VARIATION OF ASTC RATINGS DUE TO FLANKING TRANSMISSION WITHIN A RESIDENTIAL CONVERSION

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1. INTRODUCTION

Swift House is an older building in Victoria's downtown core that originally served warehouse and/or commercial purposes but many years ago was converted to a homeless shelter having many small rooms. In 2011, the building was transformed again, this time into larger, self-contained affordable housing units. The units were also brought up to BC Building Code 2006 (BCBC) requirements including provision of adequate airborne sound insulation.

Swift House is a two-storey building with poured concrete slab floors supported by cast-in-place concrete columns (of various shapes – often octagonal) spaced quite uniformly throughout the building. Under the new floor plan, unit demising (party) walls frequently terminate at these concrete columns. In some situations, however, demising walls terminate at lightweight steel stud and gypsum board corridor walls, some of which extend continuously from one living unit to the next. In other situations, one end of a demising wall will terminate at a concrete column while the other terminates at a gypsum board wall. Wakefield Acoustics Ltd. conducted a series of Apparent Sound Transmission Class (ASTC) tests between units and found the variability of measured ASTC's to be much wider than typically observed in new condominium buildings. This paper describes the ASTC tests conducted and discusses the suspected reason for the high variability in results.

2. TYPICAL FLANKING TRANSMISSION EFFECTS

The BCBC recognizes that residential unit demising walls rarely provide the same degree of airborne sound insulation in field (real world) situations as they do in laboratory test situations. Reduced ASTC ratings in field tests are sometimes due to sound leakage via cracks and/or gaps, or to other flaws in wall construction. More commonly, ASTC's are limited by structure-borne sound which "flanks" around the demising wall via continuous sidewalls and/or floor and ceiling assemblies. The BCBC therefore recommends that architects and builders chose wall assemblies with a lab-rated STC at least 5 points higher than the Code's minimum airborne sound insulation requirement of ASTC 50. Party walls having lab ratings of about STC 55, or slightly more, are then commonly selected. In multi-family residential buildings, it is not generally cost-effective to construct wall assemblies with a lab ratings greater than STC 60, since flanking will usually prevent such superior performance from being realized in the field.

3. ASTC TESTS OF TWO NOMINALLY IDENTICAL DEMISING WALLS

ASTC tests were conducted between two pairs of units having identical demising walls construction as follows:

- 2 layers of 16 mm Type X Gypsum Board,
- 152 mm, 25 ga. steel studs,
- 150 mm batt insulation,
- 2 layers of 16 mm Type X Gypsum Board,
- 152 mm 25 ga. steel studs,
- 1 layer of 16 mm Type X Gypsum Board.

Note that this demising wall includes a second 152 mm, uninsulated cavity which serves as a pipe chase for the half of the wall that separates back-to-back kitchens. Without this second cavity, this wall would be identical to BCBC Wall No. S9a, which received a lab-rated STC 59. With the second cavity present, the wall's lab-rated STC would be somewhat greater – perhaps STC 62 to 65.

The first test of this wall assembly (between Units 208 and 210) yielded ASTC 49. Figure 1 is a partial floor plan including the test wall. It is seen that one end of the demising wall terminates in a rectangular concrete column while the other terminates in a gypsum board corridor wall which was believed to run continuously (including the gypsum board sheeting) from one unit to the next.

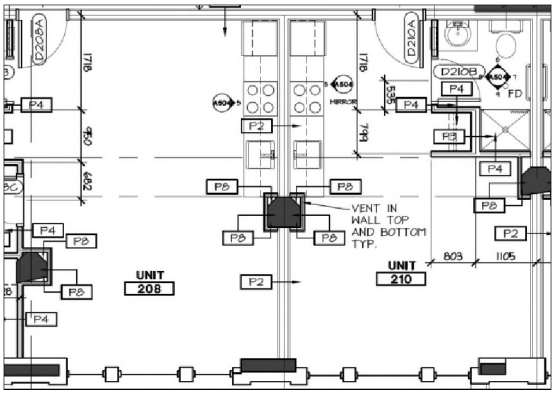

Figure 1; Floor Plan of Units 208 & 210 Showing Test Wall

Since the wall between Units 208 and 210 did not meet the BCBC's minimum ASTC 50 requirement, a second test was conducted of an identical demising wall between Units 213 and 215. Figure 2 is a plan of Units 213 and 215 showing the second test wall. Note, in this case, both ends of the demising wall terminate at octagonal concrete columns. This test yielded ASTC 59 - one of the highest field test

results that Wakefield Acoustics Ltd. has ever measured. Initially it was not clear how such as large (10 STC point) variation could occur between identical wall assemblies.

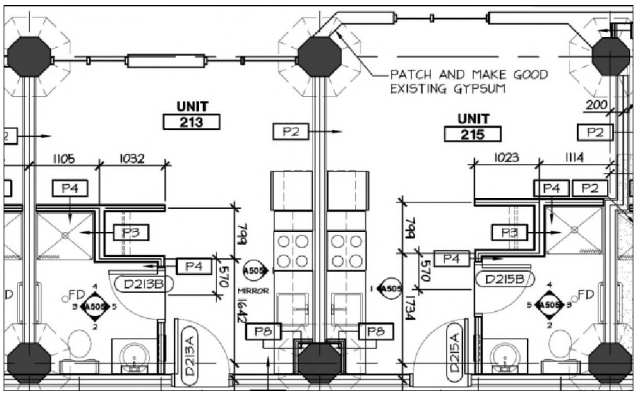

Figure 2; Floor Plan Units 213 and 215 Showing Test Wall

Figure 3 shows the Apparent Transmission Losses (ATL's) in 1/3rd octave bands from 125 to 4,000 Hertz as required in the standard ASTC test. The ATLs' obtained between Units 213 and 215 are consistently greater (by 4 to 20 dB) than those obtained between Units 208 and 210.

