

NOISE CONTROL IN HVAC SYSTEMS

As the HVAC system regulates and sends supply or return air through a complicated maze of ducting and channels, it also generates a number of sounds at various stages.

The sound is generated by mere movement of air at a certain pressure, then there are sounds that emanate from vibration of the ducts, operation of equipment like the VAV stations etc. All these sounds cumulatively add up and often exceed the threshold of tolerance and thus are interpreted as noise.

While silent and noise free operation of the HVAC system is a desirable characteristic in any situation, it assume added and critical significance in certain specific applications such as in the hospitality or healthcare sectors.

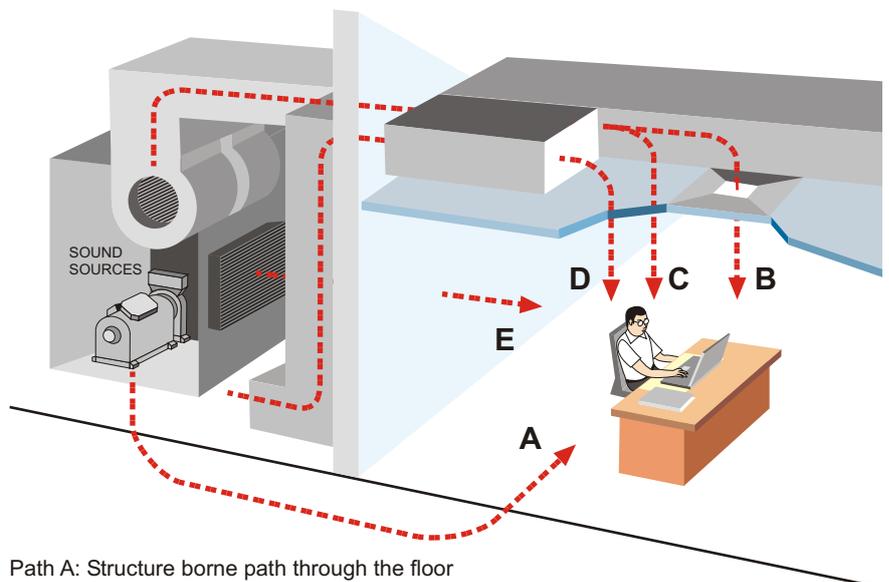
Let us first understand the types of sound that emanate from the system and their transmission.

TYPES OF SOUND TRANSMISSION

Airborne Sound: Airborne sound refers to sources which produce sound by directly setting the air around them into vibration.

Impact Sound : Impact sound refers to sources which produce sound by impulsive mechanical excitation of part of a building (e.g. by footsteps, electric light switches, slamming doors). Many sources of impact sound also produce significant levels of airborne sound.

Structure-borne Sound: Structure-borne sound is often used to refer to sound that travels for long distances via the structure, especially in connection with vibrating machinery linked directly to the structure



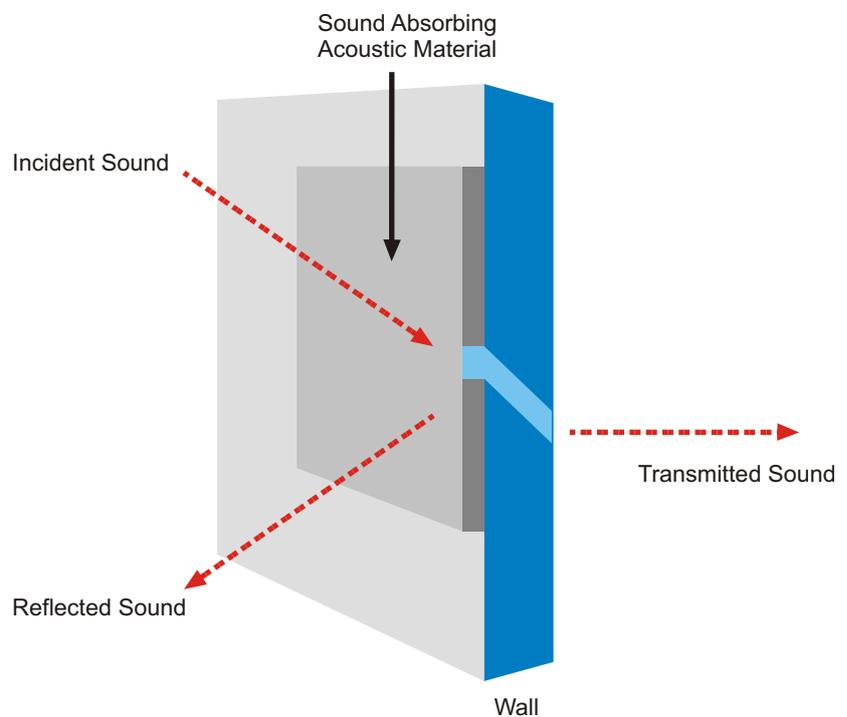
Path A: Structure borne path through the floor
 Path B: Airborne path through supply air system
 Path C: Duct breakout from supply air duct
 Path D: Airborne path through return air system
 Path E: Airborne path through mechanical equipment

