BRIEF TECHNICAL NOTES ON NOISE CONTROL

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NOISE CONTROL FOR HVAC EQUIPMENT

120 dBA! That's the fan noise on the field at the Metrodome in Minneapolis. But in this case it's from the people. That's also about as loud as being under a plane taking off or next to a 1500 kW emergency generator.

How can one create quiet space when it's that loud in a room? How can the noise ordinance be satisfied? Those are some of the questions asked by architects and engineers.

New buildings, additions and remodeling often involve HVAC equipment that creates high noise levels. ESI Engineering, Inc. (ESI) offers consulting services in noise/sound control to help you create quiet space.

NOISE ORDINANCES SET LIMITS

Most cities have their own noise control standards for land use or they have adopted rules from an agency such as the PCA. These standards describe the limiting sound levels for preservation of public health and welfare consistent with speech, sleep, annoyance and hearing within areas grouped according to land use activity.

Noise standards are generally classified according to land use activity such as: 1) residential occupancy, 2) public use and retail trade, 3) manufacturing and commercial transportation, and 4) undeveloped land and water areas. Within each land use category there is a daytime limit (7am-10pm) and a nighttime limit (10pm-7am). These standards limit the source sound levels at the location of the receiver or area of human activity, usually at the property line.

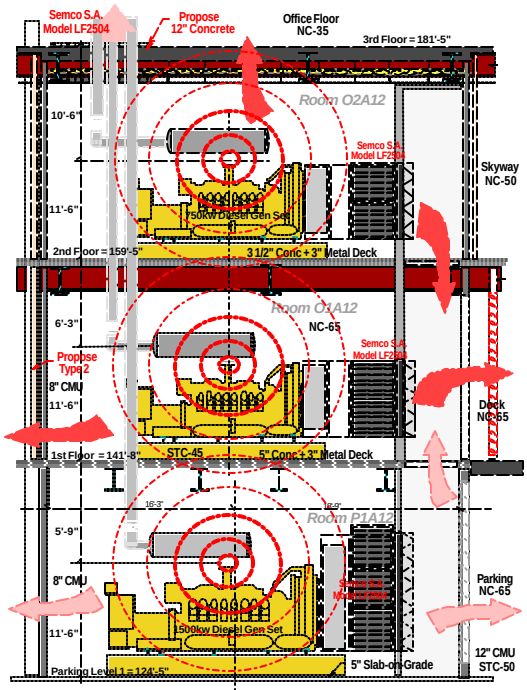
Daytime and nighttime limits are further subdivided by the noise exceeding the limit 10 percent of the time and 50 percent of the time for a one-hour survey. Continuous HVAC noise falls into the 50 percent limit. A typical standard for a residential area is as follows:

Typical Noise Standards For Residential Areas

	Daytime		Nighttime	
	L_{50}	L_{10}	L_{50}	L_{10}
Residential Area	60 dBA	65 dBA	50 dBA	55 dBA

GENERATORS CAN BE NOISY WITH PEAK SHAVING

Utility costs for large facilities include demand charges that can amount to 30 percent of monthly electrical costs. Demand is measured in kilowatts and is the average electrical load over a small period of time, usually 15 or 30 minutes. Electrical demand peaks can be lowered in several ways but generally result in generating power on site, often called ***peak shaving.***



Section View - Emergency Generators

Most large buildings are now constructed with generators to keep equipment operating during a power failure. These generators can be sized to provide power availability during peak periods as a peak shaving strategy to reduce utility costs.

Emergency generators are typically very noisy and during a power failure or emergency condition most cities make exemptions from the noise ordinance but not for peak shaving use. Such usage could continue for several hours. Consequently, better noise control procedures must be designed.

