THE EFFECT OF RESILIENT CHANNELS ON CEILING FLANKING TRANSMISSION PATHS

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1. INTRODUCTION

This paper is the fourth of a series of papers that provide an overview of work conducted by NRC in the past years on flanking transmission. NRC-IRC has carried out extensive studies to characterize flanking transmission through various building components and assemblies in the Flanking Facility[1]. One of the studies is to examine the effect of resilient channels on ceiling flanking paths. The floor-ceiling assembly in apartment buildings separates two different dwellings and the gypsum board ceiling is usually mounted on resilient channels to meet the requirements of the building code. However for row housing, the floor-ceiling assembly separates two rooms of the same dwelling and typically the floor is not sound or fire rated.. In this case, the gypsum board ceiling is often directly attached to the floor joists and ceiling flanking transmission paths between the two side-by-side rooms shown in Figure 1 can reduce the apparent STC significantly. This paper describes the improvement due to the use of resilient channels.

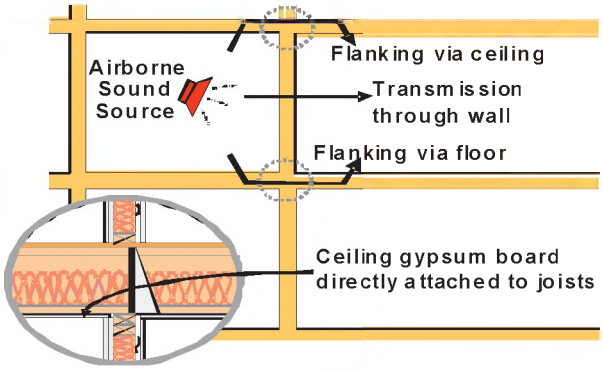

Figure 1: Types of flanking transmission paths in row housing.

2. MEASUREMENTS AND RESULTS

The apartment type floor-ceiling assembly was built in the NRC-IRC Flanking Facility for the commissioning study[1]. For the row house floor ceiling assembly, the cavity insulation, the two layers of 16 mm gypsum board and the resilient channels were removed and replaced by a single layer of 13 mm gypsum board directly attached to the wood I-joists. The direct and flanking transmission paths were evaluated for both types of ceilings using airborne and impact sound sources. This paper focuses on airborne sound transmission. The methodology used for characterizing individual flanking paths is described in the third paper[2]. The airborne measurements were carried out simultaneously in the flanking facility for three different types of junction: 1.)floor joists parallel to the wall, 2.) floor joists perpendicular to the wall and continuous, and 3.) floor joists perpendicular to the wall but discontinuous at the junction. Figure 2 shows the Transmission Loss (TL) of the horizontal *ceiling-ceiling* path for both types of ceilings for the three types of junctions. Figure 3 shows the TL of the diagonal *ceiling-floor* path. Because the method of shielding a surface does not adequately suppress low frequency transmission, the estimates for paths in the low frequencies tend to be very conservative[2]. In this paper, the raw data are shown and typically a tail is fitted to the measured estimate. Since the ceiling flanking paths are comparable for the three junctions, TLs are averaged and the differences between the two types of ceiling are shown in Figure 4. By attaching the ceiling with resilient channels to the floor joists, TL of the apartment type of ceiling is much bigger than the row house type for all paths. The vertical direct path increases by about 15 dB, the horizontal *ceiling-ceiling* path by about 20 dB and the diagonal *ceiling-floor* path by about 10 dB. No significant difference is found on the *floor-floor* path.

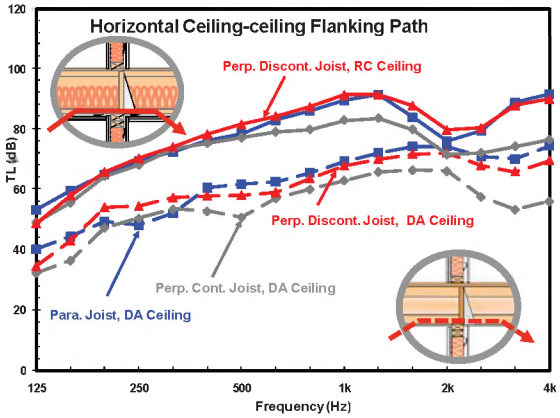

Figure 2: Flanking-TL of horizontal *ceiling-ceiling* path for apartment-type ceiling and row house-type ceiling and 3 different junctions.

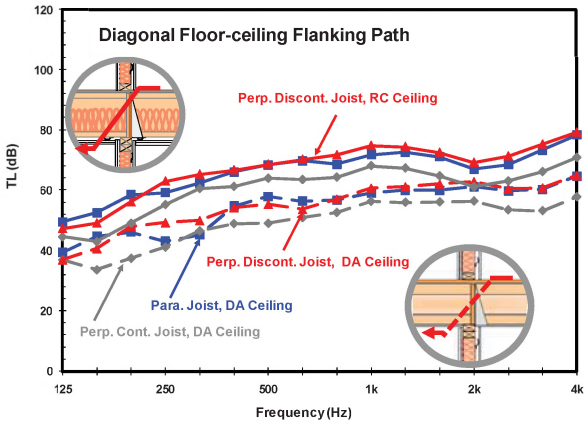

Figure 3: Flanking-TLof diagonal floor-ceiling paths for apartment-type ceiling and row house-type ceiling with 3 different junction constructions.

