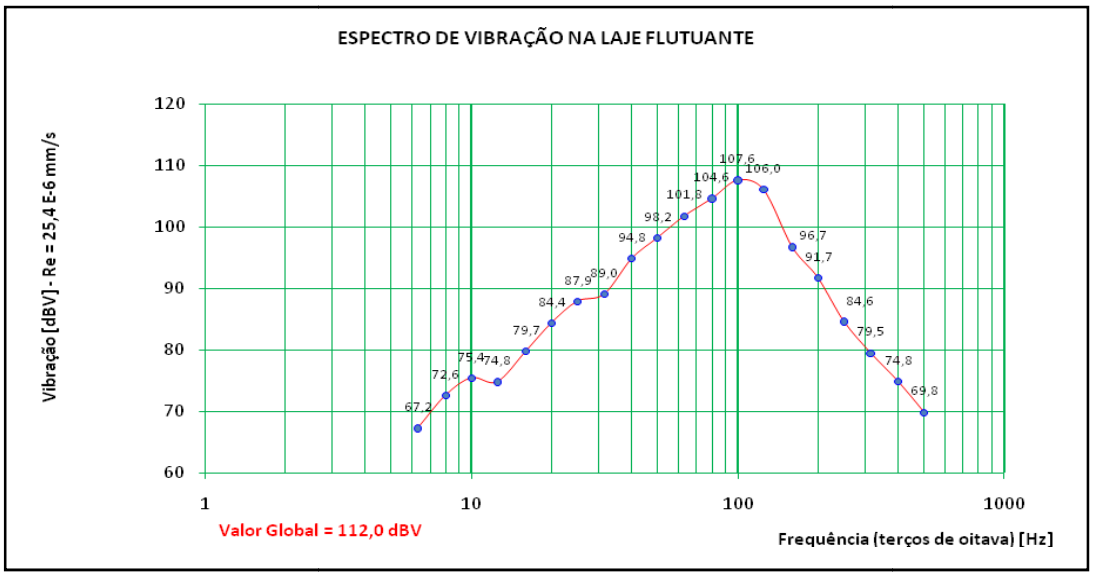

Figure 8: *Vibration Spectrum on the CDM Floating Slab (A4)*

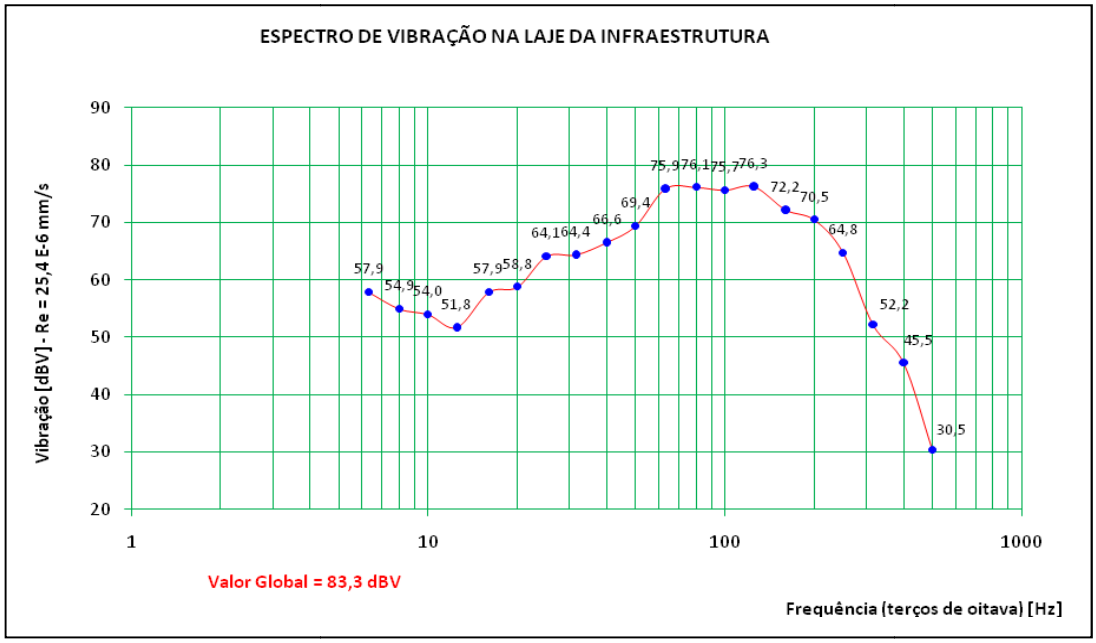

Figure 9: *Vibration Spectrum on the Infrastructure Slab (A5)*

