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Acoustic Testing of QFFG / VMC Fiberglass Pads on Concrete Floors

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Client SVA Inc.
211 Cochituate Road
Framingham MA 01701

Specimen
- 100 mm (4") Precast concrete slab
- 13 mm (1/2") Plywood
- 51 mm (2") QFFG / VMC fiberglass blocks
- 38 mm (1-1/2") Glass fibre insulation (roll)
- 150 mm (6") Precast concrete slab

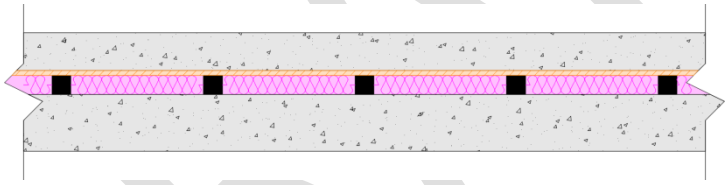
Specimen ID A1-014813-01F

Specimen Description

Topping: 100 mm (4") Precast concrete slab with the space between the slab and testing frame filled with glass fibre insulation and covered with cloth tape.

Resilient Layer: 13 mm (1/2") plywood on 2" QFFG / VMC fiberglass blocks on 38 mm (1-1/2") glass fibre insulation. The seams and perimeter of the plywood layer were covered with cloth tape. The blocks were spaced at 16" o.c. See *APPENDIX: Pad Spacing* for details. The intermediate space was filled with 1-1/2" glass fibre insulation. The insulation was cut at the location of the pads to allow them to make direct contact with the concrete structural layer.

Concrete Structural Layer: 150 mm (6") Precast concrete slab, sealed from below with duct putty and from above with glass fibre insulation and cloth tape.



Cross-section of A1-014813-01F

Specimen Properties

Element	Actual thickness (mm)	Mass (kg)	Mass/length, area or volume
4" Precast concrete slab	100	4800	248.4 kg/m^2
1/2" Plywood	13	94	4.9 kg/m^2
2" QFFG / VMC fiberglass block	51	4	44 g/each
1-1/2" Glass fibre insulation (roll)	*38	15	0.8 kg/m^2
6" Precast concrete slab	150	7460	386.1 kg/m^2
Total	**314**	**12373**	**640.4 kg/m^2**

* The thicknesses of these elements are not included in the total specimen thickness.

Test Specimen Installation

- The exposed area of the floor specimen used for the calculations of the airborne sound transmission loss was 17.85 m^2 (4.71 m x 3.79 m).
- The total area of the floor assembly resting on top of the lip was 19.32 m^2 (4.88 m x 3.96 m).
- The mass per area of the elements above the lip was calculated using the total area (19.32 m^2).
- The mass per area of the ceiling elements was calculated using the exposed area (17.85 m^2).

ASTM E90 Test Results – Airborne Sound Transmission Loss

Client: SVA Inc. **Test ID:** TLF-18-049

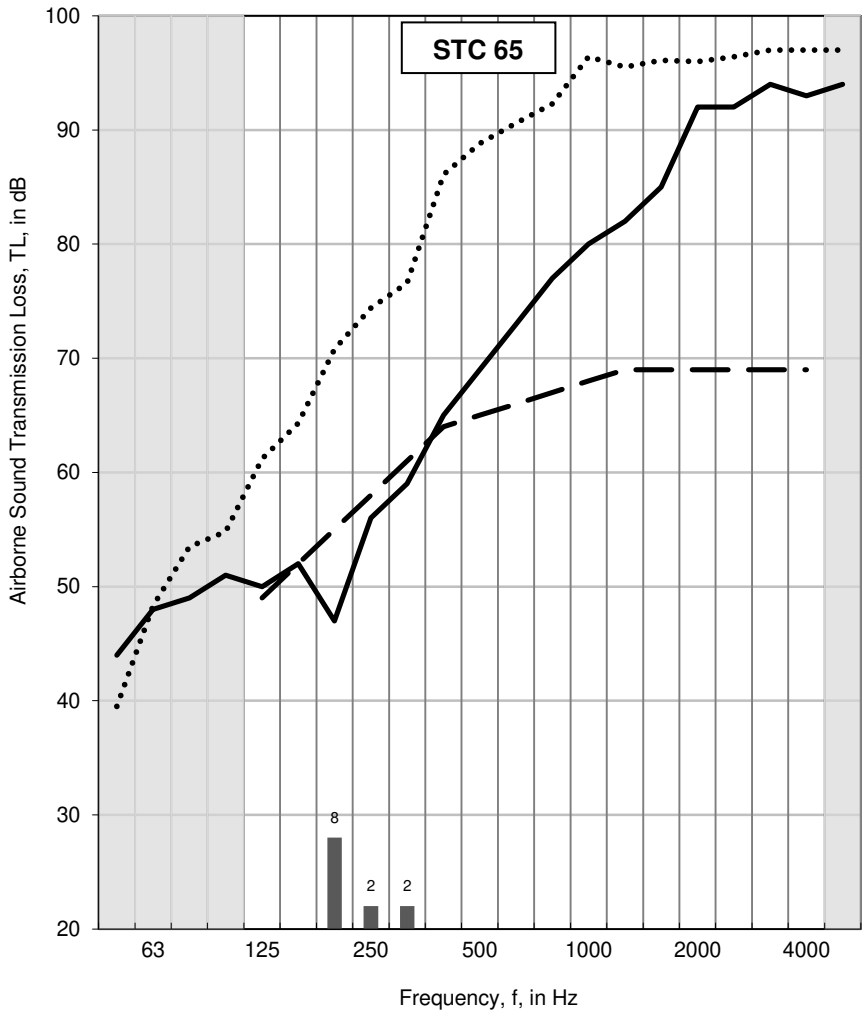
Specimen ID: A1-014813-01F **Date of Test:** 2018-12-03

