Sound Advice

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

These are basic guidelines for designing a HVAC system to meet the LEED for Schools prerequisite. Generally, the system will be a central system with one main fan serving several classrooms. Systems with a single fan per classroom can work when the fan is in a closed mechanical space with ducted supply and adequate silencing of return. Fans within the classroom typically are not satisfactory.

1. Do not place large mechanical equipment immediately adjacent to classrooms. Large air handlers that serve several classrooms and large mechanical rooms should not go above or next to a classroom or other core learning space, especially if there is a thin roof, or only a single wall between the two spaces. It makes isolation of the sources difficult. Also, main ducts typically end up over classrooms, and the design is problematic.
2. No main system ducts above classroom ceilings - utilize hallways, storage areas, and noncritical areas such as bathrooms.
3. Provide distance between main fans and first classroom takeoffs. If using rectangular duct and flex duct, typically 20-40 feet is enough space to reduce noise through a silencer or use of duct liner. Round ducts cannot easily be silenced and may require much larger distances and use of more expensive double wall perforated inner liner duct.
4. Use rectangular ducts for main trunks over non-critical spaces. Rectangular duct provides useful low frequency noise reduction as sound travels down the duct.
5. Avoid flat oval ducts – for now. Flat oval duct is known to be poorer at attenuating sound down the duct, and there is no published dB/ft data or algorithm to calculate its noise reduction properties. Until better information is available, we recommend avoiding it.
6. Do not use round ducts if possible where sound attenuation down the duct is needed (main trunks near the main fans). Round duct is a poor choice for this. 10 feet of 1" internally lined rectangular duct is as effective as 35 feet of 1" internally lined round duct. Unlined round duct provides essentially **NO** sound attenuation.
7. Incorporate wide turns in large ducts - A 62" turn can provide the equivalent noise reduction of 20-25 feet of rectangular duct. Lined turns also help at higher frequencies.
8. Use fiberglass internal duct liner where permitted – GreenGuard™ certified duct liners are available now as are low formaldehyde content internal duct liners. Formaldehyde free external duct wraps are available. Other duct liners with good acoustical performance are cotton, melamine foam, and polyimide foam.
9. Generally do NOT use closed cell (elastomeric) foam products as an internal liner – most perform poorly. Some products such as Armacell AP Coilflex are closer to the performance of fiberglass, but require careful estimation of actual performance as limited data is available.
10. Use low frequency tuned low pressure drop silencers where needed. A typical silencer such as an IAC 7LFL (seven foot long) is equivalent to about 25 feet of 1" lined rectangular duct. Less effective silencers are available with either no fill or a film between the perforated metal and fill if required.

11. To reduce breakout noise use mass loaded vinyl duct wrap. Alternatively use gypsum lagging where required or consider round duct. The vinyl wrap is more effective when good sound attenuation is required down the duct. Gypsum lagging stiffens the duct and greatly reduces the low frequency sound attenuation often needed down the duct thus carrying the low frequency rumble problem downstream. Round ducts are highly effective at limiting noise breakout, but are also not good for attenuation of low frequency noise down the duct. Both are still very useful tools in the right circumstance.
12. Use VAV valve systems, not fan powered boxes - VAV boxes with valves and no fans are much easier to comply with requirements, even if over a classroom ceiling (not recommended over ceiling as a design practice). Fan powered boxes are much more difficult.
13. Closet located systems can work, but system must be efficient with low sound levels within enclosed closet with seals on door, with good silencing of return and ducted supply over the ceiling with silencing.
14. Use greater than normal lengths of flex duct at diffusers when ducts downstream of VAV boxes are not lined – 6 to occasionally 9 feet of flex duct will be required. Flex duct Insertion Loss (IL) must be specified by frequency per those reported in ASHRAE chapter 47 to avoid flex duct with poor acoustical performance from being used.
15. Use suspended mineral fiber ceiling panels to hide and reduce noise from VAV boxes and ductwork. Use NRC 70 or greater rated panels to comply with room acoustics requirements. Systems in the room with the class, or exposed via an open closet top, or with exposed ducts should be avoided at all cost. Avoid designs with exposed roof deck, as noise isolation and HVAC noise control becomes problematic.
16. Connect flex duct to diffusers with round necks - avoid square to round transitions added to diffusers with square necks unless adequate information is provided as to their effect on NC ratings. Diffuser noise is driven by the FPM (feet per minute) airflow speed. If you take a 12"x12" air device and place a 10" neck, you have reduced the area to 54% of that reported by the manufacturer, leading to 183% higher airflow rate and leading to 15 dBA increase (or a 15 point NC rating increase).
17. Do not use opposed blade dampers (OBD's) behind diffusers – OBD's and similar devices when placed behind a diffuser can increase the noise 5-7 dB just by their presence and over 20 dB when closed down. Often it is not readily disclosed in manufacturer data (found in the details).
18. Do not use manually adjustable deflectors – this leads to indeterminable NC levels, and is generally bad practice from a noise control standpoint. People are people and they will adjust them and then complain about the noise levels.
19. Specify quiet NC Ratings for diffusers – This is the least expensive noise control you can make. Using quiet air devices will make it much easier to control noise from fans and VAV boxes and comply with requirements. Specify manufacturer's NC ratings that are NC 25-28 or less for typical classrooms. This may require using a larger neck and flex duct size. For typical classrooms with several air devices this results an NC rating in the room of not more than NC 30-33 and an A-weighted sound level of 35-38 dBA, allowing control of fan noise levels to 44 dBA. If air devices dominate the noise levels, fan noise then would have to be controlled to 38 dBA or less.
20. Have a professional advise you along the entire design process – This sheet is the tip of the iceberg of expertise we can provide. A little input at every stage of design can save countless hours of design time and produce a less costly and more effective design.