

COMPARISON OF AIRBORNE AND IMPACT SOUND INSULATION IMPROVEMENT DUE TO ADDING TOPPING ON HOMOGENEOUS FLOORS

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1 Introduction

For the upcoming change of the airborne sound insulation requirement in the National Building Code [1], measuring direct and flanking path data is one way to predict the ASTC rating of the system [2]. In order to minimize the overlap of measured airborne and impact floor data, NRC has looked at interpolating floor topping improvements to similar floors type. In this paper, homogeneous floors are considered.

The first part of the results section will compare the one-third octave airborne and light impact improvements due to toppings on cross-laminated timber (CLT) and concrete floors. The second part will focus on the improvement of the single number ratings (SNR) of these floor types.

2 Specimen Descriptions and Properties

Each floor is described by a short code of the elements it is composed of, starting from the top to the bottom layer. The number following the short code is the thickness of the layer in mm. For example, CON38_RESL9_CON200 describes a 38 mm concrete topping installed on a 9 mm resilient interlayer on top of a 200 mm concrete slab. There are three base floor assemblies that are compared in this paper :

- CLT5 - 5 ply - 175 mm thick
area density = 91 kg/m² (525 kg/m³)
- CLT7 - 7 ply - 245 mm thick
area density = 130 kg/m²(525 kg/m³)
- CON 200 - 200 mm thick
area density = 504 kg/m²(2520 kg/m³)

with one topping :

- CON 38 - 38 mm thick - 103 kg/m²

installed on two different resilient mats :

- RESL8 - 8 mm thick rubber - 3.6 kg/m²
- RESL9 - 9 mm thick closed-cell foam - 0.3 kg/m²

Each assembly was tested according to ASTM E90 and ASTM E492 in the NRC floor facility which has a test opening of 17.9 m² and room volumes of 175 m³ each.

3 Results and Discussion

3.1 Third Octave Band Comparison

Plotting all airborne TL curves in Figure 1 shows improvement in TL due to the addition of a topping on a bare CLT5 floor (up to 12 STC points). The Δ TL of the topped floor assemblies (Figure 2) show 5 to 10 dB more improvement for the same topping and interlayer on the CLT5 floor, compared to the CON200 floor.

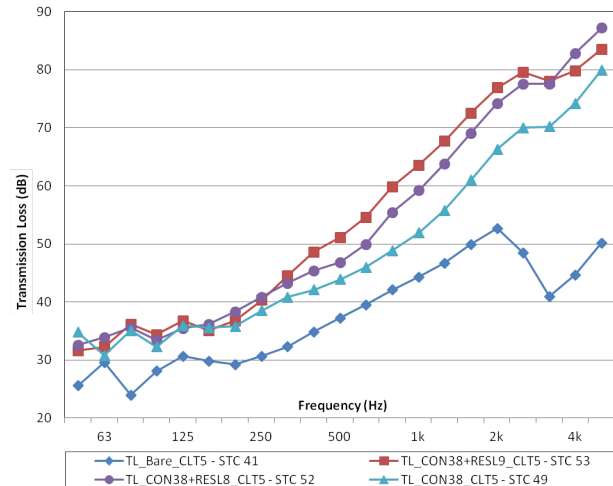


Figure 1: TL data of CLT5 floor with various toppings

One approach to reduce airborne sound transmission through a partition is to increase the mass of that partition. For example, installing a 103 kg/m² concrete topping on a 91 kg/m² base CLT more than doubles the mass of the base assembly. By doubling the mass, there is a theoretical 6 dB increase to the TL curve, which is observed up to 200 Hz (see Figure 2). Above the mass-spring resonance at 200 Hz, there is additional losses due to decoupling of the floor elements.

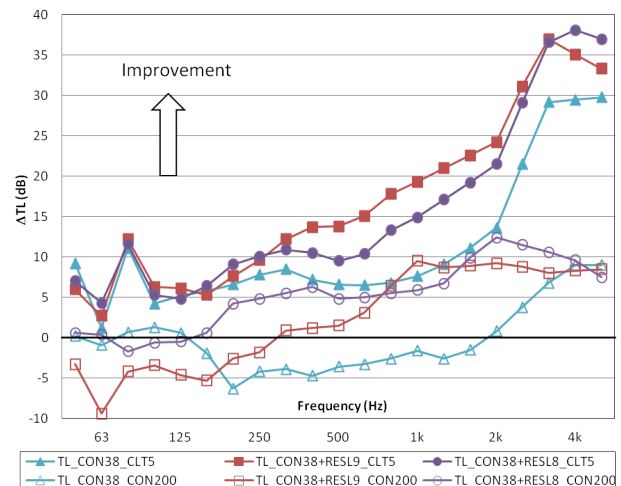


Figure 2: Δ TL data of CLT 5 and CON 200 with various toppings

Plotting the improvement of impact sound pressure levels (Δ ISPL) of the same six floor assemblies (Figure 3), the opposite trend of the Δ TL can be observed : the floor toppings reduce the impact noise more on the concrete floor

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than on the CLT5 floor. The addition of a decoupled topping onto the bare concrete floor reduces the mechanical impedance match of the steel impact hammers and the concrete floor, thus reducing the power injected into the floor.