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	174.0	19.6 to 19.7	40.4
Lower	177.4	20.3 to 20.4	38.4

Area S of test specimen:	17.85 m^2
Mass per unit area:	640.4 kg/m^2

f (Hz)	Airborne TL (dB)	
50	44	
63	48	
80	49	
100	51	
125	50	
160	52	
200	47	
250	56	
315	59	
400	65	
500	69	
630	73	
800	77	
1000	80	
1250	82	
1600	85	c
2000	92	c
2500	92	*
3150	94	*
4000	93	*
5000	94	*
Sound Transmission Class (STC)	**65**	

Sum of Deficiencies (dB)
12
Max. Deficiency (dB)
8 dB at 200 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Airborne sound transmission loss measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".**

In the graph:
The solid line is the measured sound transmission loss for this specimen. The dashed line is the STC contour fitted to the measured values according to ASTM E413-16. The dotted line (may be above the displayed range) is the flanking limit established for this facility. For any frequency band where the measured transmission loss is less than 10 dB lower than the dotted line, the reported value is potentially limited by flanking transmission via laboratory surfaces, and the true value may be higher than that measured. Bars at the bottom of the graph show deficiencies where the measured data are less than the reference contour as described in the fitting procedure for the STC, defined in ASTM E413-16. The shaded cells in the table and areas in the graph are outside the STC contour range.

In the table:
Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. The reported values have been corrected according to the procedure outlined in ASTM E90-09. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level, in which case, the corrected values provide an estimate of the lower limit of airborne sound transmission loss.