SOUND ABSORPTION V/S SOUND INSULATION

Sound Insulation: Sound insulation refers to the act of impeding the transmission of sound from one area to another or from a source to a receiver. Typical examples include the sound insulation between adjacent apartment units or between a busy highway and one's bedroom. The best way to improve the insulation between two areas typically involves the use of heavy materials such as concrete or gypsum board.

Sound Absorption: Sound absorption refers to the phe

nomenon whereby some or all of the sound energy incident on a surface is either converted into heat or passes through the absorber.



HVAC NOISE CONTROL

1) Duct Velocities

Air velocity within a duct system influences the noise levels significantly. Regenerated noise can be created by transition pieces, bends, dampers, grilles and diffusers. Regenerated noise can be avoided by limiting the air velocities within the duct system.

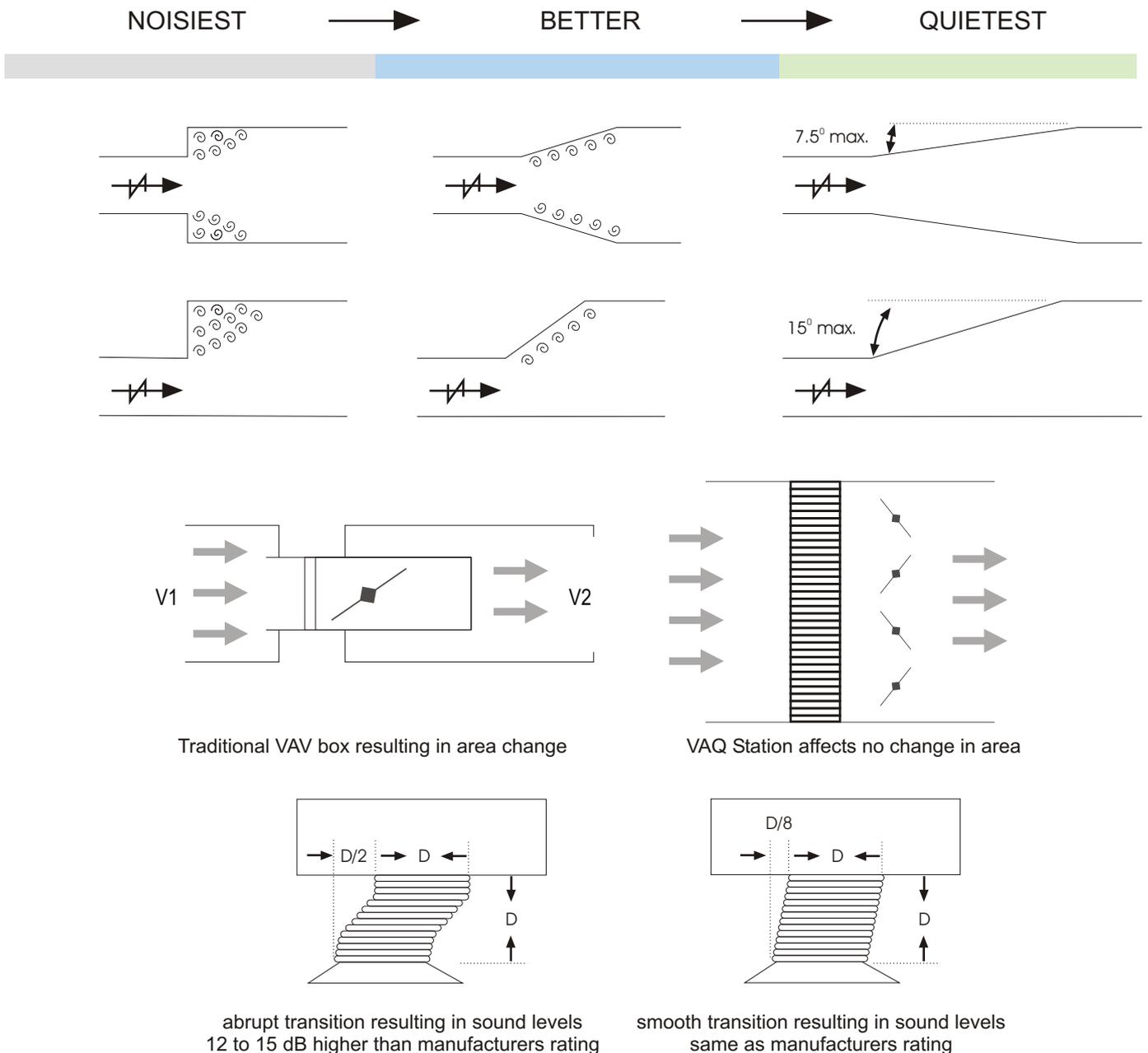
NR or NC Design requirement	In-duct air velocity (m/s)		
	Main	Branch	Final run-outs
20	4.5	3.5	2.0
25	5.0	4.5	2.5
30	6.5	5.5	3.25
35	7.5	6.0	4.0
40	9.0	7.0	5.0

