Basic evaluation of the effectiveness of loudspeaker suspension mountings for installed entertainment systems.

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It has recently being brought to our attention that various unsubstantiated claims are being made about the ability of resilient suspension mountings to reduce acoustic transmission through building structures and reduce the volume levels within the same room as they are playing. The rather curious nature of some of these claims has lead us to perform the following tests The tests were performed with a view to ascertain exactly what benefits are achieved by the use of such mountings.

The set-up.

For this test a set of three Bose Panaray 502 loudspeakers were used. This type of loudspeaker is typical of those mounted to walls in pubs, bars, clubs, and restaurants. The speakers were each fixed by means of their own brackets to a lightweight concrete block wall, again typical of the sort of structural wall used in recently built commercial / industrial premises.

Loudspeaker one was fixed to the structure directly by the use of plastic plugs and screws.

Loudspeaker two was fixed to the structure by means of a piece of unistrut in which was bolted two isolation mounts of the type used by the UK's leading night club chain. The bracket was then bolted to this assembly.


Loudspeaker three was not fixed to the structure at all, but was mounted on a loudspeaker stand and placed close to the wall. The floor was of solid concrete on earth construction.

All the loudspeakers were driven from the same amplifier and the signal was transferred by moving the connector between the boxes.
The tests performed with these boxes are limited to the frequency response of the loudspeaker itself. The Bose 502 does not perform well below 100 Hz. This is typical of most “full-range and sub” systems found in most modern entertainment venues. As this is the case we will be performing experiments with both types of loudspeaker. This section concentrates on the smaller so-called “full range” loudspeakers that are actually limited to performance above 100 Hz Measurements were taken with a Castle GA111 sound level meter and a SMAART Live acoustic analyser microphone positions were co-located in each case. Sound source was from SMAART Live’s internal pink noise generator.

Test 1
Does the mounting of a loudspeaker have any effect on the sound pressure levels in the room into which it is playing?

For this test we placed the measuring equipment in the room into which the loudspeakers were playing. A signal was applied to each loudspeaker in turn and the results logged.

The results were as follows.

Loudspeaker 1 (fixed direct), a measurement of 97.4 dBa was recorded.

The signal was disconnected and applied to the next loudspeaker

Loudspeaker 2 (resilient mountings), a measurement of 97.7 dBa was recorded.

Again the signal was disconnected and applied to the third loudspeaker.

Loudspeaker 3 (stand mounted), a Measurement of 98.6 dBa was recorded.

As these results were so close we decided to verify the production tolerance differences of loudspeaker two and three. These were swapped and the test on these repeated. The results were as follows.

Loudspeaker 2 (now 3) was 97.7 now 98.5. Loudspeaker 3 (now 2) was 98.6 now 97.4

The results were deemed to be within the manufacturers production tolerances for this type of loudspeaker, and as these particular units were old, but fully working the results were recorded as not being of measurable difference. From this it was decided that any result not more than 1 dB of difference and not of substantial difference in frequency content would be noted as being “of no difference”

The conclusion of test 1 was as follows.

Loudspeaker mounting systems for speakers of this type have no significant impact upon the sound levels within the room into which the music is being played.

This result follows what is widely accept within the industry. For years loudspeakers operating above the sub-bass range have been flown or mounted by various means yet no installer or operator has noticed any significant alteration in output purely as a function of the method of suspension.

Test 2

Structural Transmission.

Two locations were chosen to measure the results of this test. The first was in the next room immediately to the other side of the wall where the loudspeakers were mounted. The second position was in the room immediately above the room where the loudspeakers were mounted. The floor was of plasterboard, joists, chipboard, carpet construction.

Once again the three loudspeakers were fed with the same level of pink noise. The signal was again swapped from loudspeaker to loudspeaker, and measurements were taken

The results were as follows.
Loudspeaker 1 (Directly fixed)
61.8 dBa in the adjacent room
58.0 dBa in the room above
Loudspeaker 2 (Resilient mountings)
61.0 dBa in the room next door
57.1 dBa in the room above
Loudspeaker 3 (On a stand)
63.2 dBa in the room next door
56.5 dBa in the room above.

This time the sound pressure levels alone did not tell the whole story. A look at the plots (fig 1) show a noticeable reduction in transmission over a narrow bandwidth from the resiliently mounted loudspeaker compared to the directly mounted loudspeaker through the wall. It appears that this band is primarily the resonant node of the wall. Somehow the resiliently mounted loudspeaker seems to be damping this resonance. Below this node the resilient loudspeaker begins to have similar properties to that of the directly mounted loudspeaker all be it 2 to 3 db lower in level.

NOTE: The spike at 50Hz in this trace was a motor in the adjacent building and can be discounted

A look at the lower frequencies further show that both the wall mounted loudspeakers continue to perform similarly compared to the stand mounted one. The stand mounted loudspeaker exhibits a greatly reduced low frequency transmission.

