OPTIMUM POSITIONING OF DUCT SILENCERS IN SOUND-RATED CONSTRUCTION

Mei Q. Wu, Tom Paige and Donald L. Allen
Vibron Limited, 1720 Meyerside Drive, Mississauga
Toronto, Ontario, L5T 1A3

1.0 Introduction

In sound-sensitive spaces, particularly sound studios constructed with high transmission loss partitions and ceilings, penetrations for mechanical system air-handling ducts are an important concern. Typically, duct silencers are provided at or near the penetrations to maintain the STC ratings of the walls and ceilings. This paper looks at factors related to the optimum location of duct silencers between spaces requiring sound-rated constructions. The constructions studied are based on the actual constructions used in the CBC Broadcast Centre in Toronto.

2.0 Scope of the Study

Two configurations were studied. The first case is shown in Figure 1. An air-handling duct penetrates a wall separating a noisy space and a quiet space, such as a studio, in order to supply air to the quiet space. A duct silencer is used to attenuate the noise which breaks into the ductwork inside the noisy space. If the silencer is located completely inside the noisy room, then the noise breaking into the ductwork or the silencer close to the wall will not be attenuated. If the silencer is located completely inside the quiet space, then the noise can break out from the silencer into the quiet space before it is attenuated.

The second case, as shown in Figure 2, is similar to the first case. However, in this case, the duct does not terminate in the quiet space. Instead, it runs through the quiet space and terminates in the next room. Noise intrusion in the quiet space is caused by noise breaking out of the duct into the room. The objective of the study is to determine for each configuration, the optimum position of a duct silencer to minimize noise transmitted to the quiet space.

3.0 Analysis Methodology

A computer program was developed to calculate the resultant noise levels inside the quiet space under various assumed parameters. The program was developed based on the noise calculation methods provided in the ASHRAE Handbook and prominent noise control books (Ref.'s 1, 2 and 3).

The following base parameters were assumed in the calculations:

* noise levels in the noisy room are 80 dB in each octave band;
* the thickness of the wall separating the noisy and quiet space is negligible;
* the duct dimensions are 30" x 14";
* there is 20 feet of duct in the noisy room and 10 feet (case 1) or 20 feet (case 2) of duct in the quiet room;
* the duct and silencer are both made of 22 gauge galvanized steel;
* the silencer is 5 feet long and has insertion losses of 4, 7, 14 and 25 dB in the first four octave bands, respectively.

The effects of varying silencer wall thickness and insertion loss were also investigated.

4.0 Summary of Results

4.1 Case 1; Duct Terminating in Quiet Space

a) Lower noise levels can be achieved in the quiet space when the silencer is located completely inside the quiet space. This conclusion is expected because when the duct terminates in a space, the break-out noise is usually negligible compared to the noise radiated from the termination. When break-out noise is not of concern, a longer run of silencer in the quiet room will provide more attenuation and will result in a lower noise level in the room.

b) When the silencer has high insertion loss (e.g. 8, 14, 25 and 40 dB in the first four octave bands respectively), the difference between locating the silencer completely inside the quiet space and locating the silencer completely inside the noisy space can be 6 dB in the first octave band and 14 dB in the fourth octave band.

c) When the silencer has a thicker wall (e.g. 14 gauge galvanized steel), the difference between silencer locations will be less than 1 dB.

In summary, the silencer performance is maximized by placing it in the quiet room, although sensitivity to silencer location is reduced with increased silencer wall thickness.

4.2 Case 2; Duct Passing Through Quiet Space

a) Above and including the second octave band, break-out noise levels are lower when the silencer's centre is at the wall compared to other silencer locations. The difference in the resultant noise levels is in the range of 2 to 7 dB. The difference is higher when the silencer has higher insertion loss and the lower when the silencer has a thicker wall.

b) First octave band noise levels are minimized if the silencer is completely located inside the quiet space. The noise levels can be 3 to 4 dB lower than if the silencer is located completely inside the noisy room. This noise level difference does not depend much on the silencer insertion loss or the silencer wall thickness.

In summary, the silencer should be placed symmetrically between rooms for optimum performance, unless the noise in the noisy room is predominantly first band, in which case silencer placement inside the quiet room is optimal.

5. Conclusions

An optimum silencer location can usually be found to minimize noise transmitted between spaces. The optimum location depends on many factors including silencer wall thickness and insertion loss. The optimum location of each individual case should be calculated based on the ductwork configuration and other parameters of that individual case. The above investigation provides only general guidelines for selecting the silencer location under some typical conditions.

6. References

1. American Society of Heating, Refrigeration and Air-Conditioning Engineers, ASHRAE Handbook, Chapter 52 Sound and Vibration Control.

2. Cyril. M. Harris, Handbook of Noise Control. McGraw Hill, New York.

3. Leo L. Beranek, Noise and Vibration Control. McGraw Hill, New York.

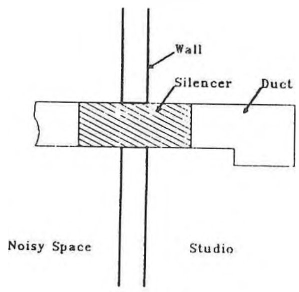

Figure 1

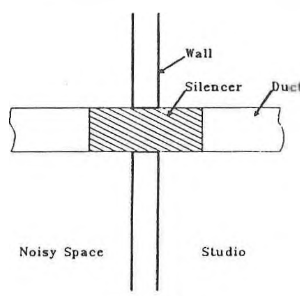

Figure 2