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2) Regenerated noise from duct elements and VAV boxes

Apart from noise of fans, aerodynamic sound is generated at duct elbows, dampers, branch takeoffs, air modulation units, sound attenuators, and other duct elements. Produced by the interaction of moving air with the structure, the sound power levels in each octave frequency band depend on the duct element geometry and the turbulence of the airflow and the airflow velocity in the vicinity of the duct element. Duct-related aerodynamic noise problems can be avoided by

- Sizing ductwork or duct configurations to keep the air velocity low
- Avoiding abrupt changes in duct cross-section area
- Providing smooth transitions at duct branches, takeoffs, and bends



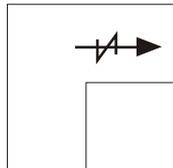
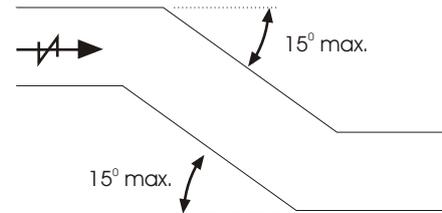
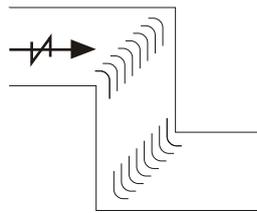
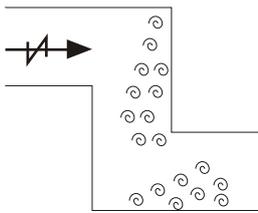
NOISIEST



