FLANKING TRANSMISSION IN WOOD FRAMED MULTIFAMILY DWELLINGS

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1. INTRODUCTION

A three-year project at the National Research Council Canada to study flanking transmission in wood-framed construction under controlled conditions was recently completed [1,2]. The focus was horizontal and vertical flanking involving the wall/floor junction in multifamily buildings built to resist wind or seismic loads. This paper reports on the effect of joist orientation (relative to the wall/floor junction), junction blocking details, joist type (solid lumber vs. wood-I joists), and wall framing (double stud, single stud or single stud shear walls) for airborne excitation. The wall and floor specimens divide the test facility into four rooms (labeled A, B, C, and D in the figures). Flanking paths involving room surfaces other than those of the test specimens are negligible.

2. RESULTS

The influence of joist orientation was tested both with wood-I joists and with solid lumber joists, but effects of joist continuity and junction details complicate the comparison. The OSB subfloor was continuous under the AB partition wall in both cases. With joists perpendicular to the partition wall, the wood-I joists were also continuous under the wall.

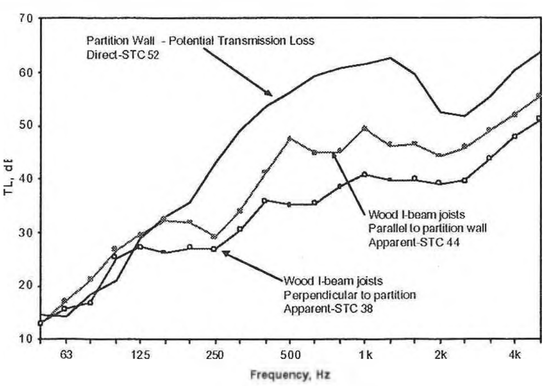

Figure 1: Apparent TL between rooms A and B for the two wood-I joist orientations shown in Figure 2. The direct transmission loss through the wall construction is also shown for comparison.

It is clear from Figure 1 that the apparent TL between rooms A and B is well below the direct TL of the wall. A series of measurements with different surfaces shielded showed that the floor-floor path between rooms A and B limits sound transmission. Clearly, flanking transmission is strongest with joists perpendicular to (and continuous under) the party wall. In both cases, improving the party wall would not appreciably affect the apparent transmission loss.

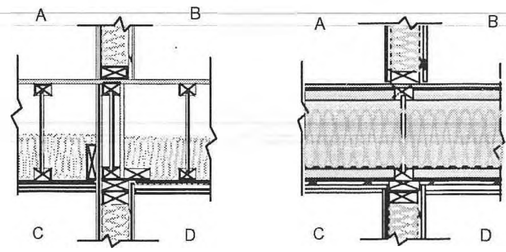

Figure 2: Floor-wall junction details with wood-I joists.

Figure 3 shows that the solid wood joists gave similar apparent TL results, for both joist orientations. Construction details are shown in Figure 4. Only the OSB was continuous across the junction, and this junction was more complex.

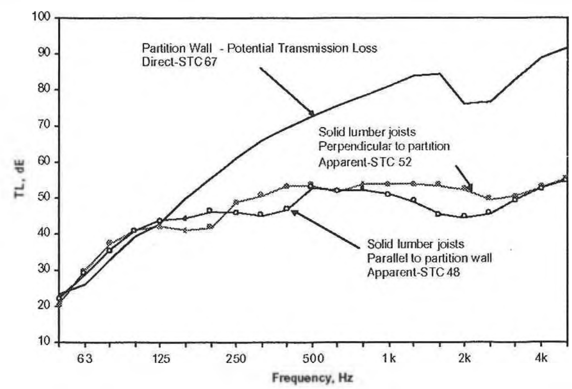

Figure 3: Apparent TL between rooms A and B, for the solid wood joist constructions shown in Figure 4.

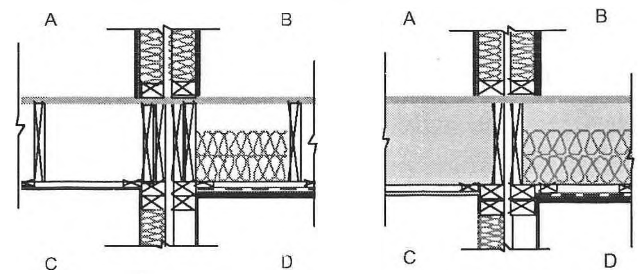

Figure 4: Floor-wall junction details with solid lumber joists.

Clearly any attempt to improve the sound isolation between rooms A and B must focus on the paths involving the floor.

This can be done either by reducing the energy getting into the floor structure, or by increasing the attenuation at the floor/wall junction. Figure 5 shows five junctions tested with the same floor (wood-I joists parallel to the wall) to assess the influence of the floor/wall junction on the flanking paths.