ROOF-TOP HVAC NOISE IS SOLVED IN MANY WAYS

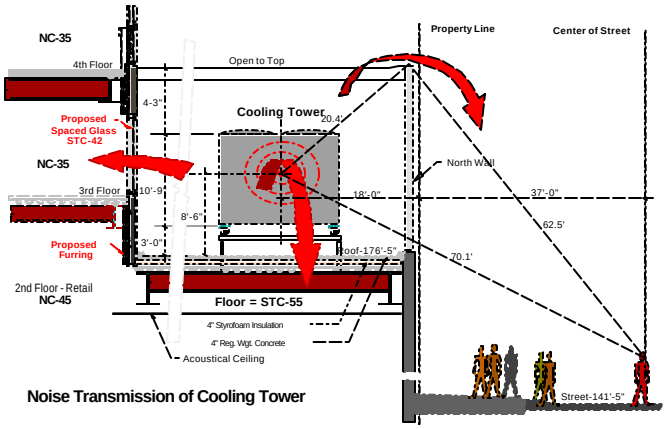
The most frequent complaints about rooftop noise are likely to occur at night when the ambient noise is lower than

during the daytime hours. Some of the noise problems can be reduced by the way the unit is designed such as 1) eliminating belt squeal, 2) use of soft starters, 3) reducing fan speed as capacity is reduced and 5) the use of variable frequency drives.

When locating HVAC units on the top of a building, it is best to position the unit over the least noise sensitive area. The need for vibration isolation requires evaluation early in the design process or else the noise criterion for the spaces directly below may not even be achievable.

The noise of a rooftop installation may propagate to other nearby commercial or residential buildings at or above the elevation of the HVAC unit. In such instances, the addition of sound attenuators on the intake and discharge or the installation of barriers in the source-receiver path may be required.

Specially constructed screens and barriers can be used to control noise. Also, buildings or parts of buildings, earth berms or other formations can be used as attenuation devices.



Noise Transmission of Cooling Tower

SCREENS AND BARRIERS

Screens and barriers along city freeways and atop low-rise buildings are very effective in controlling noise. Sound waves traveling over the barrier are diffracted, creating a quiet zone on the side opposite the noise source. The sound attenuation is a function of the geometry of the diffracted path versus the direct path.

Barrier attenuation inside a building is usually less than predicted. For example, noise over a partition is reflected from the ceiling and walls and is flanked around corners, etc. All of this reduces the effectiveness of the barrier but can be analyzed as part of the room acoustics.

A screen or barrier need not be massive but should have a minimum STC-rating (sound transmission class) of STC-30. It should be impervious to force the sound waves into a diffracted path.

DUCT SILENCERS ARE PROVEN WITH LAB TESTS

In many cases duct lining alone cannot sufficiently attenuate the noise from HVAC equipment. Duct silencers provide good noise reduction because they are laboratory tested under controlled conditions.

IAC developed the principles of dynamic insertion loss and self-noise ratings for forward flow (+) and reverse flow (-) conditions for silencers. Forward flow occurs when air and sound-waves travel in the same direction, as in an HVAC supply system or a fan discharge. Reverse flow occurs when sound-waves and air travel in opposing directions, as in a typical return-air system.

Since attenuation values are generally higher in the first five octave bands in the reverse flow mode compared to the forward flow mode, more economical silencer selections can often be made on return-air systems.

LARGE PLENUMS PROVIDE SOUND ATTENUATION

When large values of sound attenuation are required, a sound absorption plenum will also be advantageous. The methods for approximating the acoustic attenuation of a plenum depend on the sound absorption coefficients of the plenum lining, the exit area, wall surface area, and the distance between the entrance and exit.

For sound frequencies sufficiently high that the wavelength of sound is less than any of the plenum dimensions (width, height, or length), the methods are accurate to a few decibels. At lower frequencies, when the wavelength of sound becomes greater than the plenum dimensions, the attenuation approximations are conservative and the actual sound attenuation exceeds the approximation.

SUMMARY

New buildings, additions and remodeling can involve HVAC equipment creating high noise levels. Remember:

- City Noise Ordinances set the limits
- Generators can be noisy with peak shaving
- Rooftop HVAC noise is solved in many ways
- Screens and barriers work well outside
- Duct silencers are proven with lab tests
- Large plenums can provide sound attenuation

ESI ENGINEERING, INC.

ESI Engineering, Inc. (ESI) offers consulting engineering services in noise and vibration. These services include:

- Establishing Noise Criteria
- Measuring Actual Conditions
- Selecting Isolation Materials

ESI has experience in building construction and equipment installation in many industries.

We would like to serve you. Please contact us at:
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