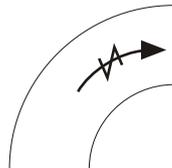
BETTER



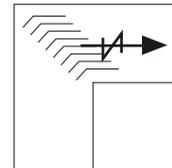
QUIETEST



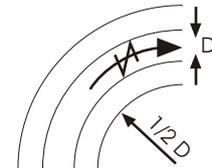
Square



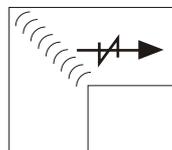
Long Radius



Square with Long Trailing Edge vanes

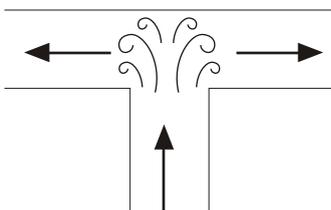


Long Radius with vanes



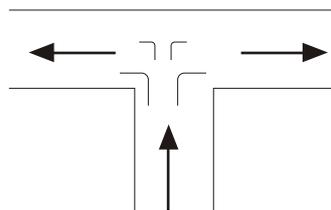
Square with short vanes

NOISY



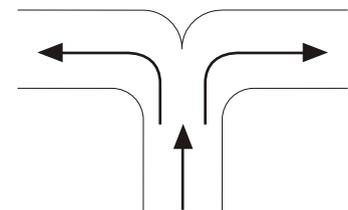
No vanes to direct airflow

BETTER

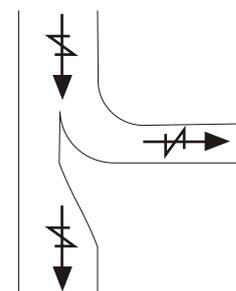
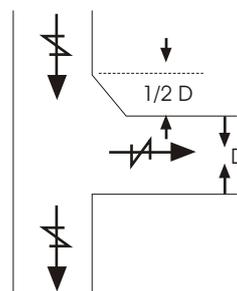
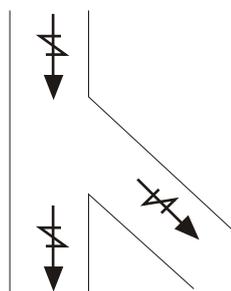
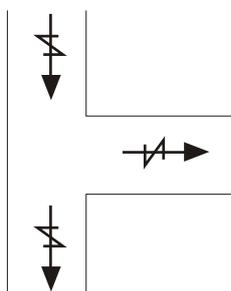


Two square elbows back-to-back

BEST



Dual radius split



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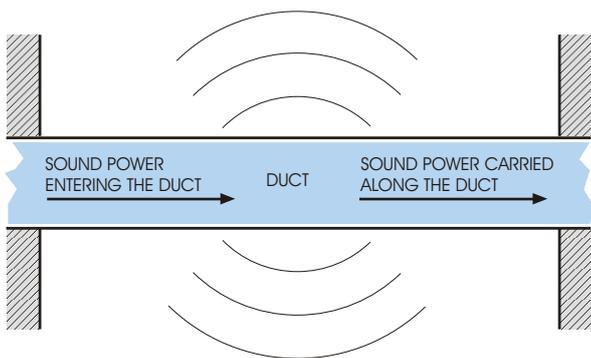
3) Sound radiated through ducts

An HVAC fan and its connected ductwork can act as a semi closed, compressible fluid pumping system where both acoustic and aerodynamic air pressure fluctuations at the fan are transmitted to other locations in the duct system.

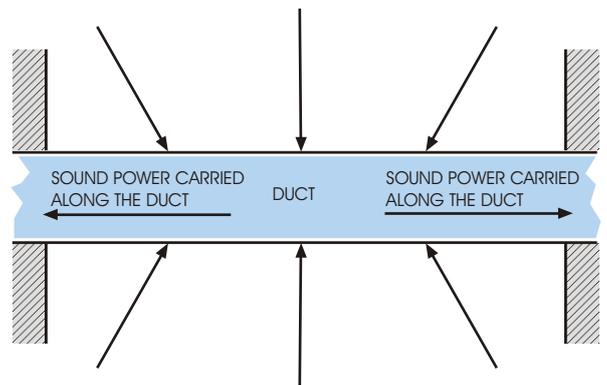
Breakout is the sound associated with fan or airflow noise inside a duct that radiates through duct walls to the surrounding area.

Sound that is transmitted into a duct from the surrounding area is called breakin noise which is carried further in the ductwork.

