Determination of Flanking Transmission and Field Sound Transmission Loss in Wood-Framed Constructions Using Intensity Methods

T.R.T. Nightingale, Acoustics Laboratory, Institute for Research in Construction,
National Research Council Canada, Ottawa Ontario K1A 0R6

Introduction

The method of acoustic intensity is used to determine the presence and magnitude of flanking transmission in a common double wood stud construction. This work was conducted as part of a joint research project with Canada Mortgage and Housing Corporation. Two construction specimens are considered. The first, without a construction fault, represents the ideal case in which there should be no flanking, (base condition -- See Figure 1). The second specimen has a potentially common construction fault. The plywood floor decking of the upper rooms is continued across the party line, (see Figure 2). The results of the intensity measurements are presented for the various surfaces. Difficulties encountered when using the intensity technique in the presence of flanking transmission are also discussed.

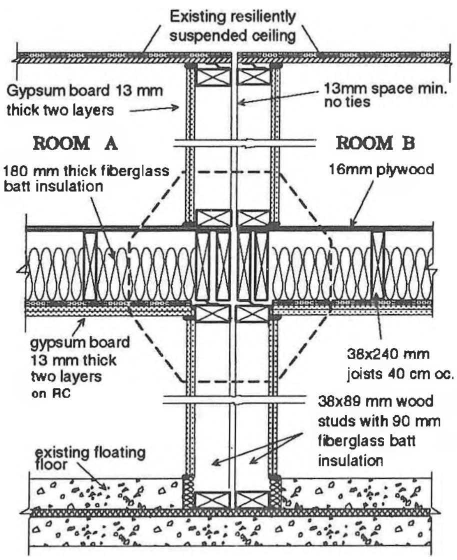

Figure 1: Section of base condition specimen at the party wall.

Measurement Technique

It is generally assumed that conventional measurement procedures involving either a P-P or P-V intensity probe will provide an accurate measure of an individual surface's radiated sound power. In fact, significant difficulties can be encountered when measuring the intensity of a surface that is physically connected at right angles to a much more energetically radiating surface. Consider measuring the

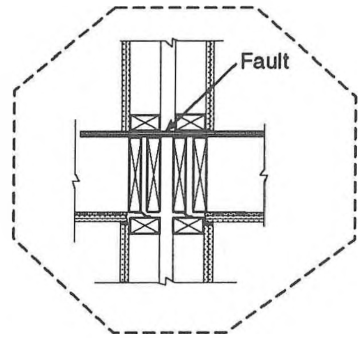

Figure 2: Section showing the construction fault.

transmission loss (TL) of the party wall shown in Figure 1 using the intensity technique when the floor is the dominant radiator, (i.e., under extreme flanking caused by the construction fault, Figure 2). Figure 3 shows the party wall transmission loss as computed from the measured intensity with and without the floor masked. The masking consisted of 1/2 inch thick gypsum board over 5/8 inch thick plywood separated from the measurement surface by 2 inch thick fiberglass batt insulation. A resilient air-tight joint between masking and measurement surfaces proved to be critical. The joint was made by using closed cell neoprene pipe lagging placed over the edge of the masking panels butting the measurement surface. The measurement surface was 4.54 m wide and 2.40 m high. Ninety-five points were used to sample the surface; using 10 columns over the width and 11 rows over the height. The probe was located at 6 cm from the measurement surface. The integration time was at least 60 seconds for each measurement point and the receiving room had at least 25 m^2 of 50 mm thick rigid fiberglass absorbing material. The results indicate that the P-P intensity probe is incapable of determining the normal radiated intensity of the measurement surface when there is an adjacent non masked radiating surface coupled at right angles. This has a significant impact on the usefulness of the method under extreme flanking conditions. Under these conditions, masking should be considered. In all subsequent intensity test data presented here, flanking surfaces were masked.

Party Wall Intensity

Figure 4 shows the measured TL between rooms A and B. From the figure, it can be seen that the fault affected the TL of the party wall as derived from the transmitted acoustic intensity. In terms of a single number rating the sound

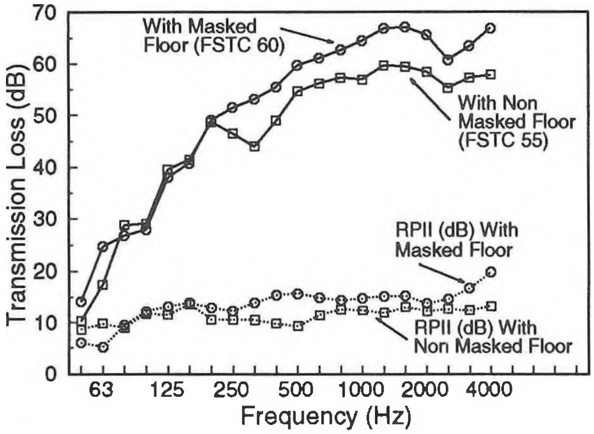

Figure 3: Party wall transmission loss obtained from the acoustic intensity with and without the floor masked.
$RPII=[L_p-|L_I|]_{calibration}-[L_p-L_I]_{measurement}$.