ASTM E492 Test Results – Normalized Impact Sound Pressure Levels

Client: SVA Inc. **Test ID:** IIF-18-036

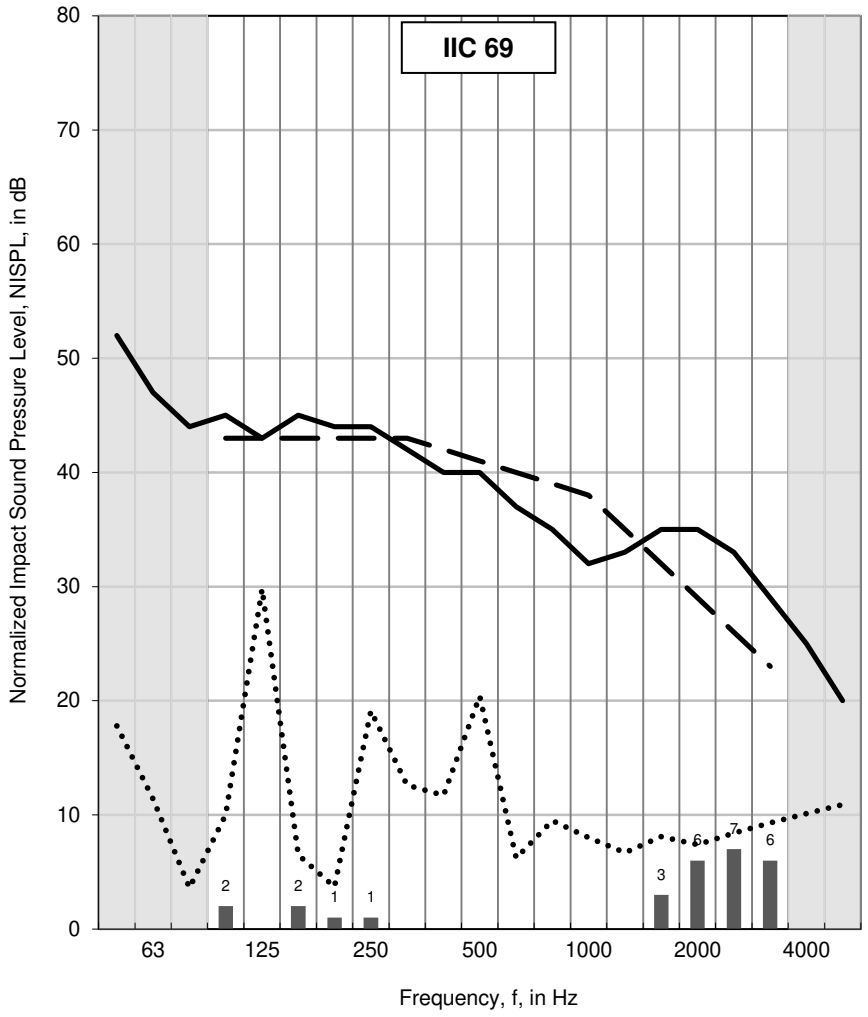
Specimen ID: A1-014813-01F **Date of Test:** 2018-11-30

Room	Volume (m³)	Air Temperature (°C)	Humidity (%)
Upper	174.0	23.1	32.5 to 33.1
Lower	177.4	21.4	35.4

Area S of test specimen:	17.85 m^2
Mass per unit area:	640.4 kg/m^2

f (Hz)	NISPL (dB)	
50	52	
63	47	
80	44	
100	45	
125	43	c
160	45	
200	44	
250	44	
315	42	
400	40	
500	40	
630	37	
800	35	
1000	32	
1250	33	
1600	35	
2000	35	
2500	33	
3150	29	
4000	25	c
5000	20	*
Impact Insulation Class (IIC)	**69**	

Sum of Positive Differences (dB)
28
Max. Positive Difference (dB)
7 dB at 2500 Hz



For a description of the test specimen and mounting conditions see text pages before. The results in this report apply only to the specific sample submitted for measurement. No responsibility is assumed for performance of any other specimen. **Measurements of normalized impact sound pressure level (NISPL) were conducted in accordance with the requirements of ASTM E492-09, "Standard Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine".**

In the graph:

The solid line is the measured normalized impact sound pressure level (NISPL) for this specimen. The dashed line is the IIC contour fitted to the measured values according to ASTM E989-06. The dotted line is the background sound level measured in the receiving room during this test (may be below the displayed range). For any frequency where the measured NISPL is less than 10 dB above the dotted line, the reported values were adjusted as noted below. Bars at the bottom of the graph show positive differences; where the measured data are greater than the reference contour as defined in ASTM E989-06. Shaded cells in the table and areas in the graph are outside the IIC contour range.

In the table:

Values marked "c" indicate that the measured background level was between 5 dB and 10 dB below the combined receiving room level and background level. Values marked "*" indicate that the measured background level was less than 5 dB below the combined receiving room level and background level and the reported values of NISPL provide an estimate of the upper limit of normalized impact sound pressure level, according to the procedure outlined in ASTM E492-09. The reported values of NISPL have been corrected according to the procedure outlined in ASTM E492-09.

APPENDIX: ASTM E90-09 – Airborne Sound Transmission – Floor Facility

Facility and Equipment: The NRC Construction Floor Sound Transmission Facility comprises two reverberation rooms (referred to in this report as the upper and lower rooms) with a moveable test frame between the rooms. Both rooms have an approximate volume of 175 m^3. In each room, there are 8 pre-polarized diffuse-field ½" microphones, Bruel and Kjaer Type 4942. Measurements are made in both rooms simultaneously using a NI PXI-4499 DAQ system with LabVIEW measurement software. Each room has four bi-amped loudspeakers driven by separate amplifiers and noise sources. To increase diffusivity of the sound field, there are fixed diffusing panels in each room.

