

Building Noise Control

S/R Chptr 19

Noise Reduction

3 Components

1- Reduce noise generation at source

-and installation proper equipment selection

2- Reduce noise transmission point to point

- proper selection and installation of construction material

3- Reduce noise at the receiver

- meet noise criteria level through appropriate acoustical treatment

and possibly-Combination of all

Design Considerations

- 2 things happen with the reflection of sound in a room:
- 1- the noise level (volume) is greater than it would be in an open field
- 2- there is a delay factor- after the sound source has stopped some sound will persist in the space- *reverberation*

reverberation and echos

reverberation is similar to an echo but there are significant differences-

- Echo- discreet reflection of a sound- usually delayed 1/10th of a second or more
 - an entire word can be return intact
 - canyon wall
- Reverberation- continuous reflection over a short time span
 - organ note dying out slowly in a cathedral

Reverberation

- Reverberation-slow fading of sound in an enclosed space
- Reverberation Time- the amount of elapsed time before complete silence after a 60dB sound has stopped
- As space becomes larger T_R tends to increase
- absorption increases T_R decreases
- different room functions require different T_R

Reverberation

- Speech typically requires short T_R
- Music typically requires longer T_R

- Absorptive treatment in a room will affect the reverberant noise level within that room but have little effect on the noise level in the adjoining spaces

Absorbent material can also be: carpets, drapery, sprayed on acoustic plaster

Absorption Recommendations

Absorption techniques are good:

- 1- to change room reverberation techniques
- 2- In spaces with distributed noise sources such as offices, schools, restaurants, and machine shops
- 3- In spaces with hard surfaces and little absorbent content
- 4- where listeners are in the reverberant field

Specific noise control

A specific, concentrated source of noise should be controlled by isolation (mech room enclosure)

Absorptive Materials

Acoustic Tile

- standard sizes, various colors, finishes, some fire rated,
- mineral fiber or faced fiberglass
- NRC absorption rating;
 - 0.45- 0.75 mineral fiber tiles
 - 0.95 fiberglass

Absorptive Materials

Perforated Metal Faced Units

- (Acoustically Transparent Surfaces)
 - perforated metal or material acting as a protection or stiffener over an absorbent material-material is typically acoustically transparent except at higher frequencies

Absorptive Materials

Acoustic Panels

- Treated wood fibers bonded with inorganic cement- 1-3" thickness typical
- suspended from ceiling and or attached directly to ceiling or walls
 - advantage- have greater structural integrity than the tiles

Absorptive Materials

Acoustic Plaster

- plaster fiber mix- applied to irregular surfaces
- usually up to 1 1/2" thick
- easy installation but not good in abusive area or high humidity areas
- acoustic value is typically below that of comparable tiles or panels

Absorptive Materials

Sound Blocks

- masses of suspended acoustic material can achieve absorptive coefficients of greater than 1
- can visually dominate a space

Absorptive Materials

Wall Panels

- wood or metal backing on mineral fiber or fiberglass substrate and fabric covering
- NRC from 0.5- 0.85

Absorptive Materials

Resonator sound absorbers

- fiber cylinders installed at ceiling
- effective absorbers of sound - visually obtrusive-often custom design

Absorptive Materials

Carpet and Drapery

- cover large reflective surfaces
- carpet's absorption is increased with padding
- drapery best with middle and higher frequencies
- high degree of folding helps

Examples

Speech

- Need more articulated space
- Less reverberation
 - Typical reverberation time is less than 0.5 sec but not less than 0.35(depending on room volume [m³]) see fig 19.13

Examples

Music

- More reverb than a speech environment is desirable
- Large volume space requires direct path sound reinforcement by reflection
- Relatively long reverb time enhances music – adds fullness and life to music
- Reverb time should vary inversely with frequency
 - Longer at lower / shorter at higher (clarifies and adds directness)
- Direct path (including visual) good for higher frequencies

Sound paths

Control to provide adequate sound quality to all in space diagrams-first bounce

- Specular
- Echo
- Flutter
 - Between 2 non absorbing surfaces- change shape, relationship or absorption
- Diffusion -reflected from concave surface
- Focusing
- Creep
- Standing wave- similar to flutter but configured to match wavelength

Impact Noise

- Erratic noise caused by footfalls, dropped objects vibrations of mechanical equipment
- Impact Isolation Class (IIC)
- Code required for adjacent dwellings
 - Improved with carpet, resilient tile floor, suspended ceilings, concrete slab floated on compressed glass fiberboard laid on the structural floor

Sound Transmission and Isolation

- Other than controlling sound within a space, it is important control the transmission of sound between 2 spaces
- Transmission Loss (TL)- the amount of noise reduced as the sound travels through the wall. Ratio expressed in dBs of acoustic energy reradiated on receiving room side of wall.

Sound Transmission and Isolation

- TL-lab controlled value for wall's material ability to act as acoustic barrier
- Noise Reduction (NR)- accounts for the TL and the receiving room's acoustic character.
 - (reverbs and absorption)

Sound Transmission and Isolation

Sound Transmission Class (STC) is often used in place of the TL rating

STC- the index of a partition's resistance to the passage of sound

The STC of a wall can be compromised when it only extends up to a light suspended ceiling, it is not sealed well at penetrations or if the barrier is penetrated by a common air duct

Sound Transmission and Isolation

- Doubling the walls mass is one method of increasing TL but other methods are more viable such as
 - - staggered studs and resilient channels

Sound Isolation Descriptors

Hearing conditions in a room can be altered by changing either the barrier characteristics and or the background sound level

- barrier effectiveness expressed in STC
- ambient noise level is frequency dependent it is approximated by NC (HVAC)

The perceived isolation value of a barrier may be enhanced by raising the background , masking, noise level in the receiving room

Fig 19.37

Overall Approach

- Isolate specific concentrated noise generators
- Design for room Noise Criteria
- Control Absorption and Reverberation in room
- Control the transmission of sound between 2 spaces
- Certain rooms' design require a more detailed control of reverberation times, location of reflections and listener positions (direct and reflected sound paths) - auditoriums, music halls, open office landscapes- this can be manually "roughed in" but should be modeled for a more complete analysis and design