Structure borne noise from railways – a case study

Michel Villot

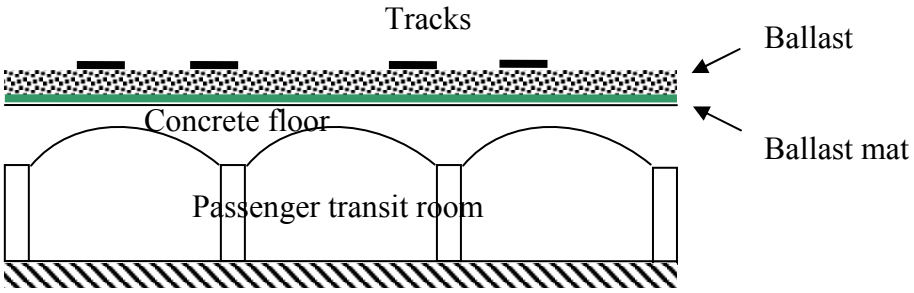


Figure 1: side elevation of the train station (simplified drawing)

1. Theoretical study

In the RER Massena train station in Paris, the train tracks are at ground level and lay on a thick concrete floor above a passenger transit room (leading to the METEOR underground subway station nearby) as shown in figure 1. The insertion of a ballast mat between ballast and concrete floor was then studied in order to decrease both the vibration level of the floor and the structure borne noise radiated in the passenger transit room. A theoretical 2D simplified multilayer model based on the wave approach and described in [1] was used to estimate the insertion loss of a ballast mat, calculated from the floor velocity level difference ΔLv with and without mat, the excitation being a 2.6 m wide strip force as shown in figure 2.

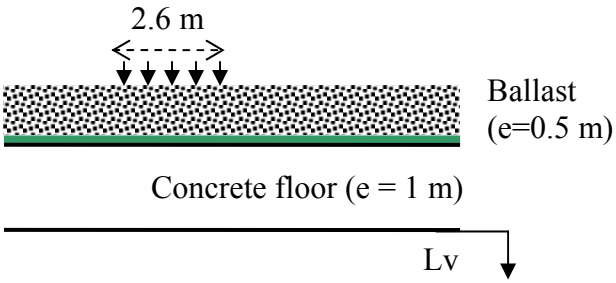


Figure 2: Multilayer model (infinite layers)

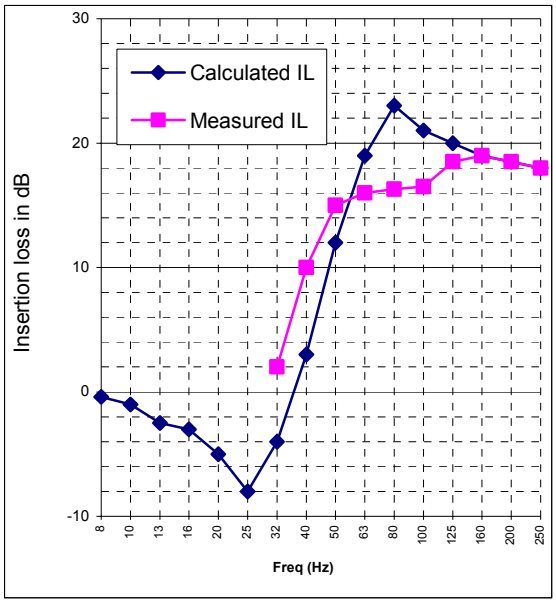
A ballast mat of stiffness 0.05 N/mm^3 was then chosen in order to get a resonance frequency around 25 Hz.

2. Experimental results

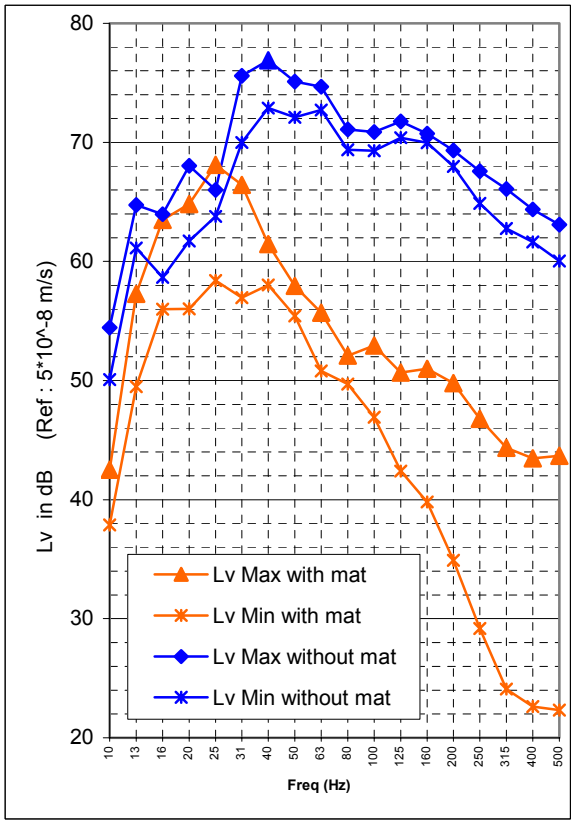
When the train station was built, the tracks were temporarily relocated around the construction site and above the passenger transit room, which was much wider than the train station itself and was already built in this area; a first set of measurements of the concrete floor velocity were then performed without ballast mat for several passing trains. When the train station was completed and the tracks were back to their original location, still above the transit room and with ballast mat this time, a second set of measurements were performed. The difference between the two sets of floor velocity level measured (shown in figure 3b) was calculated and compared to the insertion loss given by the manufacturer and calculated using a simplified 1D analytical model [2]; the comparison (shown in figure 3a) is quite satisfactory. It should be noted that the insertion losses calculated by the two models (1D and 2D) were very similar, the differences probably coming from different input data (material dynamic characteristics).

Figure 3: Comparison between calculated (manufacturer's model) and measured insertion loss.

(3a) Insertion loss



(3b) Velocity levels measured



References

[1] M. Villot and J. Chanut, "Vibrational energy analysis of ground structure interaction in terms of wave type", *Journal of Sound and Vibration*, **231,** 711-719 (2000)

[2] R. Wettschureck et al, "Reduction of structure-borne noise emission from above ground railway lines by means of ballast mats – analytical model and measurements", Inter-noise 97, Budapest, Proceedings