Sound Advice

Helpful Information from ***Stewart Acoustical Consultants*** 919-858-0899
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HVAC DESIGN - BASIC GUIDELINES

The following is a very condensed guide to initial design of quiet HVAC systems concentrating on the problems we encounter the most. A much more detailed guide, available as a paperback book from ASHRAE, is A Practical Guide to Noise and Vibration Control for HVAC Systems by Mark Schaffer. It is strongly recommended.

Locate all fans and noisy equipment as far away from critical spaces as practical, and never on a roof directly over a critical space. Make sure the roof under rooftop units is as rigid as possible. Consider flexibility of roof or upper floor structures in selecting vibration isolation. Make mechanical rooms large enough to allow some silencing before ducts exit. Use round duct near fans when the duct must pass over critical areas. Use rectangular duct near fans over non-critical areas. Recognize that duct linings, plenums, or silencers will usually be needed to silence fans. Less-expensive, low-frequency tuned silencers are often the best silencer choice. Turns and thin linings help reduce high-frequency noise but have little effect on low rumble. Thick linings, or rue plenums (large in comparison to connected ducts) provide the most reduction of low-frequency sound. Recognize that unlined round duct is an almost perfect conduit for fan noise with little loss. Fan noise must be silenced before entering underground round ducts.

Carefully select the most efficient fan for the application, as it will be the quietest. Poorly chosen inefficient fans can produce more noise than an efficient fan that moves ten times more air. If the fan is close to a critical space, consider an airfoil fan and silencers since the low rumble of forward-curved fans can be difficult to silence. Avoid use of several small primary air handlers since it is difficult or impossible to get sound data for them. For variable volume applications, use variable speed controls, not inlet vanes. Do not place fan-powered boxes of variable volume systems over critical areas. Make sure there is lining downstream from such boxes. Recognize that the NC noise ratings of these devices assume certain conditions that may be different from actual system and room design. Read all footnotes explaining the ratings carefully.

Minimize flow velocities in ducts consistent with needed noise levels. Use the neck size of the properly selected diffusers as a guide. Flow velocity within 10 feet of the neck should not exceed the velocity in the neck. It should not be more than about 25% higher in the next 10 feet. A common problem is a quiet diffuser directly on the side of an exposed duct with high velocity flow in the duct. The duct velocity should not exceed the diffuser neck velocity.

There is much confusion about diffuser NC ratings. The rating applies to one diffuser in a room with a "room factor" of usually 10 dB. Beware that some manufacturers use room factors more than 10 dB in rating their diffusers. Such diffusers are noisier than a diffuser with the same NC rating based on a 10 dB factor. The room factor is the difference between the sound power introduced and resulting sound level in the room. It depends on room geometry and absorption in the room. Most rooms have multiple diffusers and room factors different from 10 dB. Thus, the catalog rating must be adjusted to get the expected noise level. In addition, to achieve the catalog rating, the duct attached to the diffuser must be straight for at least 2.5 to 3 equivalent diameters. A common problem is buildings designed with inadequate plenum space to allow this. A turn near the diffuser results in uneven distribution of air over the diffuser and strongly increased noise. Dampers directly behind diffusers also must be avoided.