Developing a Guide for Flanking Sound Transmission in Wood Framed Construction

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1. INTRODUCTION

This paper reports results from continuing studies of sound transmission between adjacent units in wood-framed multi-dwelling buildings. First, the paper presents some recent extensions of our multi-year experimental study, which has assessed how common construction details affect structure-borne (flanking) transmission between adjacent rooms, for a broad range of wall and floor constructions. Previous reports have focused on the wall and floor surfaces connected at the wall/floor junction - especially the floor surface, which is often the dominant problem. This paper includes a number of other paths that may collectively become significant when more obvious paths are controlled.

Estimates of the apparent sound isolation (in terms of Apparent STC) were obtained by summing the energy transmitted directly through the separating wall or floor assembly with that for all the flanking paths involving wall, floor, or ceiling surfaces abutting the separating assembly. These estimates provide the basis for a simplified design guide[1] to predict sound isolation in typical wood-framed row housing or apartment buildings. This paper presents a subset for airborne sources and horizontal transmission.

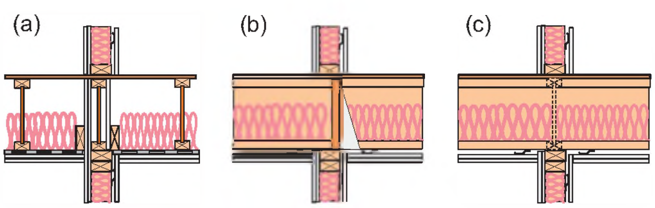

Figure 1: Construction details of the 3 wall/floor systems. Joists were oriented (a) parallel to the wall, (b) perpendicular to the wall, and (c) with joists continuous across the wall, perpendicular to it.

Results in this paper apply to wood-framed constructions, with the wall and floor assemblies shown in Figure 1, or variants on them. Construction specifications and architectural drawings are given in detail elsewhere. References to the pertinent technical standards, and procedures to determine the "**Direct** Sound Transmission Loss" (due to transmission through just the separating wall or floor assembly between two rooms) or the "**Apparent** Sound Transmission Loss" (either for individual paths involving specific surfaces in the two rooms, or the overall transmission for sound energy via all paths) are also given in Reference 2.

2. RESULTS AND DISCUSSION

As discussed in previous papers, sound isolation between two adjacent units in a wood-framed building typically involves significant transmission via several paths. Figure 2 compares direct sound transmission through the separating wall between two side-by-side apartments vs. the flanking transmission via the floor surfaces for the wall and floor assemblies illustrated in Figure 1. In this case, most of the sound is transmitted via the floors. There are other paths – such as via the ceiling or the abutting side walls – but they transmit much less than these dominant paths.

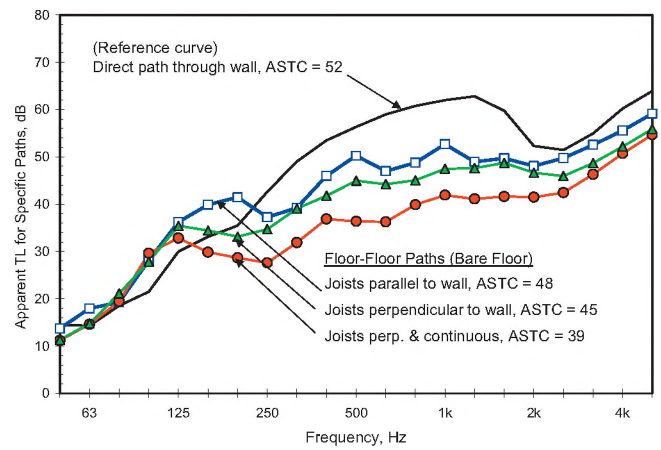

Figure 2: Apparent sound transmission loss (TL) via specific paths with bare OSB subfloor and basic separating wall, as in Figure 1.

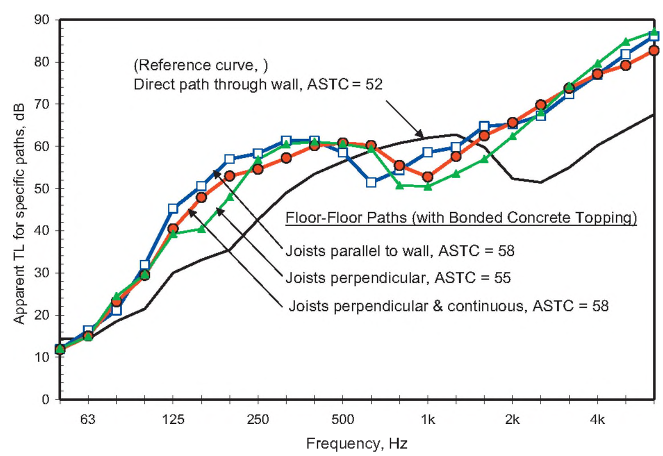

Figure 3: Apparent TL via specific paths with the same basic separating wall, and concrete topping over the OSB subfloor.

As shown in Figure 3, adding a topping over the subfloor increases the transmission loss of this path; other toppings would provide somewhat different improvements. This would increase the overall Apparent STC. In this case, other (weaker) paths become more significant; two obvious paths of concern involve the ceiling or the abutting walls.

