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Achieving Acoustic Comfort with Hi-rise Fan Coils

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Achieving sound and thermal comfort in today's hi-rise condominiums can be challenging where there's a significant amount of glazing. There are interesting times ahead when Zero Energy Buildings, ZEB, will force our love affair with glass building envelopes, to more efficient designs but until then, we'll forge ahead and try to achieve optimal comfort.

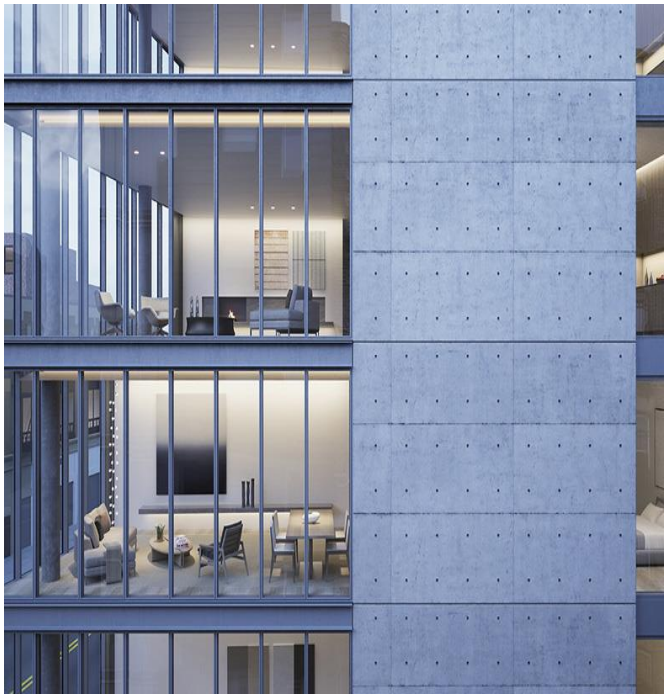

Fig. 1 Typically 60% or greater of the building envelop is glass in todays' condominium

This article will focus on acoustic comfort which has become almost as important as thermal comfort in today's office, hi-rise residential, and hospitality markets.

As already mentioned, achieving a thermal balance can be challenging with large percentages of the building envelope being glass but we know the load so it's a matter finding a way to "jam" in the BTU's we need. Higher thermal loads mean higher airflows and larger ductwork where space is at a premium. Our architect friends are reluctant to give up any precious ceiling plenum space and dislike bulkheads so airflows are often maximized using the smallest ductwork possible.

This can lead to noise issues if not properly reviewed but we often don't have the information needed to do an acoustic analysis when we're designing our mechanical systems because the architect hasn't gotten there yet, or they're waiting on an owner decision. Wall, ceiling and floor coverings all impact the "room affect" which greatly impacts the space sound levels and this information is often not available in the early design stages.

Fig. 2 Typical fan coil furred in with supply and return grill

The sound source is the fan coil unit which presents a few sound paths to the tenant space. We have the fan discharge path through the ductwork and diffusers or plenum box, the return air path through unit or wall mounted return air grill, the radiated path through the unit cabinet itself, and the structure borne path which is the units disturbing frequencies being transmitted to the structure. This classic picture from the ASHRAE archives in Fig.3 illustrates the 12 possible noise paths from an HVAC unit.

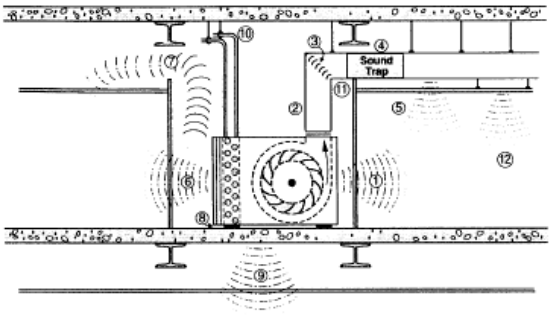

Fig. 3 Possible noise paths from an HVAC unit

These "multiple complex noise sources" are often difficult to isolate and treat.

The radiated noise path is usually taken care of by the drywall enclosure. (STC rating) A 4" metal stud wall with 5/8" drywall and 2" of 3lb/ft^3 insulation will offer a transmission loss shown in Table 1.

Octave Bands Frequency (Hz)								
31	63	125	250	500	1000	2000	4000	8000
9	14	23	40	45	53	47	48	38

Table 1 Transmission loss values for 4" metal stud wall with 5/8" drywall and 2" 3lb/ft^3 insulation.

The structure borne noise can usually be mitigated with ¼" deflection neoprene pads. The supply air path typically does not require attenuation in a ducted system provided the first diffuser is not serving a noise sensitive area like a bedroom. The non-ducted units can be problematic but often an acoustic plenum box provides enough attenuation to meet the desired sound level. The return air path can be the most difficult to attenuate because of the "line of sight" to the noise source and minimal absorption by a standard return air louver. An offset grill and/or acoustic R/A louver may be considered as well as the location and orientation of the unit.

So how can we ensure that our HVAC design will meet the acoustic expectations of our customers? Architects will have an acoustician on the design team of a theatre or performing arts center but it's unlikely to have an acoustic consultant reviewing the HVAC system in a condominium. Most manufacturers provide a 1/3 octave chart showing the sound power levels in each octave which is useful only if used as part a sound analysis.

The Temspec solution is to offer a sound analysis of your fan coil system design as part of our product applications support service. To conduct the analysis, we need the following:

- duct layout
- floor plan
- unit installation detail
- targeted sound level expressed as NC, RC or dBA.

We'll provide a report outlining the measures required, if any, to meet your space sound requirements. In most cases, the noise attenuation can be designed into, or supplied with the unit for field installation.

Fixing noise problems in the field is costly both monetarily and to reputations. Let Temspec review your system to help ensure a quiet design.

Table 2 provides typical sound level targets for different condo spaces.

Area	**NC Level (noise criteria)**	**RC level (room criteria)**	**dBA Level**
Bedroom	25-35	25-35	35-40
Dining Room	30-35	25-35	40-45
Living Room	30-35	25-35	40-45
Family Room	35-40	30-40	45-50
Kitchen	35-40	30-40	45-50
Hall Way	35-40	35-35	45-50

Table 2 Typical sound levels for condominium spaces

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