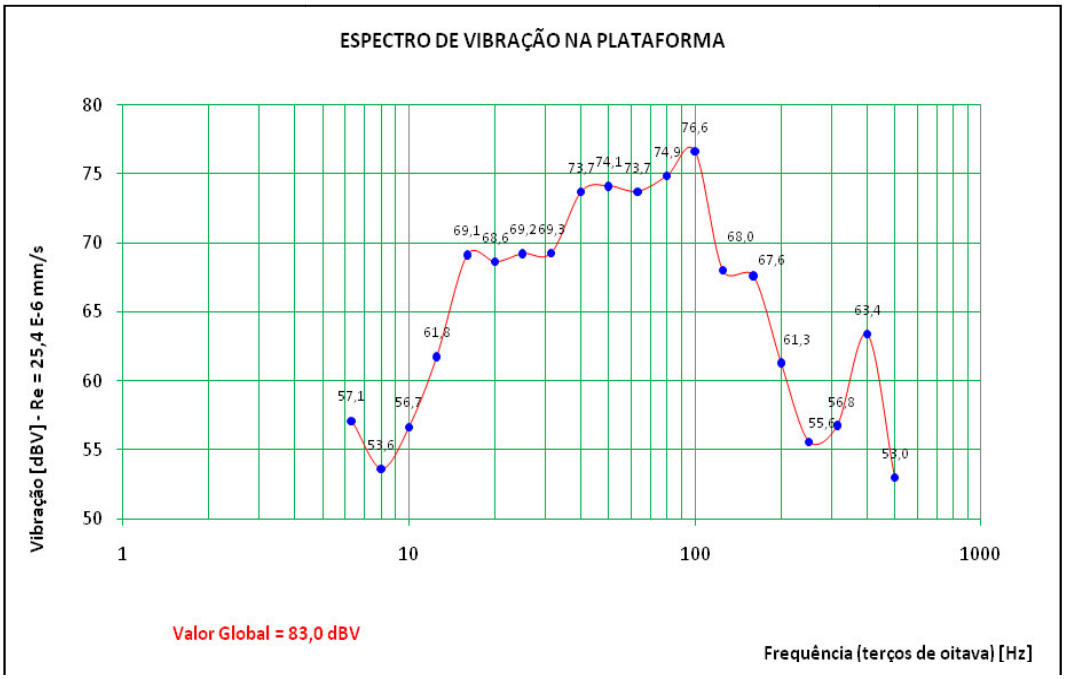

Figure 10: *Vibration Spectrum on the Platform (A1)*

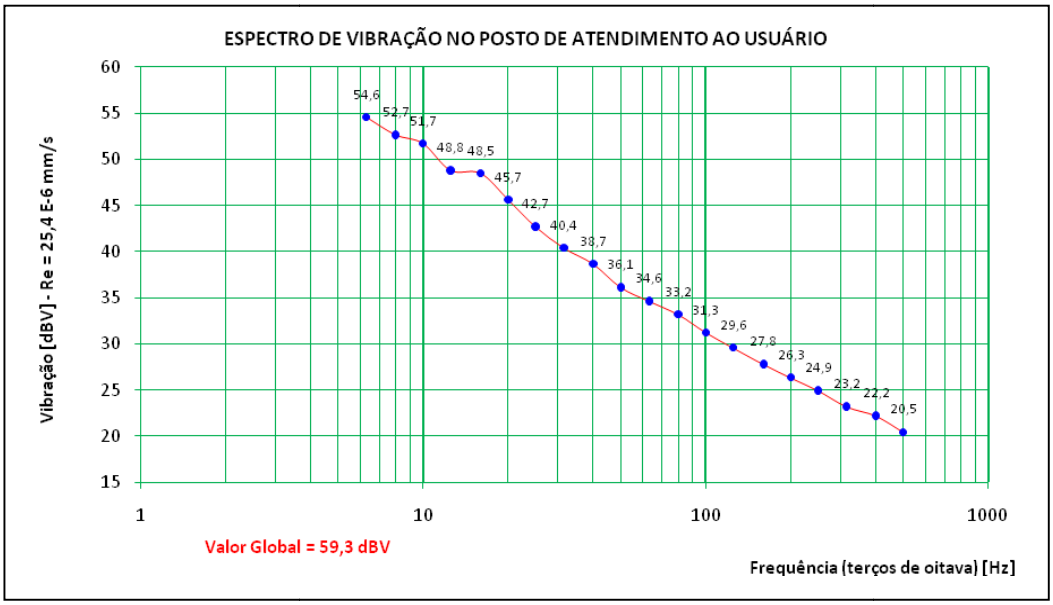

Figure 11: *Vibration Spectrum in the Customer Enquiries Desk (A2)*