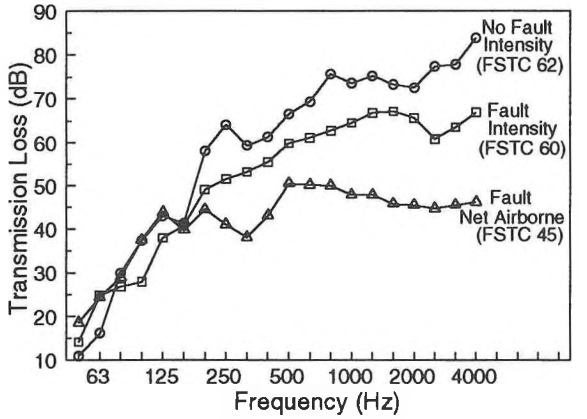

Figure 4: Party wall transmission loss obtained from the acoustic intensity with and without the fault. For the case of the fault, the net airborne sound insulation (which includes the flanking paths) is included for comparison.

insulation dropped from FSTC 62 to FSTC 60. Comparing the net airborne sound insulation with the fault (FSTC 45) to the TL of the party wall with the fault (intensity method, FSTC 60), it is evident that for frequencies greater than 200 Hz, the party wall provides much greater sound insulation. Thus, there is at least one very significant flanking path between rooms A and B, and the party wall is probably connected to the flanking path, but it is not the predominant radiator.

Floor

Figure 5 shows the measured radiated sound power for the floor and the party wall of room B when room A is the source. It is evident that the floor is the predominant radiator of acoustic energy for frequencies greater than 200 Hz. Figure 6 shows the average radiated intensity of

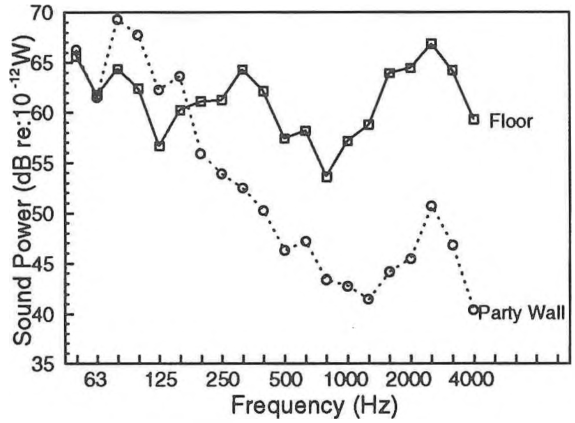

Figure 5: Measured total radiated sound power from the party wall and the floor.

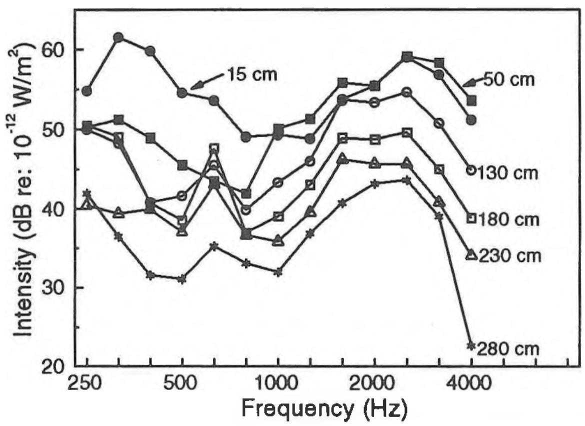

Figure 6: Measured floor intensity averaged along lines at the indicated distance from the party wall.

the floor along rows at the indicated distances from the party wall. Eight points were used in each row. There is a strong gradient in the radiated energy, indicating that the floor is more energetic near the party wall. This is especially true for frequencies greater than 800 Hz. The gradient in the radiated energy of the floor suggests that the floor is connected to the flanking path at or near the floor/party wall intersection.

Conclusions

1. Under conditions of extreme flanking, intensity methods fail to correctly isolate the normal component of the measurement surface. This can cause significant errors in the measured sound power and hence the transmission loss. For this reason, the use of masking is suggested when measuring next to a significant radiator.

2. Intensity methods allow for sound power measurement of surface sub-areas. This can be very useful to identify flanking paths.

3. Flanking transmission can significantly degrade and in severe cases control the net sound insulation.