# USING FLOOR TOPPINGS TO CONTROL FLANKING TRANSMISSION

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## 1. INTRODUCTION

The change in flanking sound insulation due to adding a floor topping is shown to be different for paths where energy propagates perpendicular to the joists, compared to those where energy propagates parallel to the joists. This paper summarises results presented elsewhere [1,2]. Floor vibration mappings reveal that a topping will change not only the power injected but also the propagation losses across the floor. The most effective toppings reduce input power and increase propagation losses relative to the bare floor. One type of topping exhibits significant improvement in the flanking sound insulation in one direction and a significant worsening in the other.

## 2. EVALUATION METHOD

The magnitude of changes to the impact sound insulation for room pairs AB and AC are compared to show that in general the improvement for direct transmission will not match that for flanking transmission involving the floor surface. The change in impact sound insulation between room pair AB is examined for each of the toppings with the joists parallel to the junction (Figure 2), and perpendicular (Figure 1). The improvement for floor flanking paths can be strongly dependent on joist orientation.

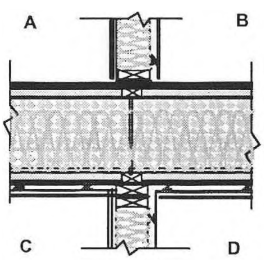


Figure 1: Sketch of the test specimen with joists perpendicular to the junction.

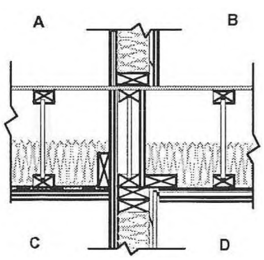


Figure 2: Sketch of the test specimen with joists parallel to the junction.

| Material | Nominal Thickness, mm | Surface Density, kg/m$^2$ | Application |
|---|---|---|---|
| OSB Overlay | 18 | 11.7 | Stapled 305 mm o.c. |
| Bonded-Gypsum-concrete | 25 | 47.1 | Bonded with agent |

Table 1: Properties of the topping layers.

The oriented strand board (OSB) overlay consisted of adding a second layer of the subfloor material; it did not extend under the partition wall. The gypsum-concrete was applied in place, allowing bonding to all surfaces contacted including the gypsum board of walls in rooms A and B. Procedures of ASTM E1007 were followed, although measurements between rooms A and B are nominally outside the scope. Normalised impact sound pressure levels (NISPL) were measured with the ISO hammer box located at the same four positions near the center of the floor in room A. The hammers impart power only into the floor surface, which is involved in all transmission paths to rooms B and C. Hence, the change in NISPL measured in rooms B and C with and without a topping indicates how well the topping controls flanking and direct transmission of impact sound.

## 3. DIRECT VS FLANKING TRANSMISSION

Since the NISPL for room pair AC is controlled by direct transmission, the change in AC sound insulation can be compared to the change for AB, to assess the effectiveness of a topping to control direct and flanking transmission, respectively. Each topping was applied to the constructions of Figure 1 and Figure 2 to determine if orientation of the joists is an important factor.

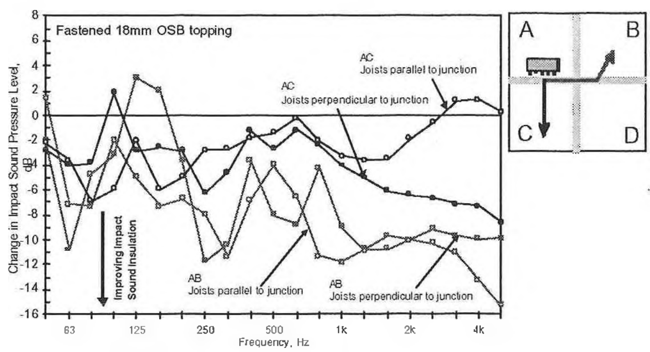


Figure 3: Change in NISPL due to 18 mm OSB overlay, as a function of the orientation of the joists shown in Figure 1 and 2.

Figure 3 shows the change in the receiver room NISPL due adding an 18 mm OSB overlay. It shows that the overlay reduced the NISPL (improved sound insulation) for both direct and flanking transmission. For frequencies above 200 Hz, regardless of the orientation of the joists, there is a greater reduction in NISPL for room pair AB than for AC. The overlay controls direct transmission less effectively than flanking transmission involving the floor surface. With the OSB overlay, the improvement for flanking transmission is not very sensitive to the orientation of the joists.

Figure 4 shows that for both direct and flanking transmission, adding the gypsum-concrete topping without an interlayer will increase the NISPL relative to the bare floor in the high frequencies. The most important feature however is the relation of the curves. In the frequency range 160–2000 Hz with the joists perpendicular to the junction, Figure 4 shows the topping attenuates floor flanking paths more than direct transmission though the floor. The opposite is true when the joists are parallel to the junction, since in the frequency range 400–2000 Hz the topping is better at controlling direct transmission than flanking transmission.