From these results we can deduce the following conclusions.

A speaker mounted directly to a wall structure will exhibit similar levels of transmission into and through the structure as a loudspeaker which is in no way connected to that structure when operating in the mid to high frequency ranges. These frequencies can only be being transmitted into the structure by airborne means.

Loudspeakers directly connected to a resonant structure will begin to introduce direct resonances when operating in the ranges where the structure is prone to resonance. Damping the loudspeaker by means of resilient de-coupling mounts will reduce the transmission.

Further questions.

This test was performed upon one form of wall structure and one form of ceiling structure. It's results whilst indicative of a common type of structure cannot be said to be comprehensive.

The author begs further questions of what the results would be when performed on various types of alternative wall, ceiling, and floor structures.

It is intended at a further date to carry out a set of more comprehensive testing with a range of wall ceiling and floor structures.

The effectiveness of mounting a sub-bass enclosure on resilient suspension mounts.

Experiment 2

A Vitavox Thunderbolt sub-bass horn was mounted on a typical commercial / industrial floor as is found in many night clubs and concert venues.

Measurements were taken directly in front of the cabinet, at the other side of the room, and in the building next door.

One set of measurements were taken with the cabinet laid directly onto the floor, a second set were taken with the same cabinet mounted on foam pads. The foam pads were of a soft nature and the cabinet would wobble if rocked by hand.

The measurements can be seen in plots 2, 3 and 4.

Sound levels were as follows.

Position 1. 1.5m from cabinet.

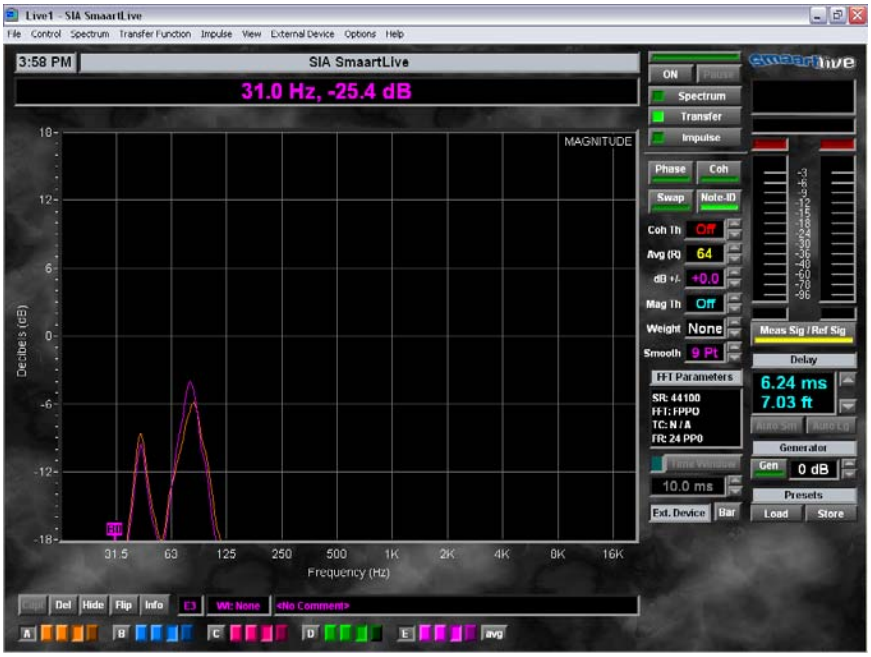
Direct mounting 95.2 dB
Foam mounting 95.2 dB

Position 2. The other side of the room.

Direct mounting 85.2 dB
Foam mounting 84.7 dB

Position 3. Next door.

Direct mounting 59.9 dB
Foam mounting 59.5 dB



Traces in orange = direct mounted.
Traces in pink = Resilient mounted

The conclusion

The results when viewed with the frequency plots are very compelling.
Mounting a floor mounted sub-bass enclosure on resilient suspension mounting makes no difference whatsoever to bass transmission into the building structure.

Manufacturers go to extreme lengths to design non resonant enclosures for their systems. This results in a cabinet that has significantly less acoustic output from it's walls compared to it's radiating surface, (be that drive unit or horn mouth). As the bass cabinets are omnidirectional the output from the radiating surface will enter the building structure with greater force than the resonances from the cabinet walls. The long wavelength and low frequency of the acoustic output from these bass enclosures also lends itself to exciting virtually every resonant planar surface it comes into contact with. This general excitement of a room is of significantly greater magnitude than any cabinet resonance transmitted by direct radiation. Unless these aspects of acoustic transmission into a building are properly addressed prior to de-coupling the loudspeaker cabinet, no noticeable effect will be had from any attempt to de-couple the bass cabinets.

Further work required.

Whilst various assumptions can be made regarding the behaviour on intermediate floors of various construction more work needs to be done to record the results in such situations.