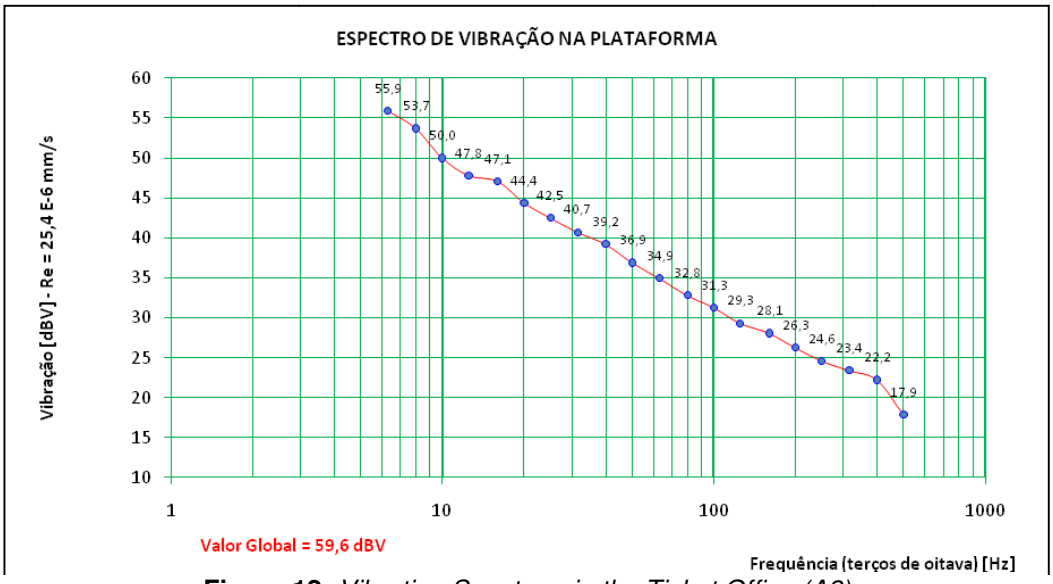

Figure 12: *Vibration Spectrum in the Ticket Office (A3)*

Following is a comparison of the vibration levels on and off the CDM Floating Slab:

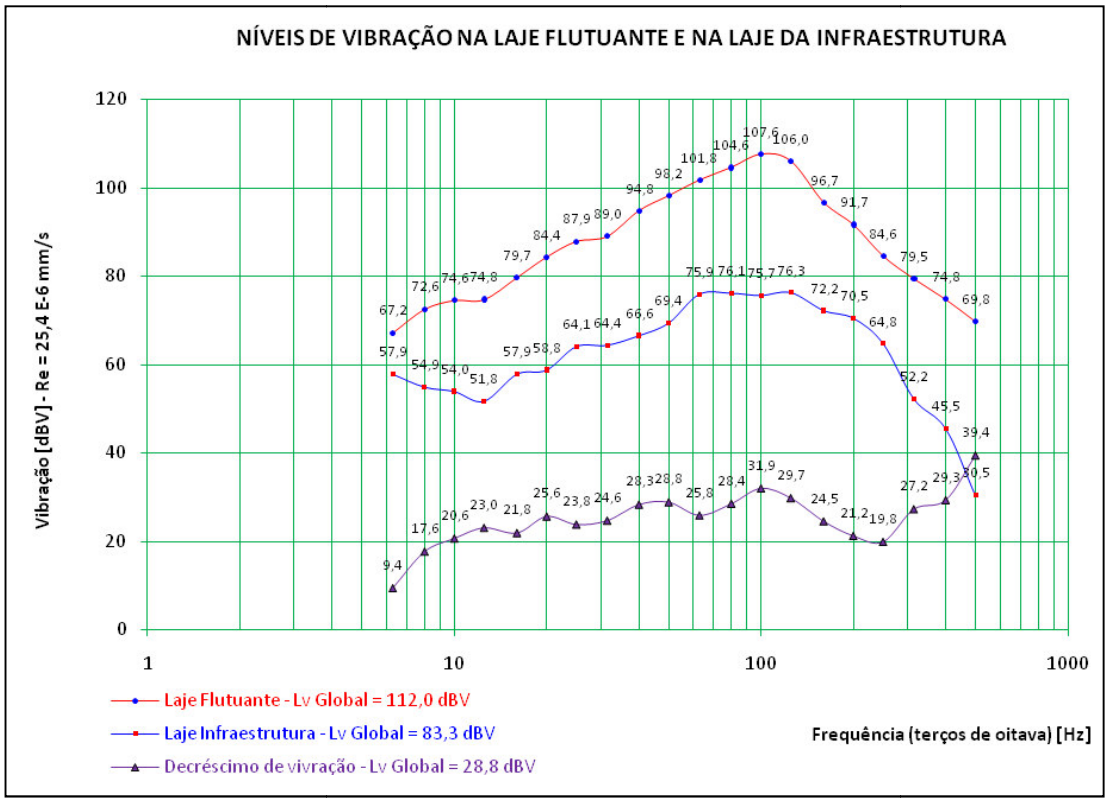

Figure 13: *Comparison of Vibration Spectra on and off the Floating Slab (A4 & A5*
Top line is spectrum on the floating slab, middle line is off the floating slab and bottom is the difference

The results show that the floating slab delivers a difference of 28.8dBV between the floating slab and the infrastructure slab.

Measurements were also compared with ones taken prior to the installation of the floating slab where the rails were supported on sleepers on ballast:

Measurement Location	Vibration RMS level dBV (re. 25.4×10^{6}mm/s)		
	Before installation of FST	With FST	Attenuation
Platform	95.4	83.0	12.4
Customer Enquiry Desk	71.0	59.3	11.7
Ticket Office	87.3	59.6	27.7

NOTE: since rail roughness measurements were not taken when the before and after vibration tests were made a true comparison cannot be made

Noise levels during train passbys were over 79dBA prior to the installation of the floating slab. After the installation the noise levels were a maximum of 63.2dBA which was a reduction of 15dBA. This brought the levels to within acceptable limits and allowed easy communication.

3. CONCLUSIONS

A floating slab can be a good way of reducing vibration and structure-borne noise in station buildings. This is particularly important where user communication is necessary: ie. ticket offices, information desks, retail etc..

REFERENCES

1. A C Engenharia Consultoria e Comercio Ltda – report January 2010
2. D. Beublet, Interlagos Station – Technical Justification Note, June 2009