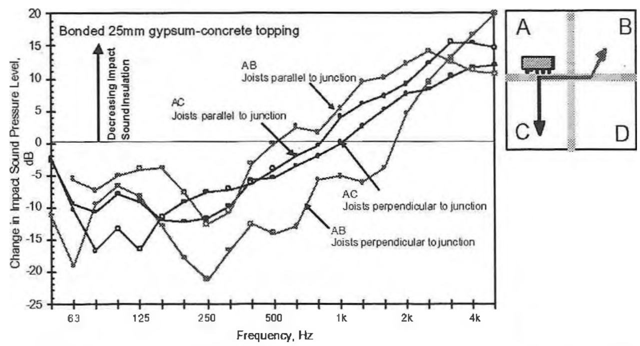


Figure 4: Change in NISPL due to applying bonded 25 mm gypsum-concrete topping as a function of joist orientation.

Changes in NISPL will differ because adding a topping changes not only power injected by the ISO hammer box, but also the propagation losses in the floor surface. Changing injected power should affect direct and flanking transmission similarly. However, for the highly-damped floors considered here, changes to propagation losses will affect flanking transmission more than direct transmission, because propagation determines the incident structural power at the flanking junction.

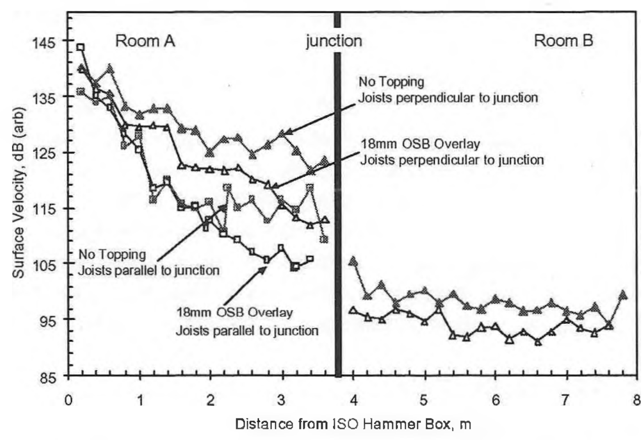


Figure 5: Surface vibration levels at 1 kHz measured along two orthogonal lines from the source with/without the OSB overlay.

Estimates of the change in propagation losses can be obtained from velocity levels measured along two orthogonal lines from the source. One line is parallel to the joist orientation, while the other is perpendicular. Results for the bare floor and the 18 mm OSB overlay, in Figure 5, indicate that for both joist orientations, the topping increased propagation losses in the exposed surface (i.e., there is a greater level difference between source and junction with the topping than without).

Figure 6 shows that adding the bonded gypsum-concrete topping applied to the same bare floor increases propagation losses when the joists are perpendicular to the junction. Here the vibration energy propagates parallel to the joists to reach the junction. The opposite is true when the joists are parallel to the junction, since to reach the junction, vibration energy must propagate perpendicular to the joists. Thus, the bonded topping is less effective when applied to flanking paths where the joists are parallel to the junction. This is consistent with the trends in the impact sound pressure levels shown in Figure 4.

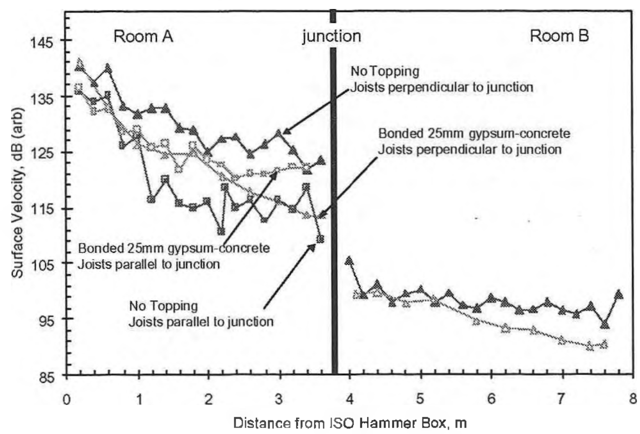


Figure 6: Surface vibration levels at 1 kHz measured along two orthogonal lines from the source with/without gypsum-concrete.

## 4. CONCLUSIONS AND REFERENCES

Vibration maps indicate that adding a topping may increase or decrease propagation losses across the floor relative to the bare floor. The change in propagation loss was shown to be a function of the type of topping and the orientation of the joists in the floor to which it was applied. A topping that increases propagation losses relative to the bare floor will be more effective in controlling flanking than direct transmission. The important implication is impact sound insulation improvements due to adding a topping when there is no appreciable flanking (i.e., using ASTM E492) should not be generalised to situations where flanking transmission across the floor surface is important.


1. R.E. Halliwell, J.D. Quirt, T.R.T. Nightingale, "Construction details affecting flanking transmission in wood framed multifamily dwellings," Proceedings INTERNOISE 2002
2. T.R.T. Nightingale, R.E. Halliwell, J.D. Quirt, "Vibration response of floors and the effectiveness of toppings to control flanking transmission", INTERNOISE 2002


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