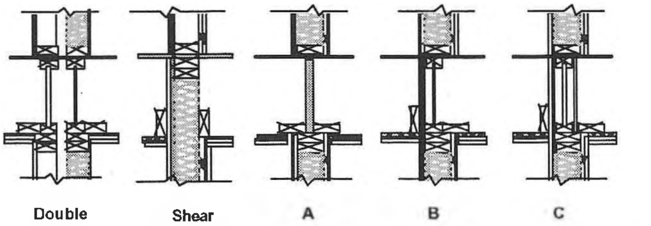

Figure 5: Sketches showing the floor-wall junction details for five variants of the double and single stud walls.

Figure 6 shows the apparent TL measured between rooms A and B, together with direct TL for these walls. In all cases the transmission is dominated by paths involving the floor, but with the more complex joint (double wall) flanking was suppressed noticeably. Single stud walls A, B, and C had essentially identical apparent TL; only case C is shown.

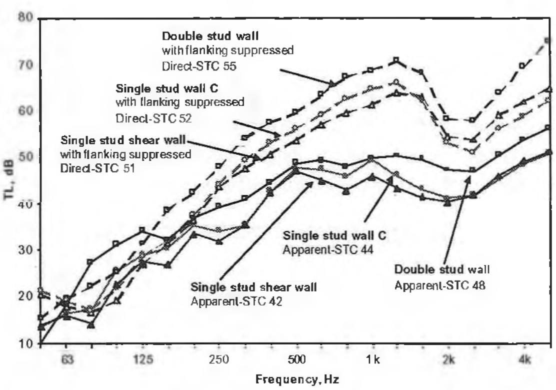

Figure 6: Apparent TL between rooms A and B for the double stud wall, single stud shear wall, and single stud wall C. Also shown is the TL expected for each wall with flanking paths suppressed.

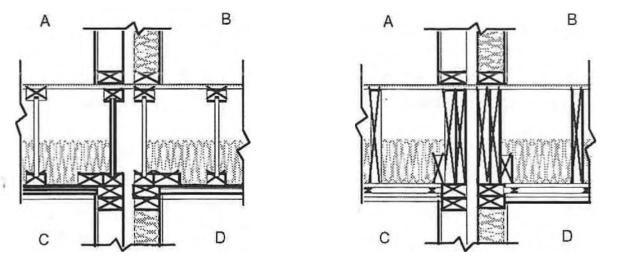

Figure 7: Sketches showing the floor-wall junctions details for comparison of solid lumber joists and wood-I joists.

The wood-I joists commonly used in current construction are lighter than traditional solid lumber so it was of interest to consider what effect this would have on the performance of the floor/wall junction. The construction details are shown in Figure 7. The apparent TL between rooms A and B, shown in Figure 8, is similar despite changing from wood-I to solid lumber joists. In both cases the TL is dominated by flanking paths involving the floor, in particular the floor-floor path. When viewing the changes in Figure 8 it is important to realize that changing the joist type affects three components in the transmission path - power incident on the junction, junction transmission, and radiation in the receiver room - which cannot be fully separated.

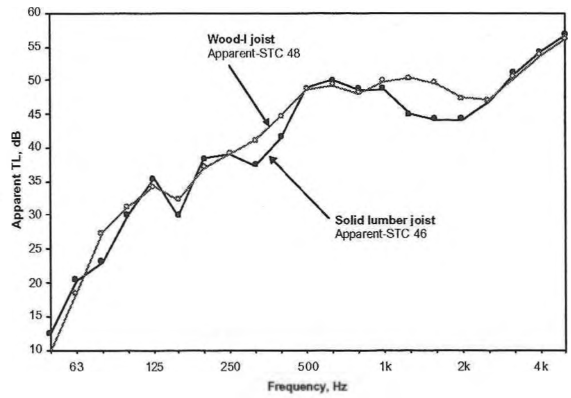

Figure 8: Apparent transmission loss between rooms A and B constructions using solid lumber and wood-I joists.

In the vertical direction between rooms A and C, the apparent TL showed little difference between the double and single stud walls. This is consistent with the direct path through the floor being the dominant path for vertical transmission. Joist type is not overly important for direct TL, especially when expressed as a single number rating. This is consistent with earlier findings [3]. Changes observable in the low and high frequencies for direct transmission do not correlate with those for flanking transmission (Figure 8). This suggests that joist type affects direct and flanking transmission differently.

3. CONCLUSION AND REFERENCES

A study of flanking transmission in wood frame construction has shown that for airborne excitation the floor/wall junction in multifamily buildings provides serious structural flanking when a continuous subfloor is used to provide resistance to wind or seismic loading.

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
3. A.C.C. Warnock, J.A Birta, Internal Report IRC-IR-811, National Research Council Canada, July 2000.

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