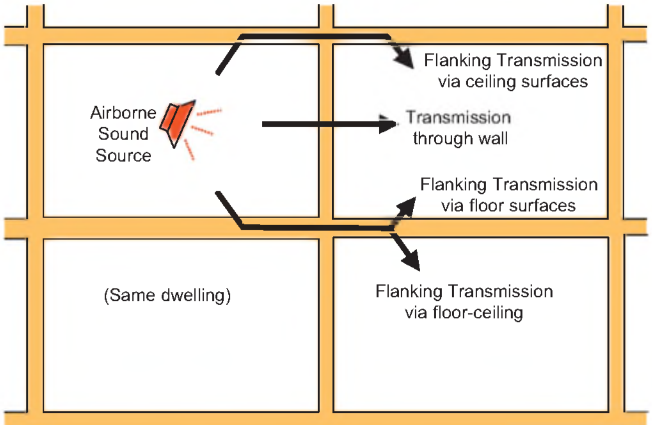

Figure 4: Transmission paths between adjacent units; the walls parallel to the plane of this figure (side walls) also transmit sound.

Figure 4 indicates some of the typical transmission paths between adjacent units. In apartments, the gypsum board ceiling is normally mounted on resilient channels (to give isolation from the apartment above), which reduces flanking transmission via this path to insignificance. But in row housing (where transmission between stories within a dwelling unit is not a concern) the ceiling would be fastened directly to the joists; then this flanking path also becomes significant (ASTC 52, as shown in Figure 5). Flanking via an abutting side wall transmits less sound (~ASTC 61 for one wall in the case tested) but this could also limit overall performance if the separating wall and the floor were improved, and would drop to ASTC 58 if there were two such walls. All paths should be considered for good design.

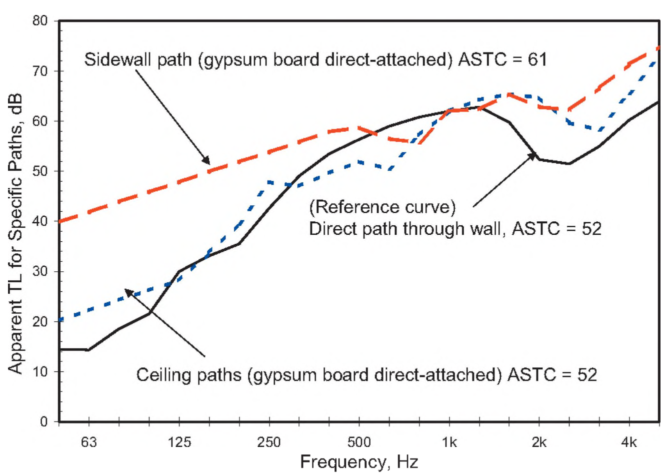

Figure 5: Estimates for flanking paths not via wall/floor junction.

In the Guide[1], tables present the combined effect of all paths for typical variants. The tables presented below are for the case with joists perpendicular to separating walls - case (b) in Figure 1. Apparent STC in a given building will not exactly match theses values, but the trends should apply.

Separating wall	Basic Wall (STC 52)	Better Wall (STC 57)	
Sidewall gypsum board	Direct or resilient	Direct	Resilient
Floor Surface	(Apparent–STC)		
No topping (basic)	43	43	43
19 mm OSB stapled to subfloor	48	50	50
25 mm gypsum concrete bonded to subfloor	49	51	52
38 mm gypsum concrete + resilient mat on subfloor	51	53	55

Table above is for "apartment design" (ceilings on resilient channels); that below is for "row house" (direct-attached).

Separating wall	Basic Wall (STC 52)	Better Wall (STC 57)	
Sidewall gypsum board	Direct or resilient	Direct	Resilient
Floor Surface	(Apparent–STC)		
No topping (basic subfloor)	42	43	43
19 mm OSB stapled to subfloor	47	48	49
25 mm gypsum concrete bonded to subfloor	48	49	50
38 mm gypsum concrete + resilient mat on subfloor	49	51	52

In all cases, the overall Apparent STC is lower than that for the separating wall – in some cases much lower. By altering design details to balance transmission via specific paths a cost-effective yet satisfactory design can be chosen.

3. SUMMARY AND REFERENCES

This paper provides a very terse overview of how experimental characterization of the direct and flanking sound transmission paths in wood-framed construction can lead to a manageable set of path transmission terms to represent the effect of specific design tradeoffs. By combining the energy transmitted via all paths it is possible to arrive at estimates of the Apparent STC for a range of constructions.

We wish to acknowledge the support of our industry partners: CMHC, Forintek Canada, Marriott International, Owens Corning, Trus Joist, and USG.

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1 Quirt, J.D. Nightingale, T.R.T. King, F. Guide for Sound Insulation in Wood Frame Construction, **RR219**, IRC, NRC Canada, (2006)

2 Nightingale, T.R.T. Quirt, J.D., King F., Halliwell, R.E. Flanking Transmission in Multifamily Dwellings: Phase IV, **RR218**, NRC Canada, (2006).
(Note that the reports are available on the IRC website at http://irc.nrc-cnrc.gc.ca/ircpubs/.)