

# EFFECTS OF STRUCTURAL FLANKING ON APPARENT STC OF STEEL STUD WALL

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## 1. INTRODUCTION

As acoustical consultants in Victoria, with its booming condominium market, Wakefield Acoustics Ltd. is often asked to conduct field tests of the Sound Transmission Class (STC) of demising walls within both newly-constructed and converted condominium buildings. The issuance of an occupancy permit often depends on achieving STC 50. Such tests present many challenges including the presence of background noise, small room sizes - often preventing valid Transmission Loss (TL) measurements in the lower frequency bands and the difficulty, particularly when testing corridor walls, in finding a wall section not fatally compromised by sound leakage via the suite's entry door. This often results in a bathroom serving as the receiving space while the adjacent corridor serves as the source space. Considerable effort must be expended to control leakage using temporary barriers (gypsum board, batt insulation etc.) placed over doorways. In a recent such test in a new concrete building not only did airborne noise leakage need to be suppressed but it was later discovered that structure-borne flanking - primarily via junctions between the test wall (a bathroom wall containing the tub) and its adjoining side walls - significantly limited the wall's sound insulation performance.

This paper presents the results of the above-described field test and discusses the effects of flanking transmission on the test results.

## 2. TEST CONDITIONS AND METHOD

The demising wall which separated the bathroom and entry/kitchen area of the test suite (#206) from the corridor was constructed as follows:

- 2 layers 16 mm Type X gypsum board,
- 152 mm steel studs @ 400 mm o.c.,
- 152 mm fiberglass batt insulation,
- 16 mm Type X gypsum board,
- 6 mm cement board.

Figure 1 shows the layout of the test wall in relation to the corridor (source space), bathroom (receiving space) and the suite entry.

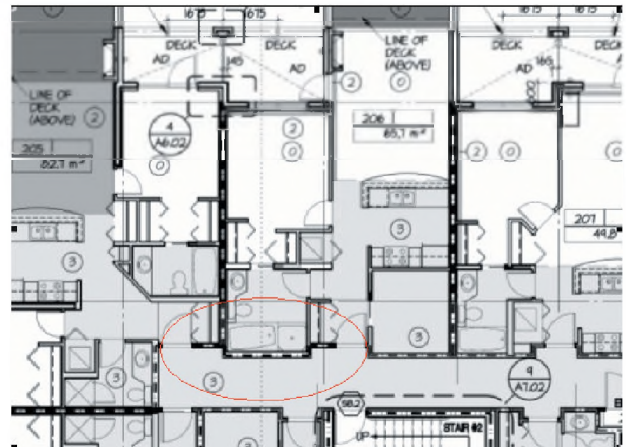


Figure 1; Layout of ASTC Test in Suite 206 showing Corridor Bathroom, Suite 206 Entry to right and Suite 205 Entry to Left.

To the extent possible given the small size of both the source (corridor) and receiving (bathroom) spaces, the Apparent STC test was carried out in accordance with ASTM E 336-05. A powerful loudspeaker fed with steady broad-band noise was placed in the corridor and average sound pressure levels were measured with a Larson-Davis Model LD2800 Real Time Analyzer at five locations on either side of the test wall using the swept microphone technique. The same system was used to measure the reverberation times in the receiving room.

After some experimentation, airborne sound leakage via the suite entry door was effectively eliminated by covering both the suite entry door and the door connecting the entry to the subject bathroom with layers fiberglass batt insulation and gypsum board. In addition, the perimeter of door between the entry and the bathroom was sealed with heavy tape. Fortunately, access to the bathroom for test purposes could be gained via a second door leading to the master bedroom.

## 3. RESULTS

### 3.1 Initial Test Results - Apparent STC 46

The initial test of the corridor wall yielded an Apparent STC (ASTC) of 46 (see Figure 2) whereas the 2006 BC Building Code (see Walls Number S9a and S9b rates this construction at STC 57 to 59. The mos

significant TL deficiencies were not in the lower 1/3-octave bands (125 to 250 Hz.) as is often the case, but rather between 1,250 and 3,150 Hz. These mid-to-high frequency TL deficiencies were not felt to be due to air-gap leakage since the TL performance recovered again in the 4,000 Hz. 1/3-octave band.