Test Procedure: Airborne sound transmission measurements were conducted in accordance with the requirements of ASTM E90-09, "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements." Airborne sound transmission loss tests were performed in the forward (receiving room is the lower room) and reverse (receiving room is the upper room) directions. Results presented in this report are the average of the tests in these two directions. In each case, sound transmission loss values were calculated from the average sound pressure levels of both the source and receiving rooms and the average reverberation times of the receiving room. One-third octave band sound pressure levels were measured for 32 seconds at eight microphone positions in each room and then averaged to get the average sound pressure level in each room. Ten sound decays were averaged for each microphone (8) located in the respective receiving rooms; these eight reverberation times were averaged to get the average reverberation times for each room. Information on the flanking limit of the facility and reference specimen test results are available on request.

Significance of Test Results: ASTM E90-09 requires measurements in one-third octave bands in the frequency range 100 Hz to 5000 Hz. The standard recommends making measurements and reporting results over a larger frequency range, and this report presents such results, which may be useful for expert evaluation of the specimen performance. The precision of results outside the 100 Hz to 5000 Hz range has not been established, but is expected to depend on laboratory-specific factors.

Sound Transmission Class (STC): The Sound Transmission Class (STC) was determined in accordance with ASTM E413-16, "Classification for Rating Sound Insulation". It is a single-number rating scheme intended to rate the acoustical performance of a partition element separating offices or dwellings. The higher the value of the rating, the better the performance. The rating is intended to correlate with subjective impressions of the sound insulation provided against the sounds of speech, radio, television, music, and similar sources of noise characteristic of offices and dwellings. The STC is of limited use in applications involving noise spectra that differ markedly from those referred to above (for example, heavy machinery, power transformers, aircraft noise, motor vehicle noise). Generally, in such applications it is preferable to consider the source levels and insulation requirements for each frequency band.

In Situ Performance: Ratings obtained by this standard method tend to represent an upper limit to what might be measured in a field test, due to structure-borne transmission ("flanking") and construction deficiencies in actual buildings.

APPENDIX: ASTM E492-09 – Light Impact Sound Transmission – Floor Facility

Facility and Equipment: The NRC Construction Floor Sound Transmission Facility comprises two reverberation rooms (referred to in this report as the upper and lower rooms) with a moveable test frame between the two rooms. Both rooms have an approximate volume of 175 m^3. For impact sound transmission, only the lower room is used. In each room, there are 8 pre-polarized diffuse-field 1/2" microphones, Bruel and Kjaer Type 4942. Measurements are made in both rooms simultaneously using a NI PXI-4499 DAQ system with LabVIEW measurement software. Each room has four bi-amped loudspeakers driven by separate amplifiers and noise sources. To increase diffusivity of the sound field, there are fixed diffusing panels in each room.

Test Procedure: Impact sound transmission measurements were conducted in accordance with ASTM E492-09, "Standard Test Method for Laboratory Measurement of Impact Sound Transmission through Floor-Ceiling Assemblies Using the Tapping Machine." This method uses a standard tapping machine placed at four prescribed positions on the floor. One-third octave band sound pressure levels were measured for 32 seconds at each microphone position in the receiving room and then averaged to get the average sound pressure level in the room. Ten sound decays were averaged for each microphone (8) located in the respective receiving rooms; these eight reverberation times were averaged to get the average reverberation times for each room. Information on the flanking limit of the facility and reference specimen test results are available on request. The spatial average sound pressure levels and reverberation times of the receiving room were used to calculate the Normalized Impact Sound Pressure Levels. Information on the flanking limit of the facility and reference specimen test results are available on request.