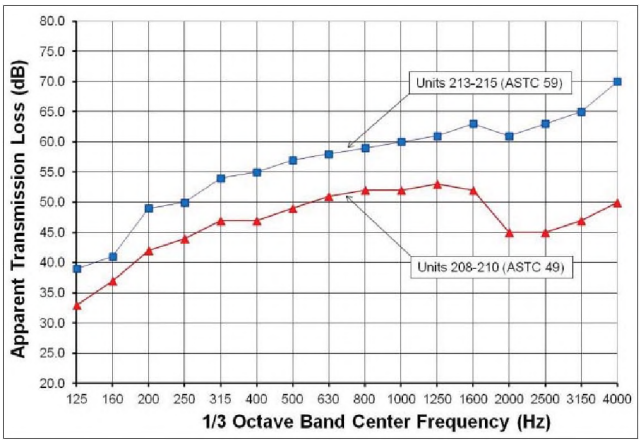

Figure 3; ATL's for Two Identical Demising Walls.

The low ATL's obtained between Units 208 and 210 were not due to sound leakage via gaps/cracks as such leakage tends to only degrade wall performance at high-frequencies.

4. ASTC TEST OF A WALL WITH NO CONCRETE COLUMN TERMINATIONS

A third ATSC test was conducted between the Bedroom of Unit 212 and the Living Room of Unit 214. Since no kitchen was involved, this demising did not include a second cavity and was constructed as follows:

- 2 layers of 16 mm Type X Gypsum Board,
- 152 mm, 25 ga. steel studs,
- 150 mm batt insulation,
- 2 layers of 16 mm Type X Gypsum Board.

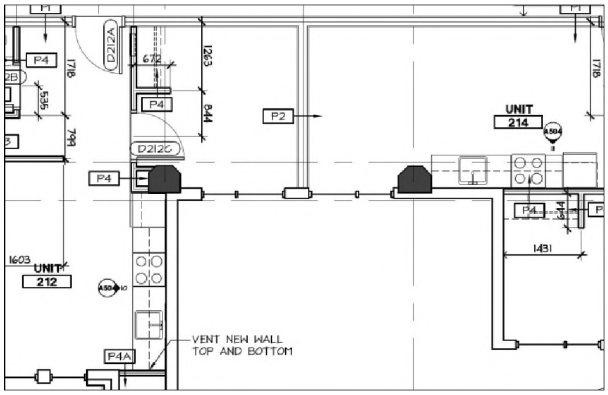

Figure 4 – Floor Plan Units 212 and 214 Showing Test Wall

This assembly is then BCBC Wall No. S9a and has a lab-rated STC of 59. The field test yielded ASTC 46. Figure 5 compares the ATL's obtained from the field test with the TL's predicted for this wall assembly using Marshall Day Acoustic's sound insulation prediction software, INSUL (Version 6.3). INSUL predicted STC 55. Again, there is no evidence of sound leakage as the difference between measured and predicted TL's diminishes in the highest frequency bands.

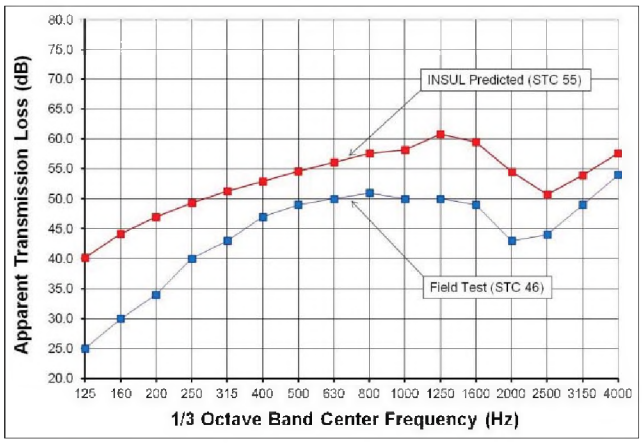

Figure 5 –Measured ATL's versus INSUL-Modeled TL's

5. CONCLUSIONS

The very substantial differences observed between the ASTC's measured between two nominally identical demising walls, and those between the measured ASTC and modeled STC of another wall assembly, are largely due to variations in structure-borne sound which, in the field, "flanks" around the primary noise barrier, principally via paths provided by continuous sidewalls. The floors and ceilings of the living units tested were reinforced concrete slabs. The rigidity of these slabs minimized their excitation by the intense sound fields created in the "source rooms" and therefore minimized the transmission of structure-borne sound into adjacent units. Flanking transmission was strongest (and therefore ASTC's lowest) where one or both ends of the demising wall was coupled directly to a gypsum board sidewall, particularly where the sidewall continued on, without a structural break, into the adjacent unit. ASTC's were maximized, and approached lab test values, where both ends of the demising wall terminated in one of