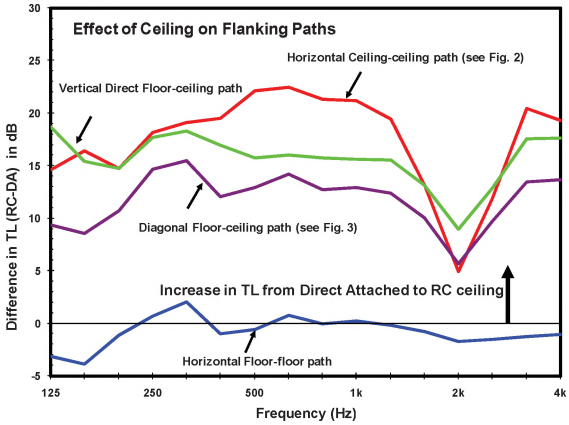

Figure 4: Differences in transmission loss between apartment and row house type ceilings for direct and flanking transmission paths.

3. DISCUSSION

There are three ceiling flanking paths as discussed in another companion paper. The *ceiling-wall* paths can be extracted from TL measurements of different shielding conditions[2]. For a single stud wall with a directly attached 'leaf' on one side, the Apparent Sound Transmission Class (ASTC) between two side-by-side rooms depends on the amount of noise transmitted through the partition wall and the flanking paths. The *ceiling-ceiling* and *ceiling-wall* flanking paths can limit the ASTC when the ceiling and wall are directly attached as shown in Figure 5. The diagonal ASTC is limited by the *floor-wall* and the *floor-ceiling* flanking paths and comparable to the horizontal ASTC as shown in Figure 6. In this scenario with both the ceiling and wall directly attached and no additional topping on the floor, a lower room in a row housing can be exposed to flanking noise coming from the neighbour's upper and lower rooms. Currently, the building code does not have any requirements on flanking transmission.

A recent paper shows that when a dominant path is treated, the hierarchy changes and other path(s) become more important[3]. As the knowledge of dominant flanking paths for different building assemblies increases, it is possible to develop design strategies and provide guidance to practitioners for designing better and cost effective sound isolation buildings.

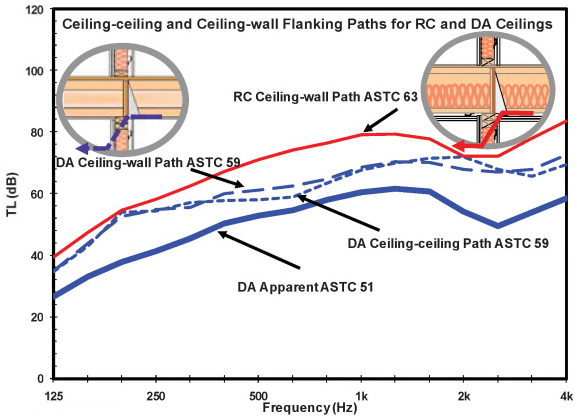

Figure 5: Horizontal Apparent-STC between two side-by-side dwellings can be limited by the *ceiling-ceiling* and *ceiling-wall* transmission paths.

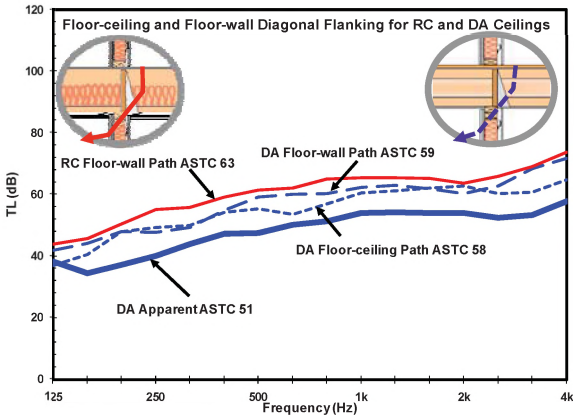

Figure 6: Diagonal Apparent-STC between an upper and a lower room is limited by the *floor-ceiling* and *floor-wall* transmission paths.

REFERENCES

[1] Estabrooks T., et al., "NRC-IRC flanking sound transmission facility", *Canadian Acoustics*, V37, No.3, 2009

[2]King F., et al., "Characterizing flanking transmission paths in the NRC-IRC flanking facility", *Canadian Acoustics*, V37, No.3, 2009.

[3]Nightingale T., et al., "A hierarchy of flanking transmission paths in lightweight wood frame construction", InterNoise 2009, Ottawa.

[4] Nightingale, T.R.T., et al. "Flanking Transmission in Multi-Family Dwellings: Phase IV", *NRC-IRC ,RR*-218, pp. 425, March 01, 2006.