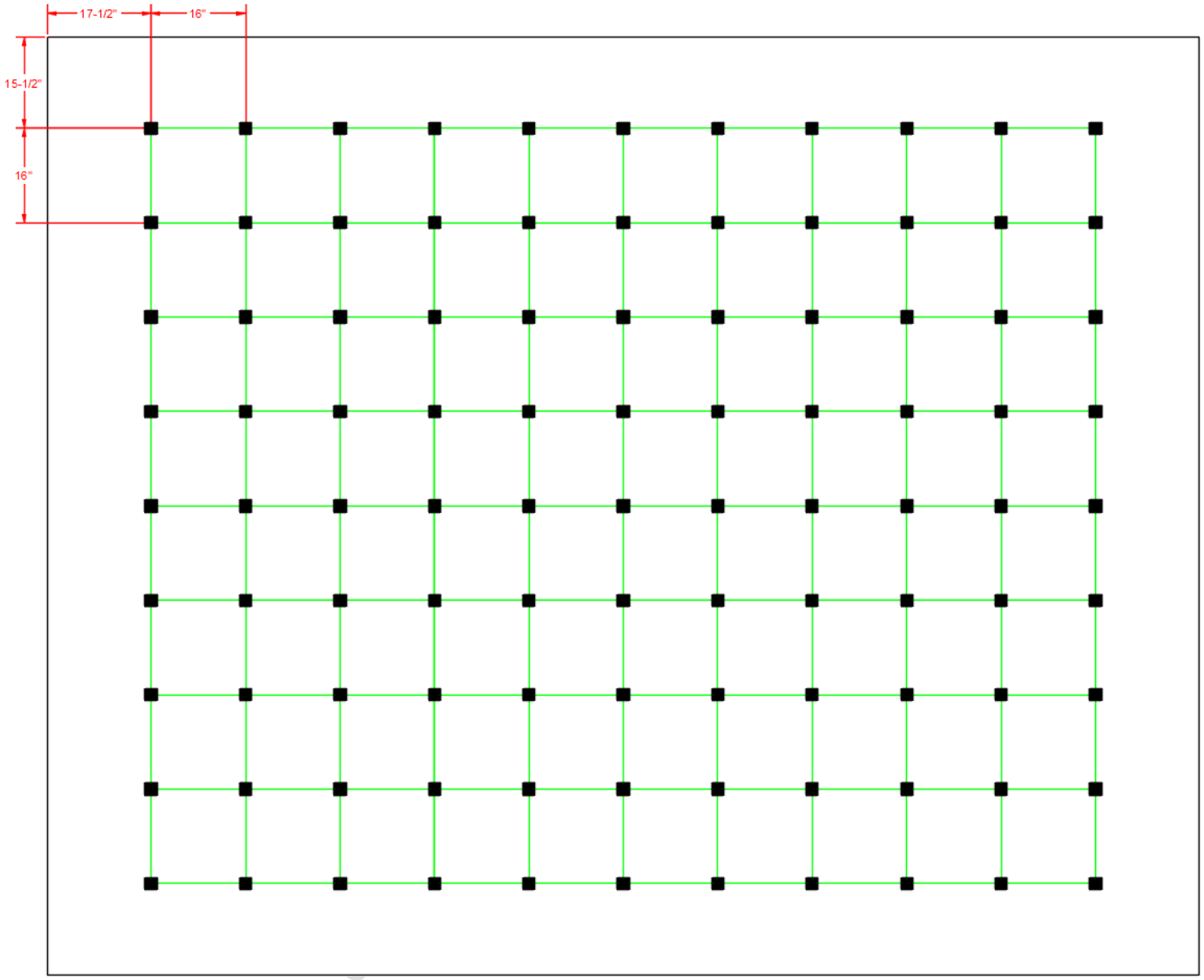
Significance of Test Results: ASTM E492-09 requires measurements in one-third octave bands in the frequency range 100 Hz to 3150 Hz. The standard recommends making measurements and reporting results over a larger frequency range, and this report presents such results, which may be useful for expert evaluation of the specimen performance. The precision of results outside the standard ranges has not been established, and is expected to depend on laboratory-specific factors such as room size and specimen dimensions.

Impact Insulation Class (IIC): The Impact Insulation Class (IIC) was determined in accordance with ASTM E989-06, "Standard Classification for Determination of Impact Insulation Class (IIC)". It is a single-number rating scheme intended to rate the effectiveness of floor-ceiling assemblies at preventing the transmission of impact sound from the standard tapping machine. A higher IIC value indicates a better floor performance.

In Situ Performance: Ratings obtained by this standard method tend to represent an upper limit to what might be measured in a field test, due to structure-borne transmission ("flanking") and construction deficiencies in actual buildings.

APPENDIX: Pad Spacing

A total of 99 pads were used. The first pad was placed at the center of the floor assembly and all remaining pads were placed in a rectangular array at 16” o.c. The dimensions of the testing frame allowed for 9 rows and 11 columns of pads. The distance between the outermost pads and the testing frame on the short edges was 15-1/2” and 17-1/2” on the long edges.



Pad Spacing for A1-014813 Floor Assemblies