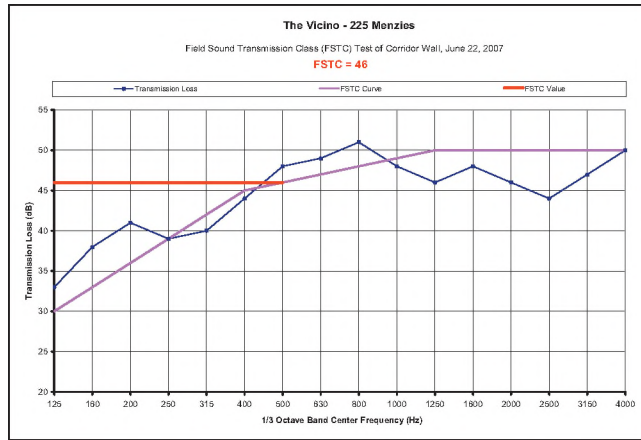


Figure 2; Results of Initial Apparent STC (ASTC) Test of Corridor Wall Showing Mid-High Frequency TL Deficiencies

Suspecting that construction flaws might be responsible for these TL deficiencies, a section of wall was opened up on the bathroom side to confirm the presence of cavity insulation and the absence of any structural bridging (by waste pipes etc.) across the cavity. No such construction flaws were discovered. This then left the possibility that structural flanking was the culprit, an opinion that was subsequently reinforced by a conversation with a specialist in this area – Dr. Trevor Nightingale of the NRC.

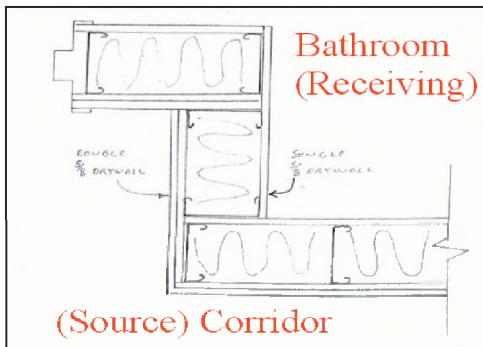


Figure 3; Detail of Junction between Corridor Test Wall and Side Wall showing Bridging of Wall Cavity by Gypsum Board.

As seen in Figure 3, the wall cavity is blocked off with one or two layers of gypsum board at each corner - apparently for flame spread prevention, but also likely for convenience during construction. Gypsum board then bridges the cavity at the corners and allows structure-borne sound to pass through it more efficiently that would be the case if the only connections were provided by lightweight steel studs.

### 3.2 Final Test Results - Apparent STC 50

Upon verification of the basic construction of the corridor wall, a second test was conducted to confirm the initial result. The section of wall board and cement board (about 1 m by 1m) removed for inspection purposes had been replaced but the small gaps around its perimeter had not been repaired (mudded) as the surface was to be tiled. Unexpectedly, this retest revealed TL improvements of 5 to 6 dB in the 1,000 to 4,000 Hz. range and an increase in ASTC from 46 to 50.

### 3.3 Near Field SPL Scans of Room Surfaces

At the time of the second test, a series of spatially averaged SPL measurements were made within about 50 mm the various bathroom wall surfaces to explore their relative significance to the overall sound radiation into the space. Figure 4 shows the various 1/3-octave band SPL spectra obtained. Note the consistency of the sound levels particularly at and above 1000 Hz., indicating that the level of induced vibration in the two side walls were no significantly different from those in the test wall.

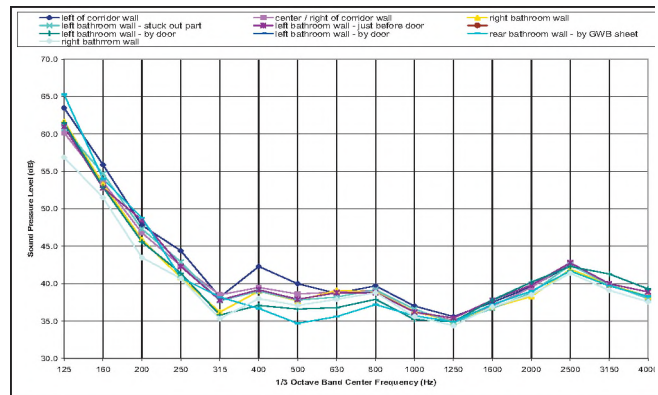


Figure 4; Results of Near-Field SPL Scans Over Wall Surfaces

## 4. DISCUSSION

These tests have shown that flanking transmission via sidewalls can result in differences between the ASTC's and lab-rated STC's of steel stud and gypsum board walls larger than indicated by the familiar 3 to 5 point "rule of thumb". Here flanking was aggravated by the small size of the test wall (i.e., relatively small ratio of area-to-perimeter) and also by the fact that portions of the side walls adjoining the corridor were exposed to the source sound field. These results also support the notion that the Building Code should be modified to better address structural flanking transmission in real buildings. Such revisions could presumably focus on specifying appropriate connectivity details rather than simply advising designers/builders to apply a safety margin of 5 STC points when selecting a wall since they won't be able to achieve lab results in the field.