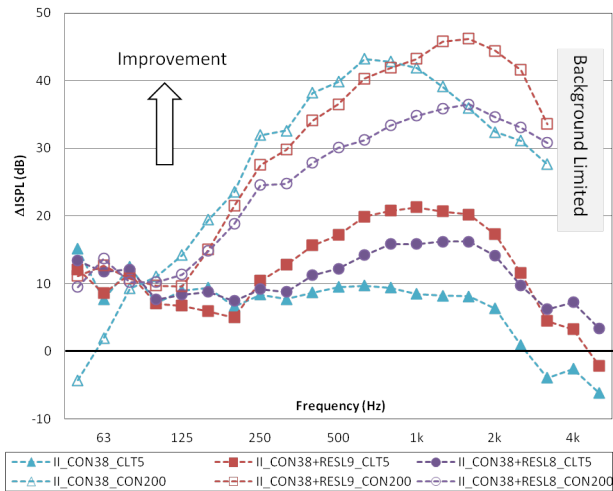


Figure 3: Δ ISPL data of CLT 5 vs CON 200 with various toppings

The differences of the Δ TLs and Δ ISPLs, found in Figure 2 and 3, are plotted in Figure 4. They show the same tendencies for floors with similar base assembly (either CLT5 or CON200).

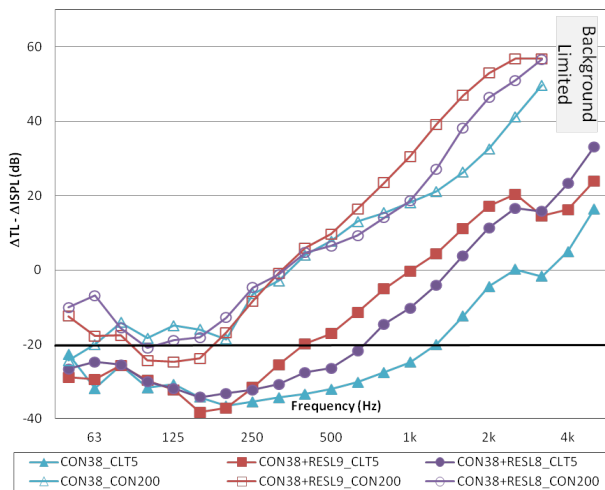


Figure 4: Δ TL - Δ ISPL (CLT5 and CON200)

Looking at the Δ TL and Δ ISPL of the CON38_RESL9 topping on three base floors (Figure 5), the CLT floors have the same trends for both Δ TL and Δ ISPL up to 1600 Hz. For the CON200 floor, the ISPL improvement is much greater than for the TL.

3.2 Single Number Ratings

The single number ratings of the bare floor assemblies with the Δ improvement calculated using only the SNRs (not the E2179 method) of the toppings are found in Table 1. The ad-

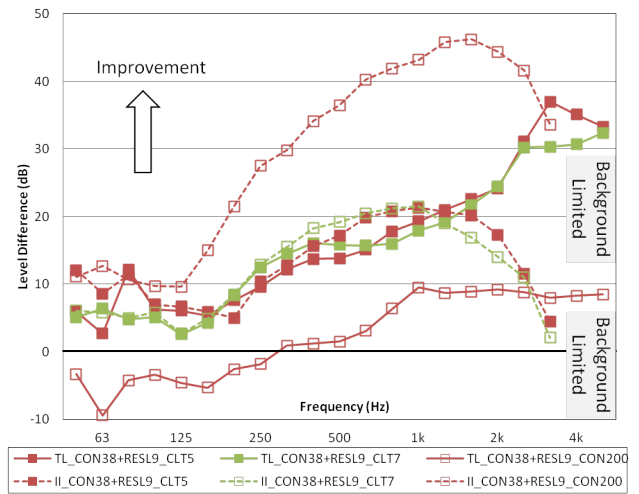


Figure 5: Δ TL and Δ ISPL data of CON38_RESL9

dition of the CON38_RESL9 on the CLT floors offers very comparable increase for both the TL and ISPL (+12 vs. +11 and +13 vs. +11), whereas for the concrete slab, only the IIC rating is significantly boosted.

Table 1: Single number ratings and improvements

	CLT 5		CLT 7		CON 200	
	STC	IIC	STC	IIC	STC	IIC
Bare	41	25	44	30	57	30
Δ Improvement						
CON38_RESL9	+12	+11	+13	+11	-1	+29

4 Conclusions

CLT floors of varying thickness react very similarly to the same topping. The addition of a concrete topping on a CLT and a concrete floor have different effects for both airborne and impact sources, and the one-third octave and SNR improvements cannot be transferred between the assemblies. In the near future, NRC is hoping to gather more data on other types of floors (steel joists, precast concrete, concrete), in order to populate the topping database and find similarities where they might exist. Currently, there is no ASTM standard method to easily calculate the Δ STC of homogeneous floors. For the Δ IIC of CLT floors, it might be possible to define a reference IIC curve for CLT floors that might be used with the ASTM E2179 standard.

References

- [1] J.D. Quirt and B. Zeitler. A new approach to building acoustics regulation in Canada. In *AWC 2014*.
- [2] B. Zeitler I. Sabourin and J.D. Quirt. Supporting better noise control in Canadian buildings. In *AWC 2014*.