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ADVANCED ACOUSTICAL CONSULTATION & SYSTEM DESIGN

19 July 2011

Mr. Rico Sabatini & Mr. Cory Gresen
Plan B
924 Williamson Street
Madison, WI 53703

Subject: Noise Transmission at 924 Williamson Street

Gentlemen:

This letter is to summarize our findings from the site visitation of 14 July 2011 and a subsequent visitation to the aligned residence on Jennifer Street between the hours of 12:05 AM and 12:35 AM the morning of 16 July 2011.

The problem that you described when engaging our services was music from the sound system at 924 Williamson Street being an irritation to neighbors, with the most intense complaints coming from residences one block to the south on the north side of Jennifer Street. * You further indicated your belief that the sound transmission was through the roof, as the shell of the building is mostly concrete masonry units, but the roof is wood framing with a rubber membrane.

The site visitation of 14 July 2011 confirmed that the roof is the basis of the problem. An initial test employed pink noise as the signal, making use of the facility's sound system to produce an internal level of 100 dBA in the dance floor area. The level around the perimeter of the building ranged in the low 60 dBA range, but averaged 72 dBA to 74 dBA on north half of the roof.

At this point we learned that the you were not using the sound system's subwoofers in an attempt to minimize complaints. Therefore, for the purpose of making the test process more complete, the test was run again with the subwoofers engaged, which increased the level on the north half of the roof to an average of 78 dBA to 80 dBA.

Compressed logarithmic scale

The comparison of inside to outside SPL (sound pressure level) measurements does not constitute a formal STC (sound transmission class) test, but does approximate that process, with an estimated transmission loss of approximately 20+ dB. We are only concerned with low frequency content, as it is the long wavelength energy that most readily transmits through barriers, and most closely follows the inverse square law when attenuating over distance.

A weighting:

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Following the pink noise signal, a recording of contemporary music with a heavy bass beat was used, supplied by you as representative of the music used for your clients. The sustained level inside at the dance floor was 98 dBA with the subwoofers operating. At your suggestion, and in order to obtain a worst case measurement, the gain of the sound system then was increased to produce a sustained level of 108 dBA inside, with a resultant level of 78 dBA to 81 dBA over the north portion of the roof, and a level of 68 dBA to 71 dBA at the south extreme of the roof.

This south extreme roof reading is important as it establishes an initial distance value, separate from the source value, for use of the inverse square law. From satellite imagery we can approximate the south extreme roof distance from the mid north roof position over the dance floor, and the distance to the back yard of the Jennifer Street resident that we met when measuring SPL values on Jennifer Street. The two distances are 77 feet and 362 feet, which result in a loss of 13 dB to Jennifer Street location. Subtracting 13 dB from 68 dBA to 71 dBA results in a range at rear of the house on Jennifer Street of 55 dBA to 58 dBA.

During the afternoon of 14 July 2011 we were not able to obtain meaningful SPL measurements at the Jennifer Street address, even though the music signal was audible, as the bulk of acoustical energy present was in the form of road construction machinery noise from Williamson Street, an HVAC related fan on a building between Williamson Street and Jennifer Street, bird calls in the trees on Jennifer Street, and intermittent road traffic on Jennifer Street.

Accordingly, we returned to the Jennifer Street site between 12:05 AM and 12:35 AM the morning of 16 July 2011. At this time, the measured SPL value obtained when no traffic noise was present was 44 dBA to 45 dBA. The music signal was again audible, but the reading did not change between times when the music was present and breaks between selections, as the reading was essentially determined by the same HVAC related fan referred to above.

As per your request, you and your staff were not informed of the timing of the second visit, so the levels witnessed at that time were presumably representative of normal operation. If normal operation is represented by the 98 dBA interior value, the south roof value would be 58 dBA to 61 dBA, and the projected values at the Jennifer Street site would be 45 dBA to 48 dBA, and these values correlate relatively well with the values measured the morning of 16 July 2011. was Available time Approx, dBA measurement Value Reduce dBA.

The correlation must take into account two factors. First, since the measured values of the morning of 16 July 2011 did not change when the music started and stopped, even though the music was discernable to a human listener, the contribution of the music to the measured values was at least 6 dB below that of the HVAC fan, so if we could have turned off the fan, the likely values would have ranged from 39 dBA to 42 dBA. Second, the path from the roof of the Williamson Street site to the Jennifer Street site is not a clear one. There are obstructions in the form of other structures, foliage, and a fence. These obstructions will account for a loss of at least several dB, further supporting the 39 dBA to 42 dBA range as the most probable actual values.

While these levels are quite low, the problem arises due to the nature of the signal with its rhythmic bass. The human ear/brain combination easily distinguishes this signal from that of sustained background noise such as produced by the nearby HVAC fan. The literature details extensive criteria for determining the irritation value of signals based upon such factors as SPL, waveform, repetition rate, time of day, etc., so it is these additional factors, not just the SPL, that result in the complaints.

* The good news is that, based upon the values determined, only a relatively small amount of attenuation will be needed to eliminate the problem. There are two reasonable options that could be done individually or in combination:

1. Application of a layer of 1/4" thick MLV (mass loaded vinyl) to the north 2/3 of the roof. The transmission loss specifications for mass loaded vinyl are not available for frequencies below the 125 Hz octave, but at the 125 Hz octave the transmission loss is 16 dB. The transmission loss of materials drops with decreasing frequency, so a reasonable projection for the 63 Hz octave is 8 dB. It is the 63 Hz octave that contains most of the frequencies of concern. The transmission loss values for a material like MLV are determined by a specific test process that should not imply that this loss value will be obtained when the material is placed directly against another barrier. In reality, the net increase in transmission loss is likely to be on the order of 4 to 6 dB in the 63 Hz octave.

   MLV is recommended because of its low cost and ease of installation. It is also light enough that it should not present a significant structural load to the roof structure, but any loading of the roof should be confirmed as safe by a structural engineer. One drawback, however, is that it may not hold up well when exposed to ultra violet radiation from the sun. This concern may be alleviated by painting it white.

2. Any barrier, and in this case the roof, has a measurable transmission loss, but this loss is determined by exposure to broadband noise, which may not account for dimensionally determined resonant frequencies. At one to three resonant nodes the transmission loss drops dramatically. If a particular musical selection has the pitch of the bass notes align with roof resonant nodes, the transmission loss will be minimal. Therefore, it may be useful to incorporate a digital processor into the sound system that would provide the following operational features:

   2.1. Generation of extremely narrow but deep notch filters adjusted to align with roof resonant nodes.

   2.2. Selective peak limiting of the bass and sub bass bands.

   If properly adjusted, this approach is likely to reduce the low bass peaks radiating through the roof by about 6 dB to 8 dB. If this 6 dB to 8 dB is added to the 4 dB to 6 dB resulting from the MLV in option 1, the total reduction will be on the order of 10 dB to 14 dB, which would be enough to lower the value at Jennifer Street to insignificance. At the same time, and also contingent upon proper adjustment, use of this device should have a minimal impact upon the musical experience of clients.

In summary, any means of providing an additional transmission loss, or effective transmission loss in the case of the digital processor, of over 10 dB should take care of the problem. The current level at Jennifer Street is already quite low compared to the levels that typically require our services. Another factor to consider is the Fletcher-Munson effect, whereby human sensitivity to low frequency material at low levels drops faster than actual levels would indicate. An actual loss of 10 dB to 14 dB relative to the currently measured levels would be perceived more as a 16 dB to 20 dB loss, and a loss of this order of magnitude would be dramatic.

Sincerely yours,

AUDIO DESIGN SPECIALISTS

John Westra,
President

JW/rf