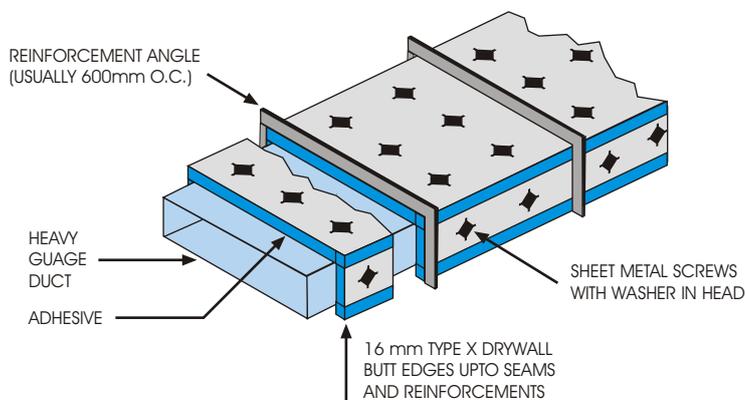
Both types of these noises can be avoided by using reinforcements on ducts and by using decoupled drywall enclosures or acoustic lining on the ducts.



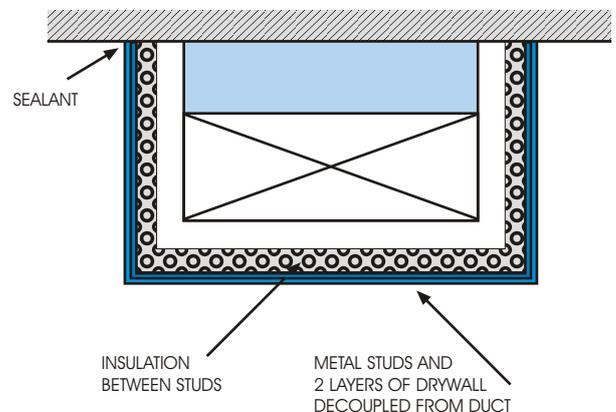
Duct Breakout



Duct Breakin

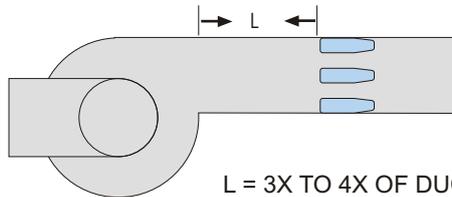
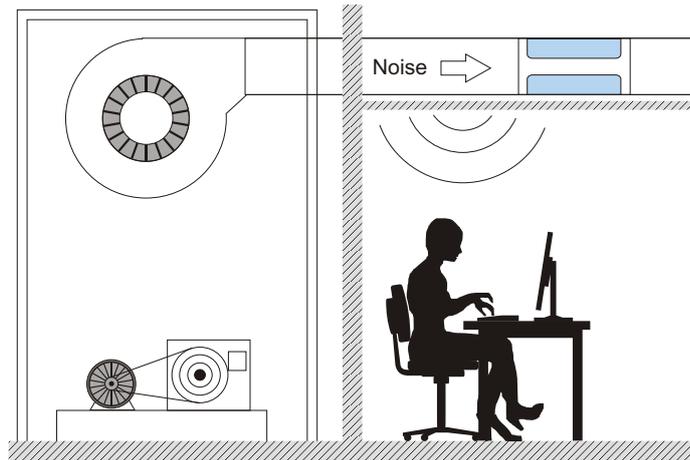


Drywall Lagging on Duct

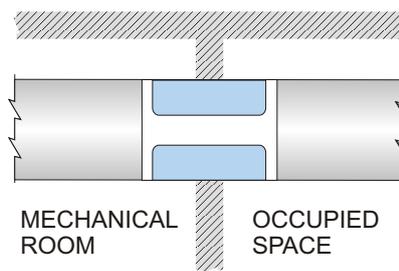


Decoupled Drywall Enclosure

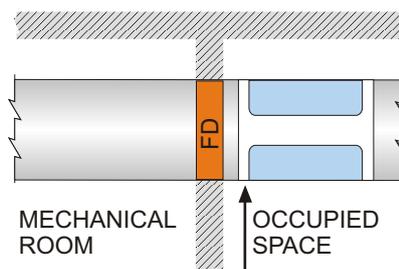
Duct breakin and breakout noises radiated through duct can be also avoided by using properly selected sound attenuator at suitable location and placement as mentioned here and hence avoid these noises.



$L = 3X \text{ TO } 4X \text{ OF DUCT DIAMETER}$

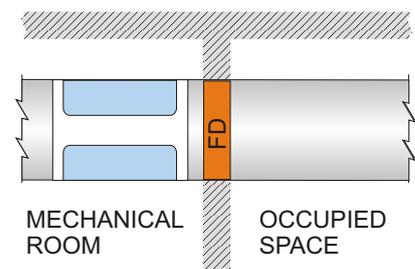


Best Silencer location if no Fire Damper



Heavier Silencer Walls may be required to stop breakout noise

Alternate Silencer location with Fire Damper

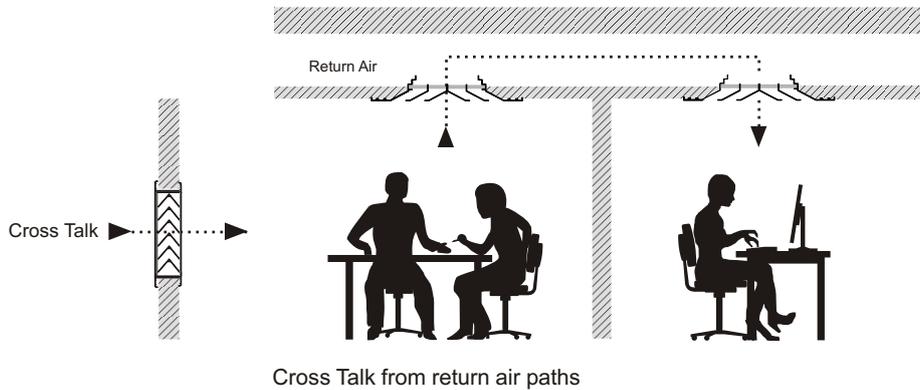


Best Silencer location with Fire Damper

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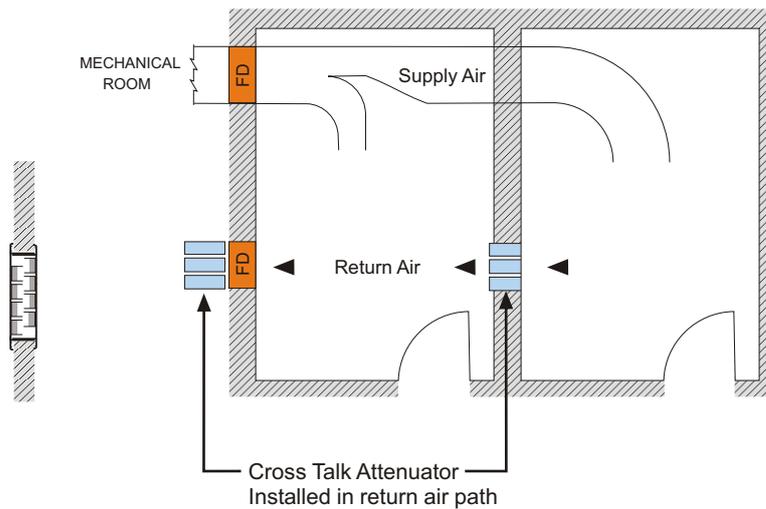
4) Cross Talk

When two adjacent or closely positioned rooms are sharing the same supply air ductwork or return air path, sound travels from return air path or through ventilation transfer at door/partition.



Acoustic Transfer Grilles

Installed in areas where ventilation is required and at the same time avoid cross talk from the adjacent room



CONAIRE PRODUCTS FOR HVAC NOISE CONTROL



A. VAQ Station : Perfect solution for climate control with optimised indoor air quality. Affects no change in area and provides smooth transitions, to avoid regenerated noise problem.



B. Sound Attenuator : Provides effective barrier to sounds radiated through supply air duct works and cross talk from adjacent rooms.



C. Acoustic Transfer Grille : Provides ventilation transfers while avoiding cross talk from adjacent rooms.