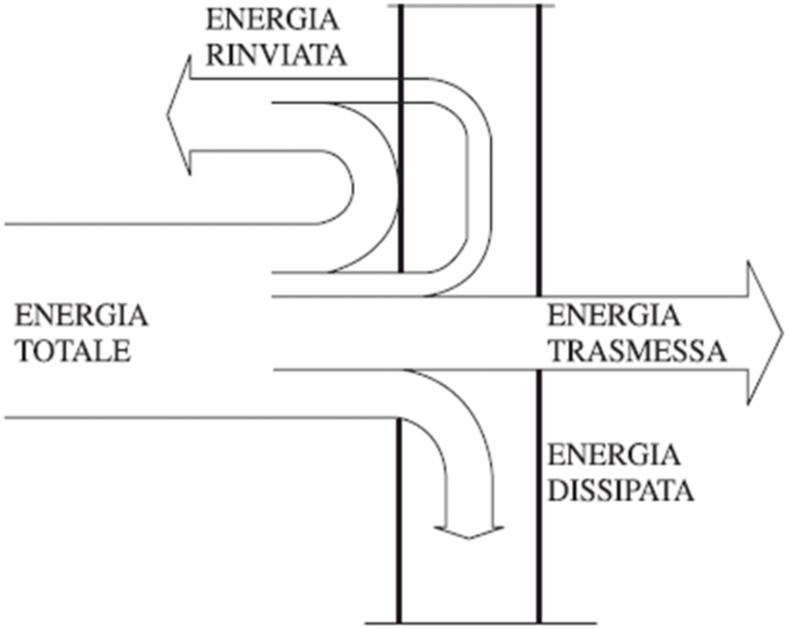
SOUND INSULATION

SOUND INSULATION: Is process whereby structures and materials are arranged to reduce the transmission of sound from one room or area of a building to another or from the exterior to the interior of a building.

Sound insulation techniques are often used in business settings, as well as in multi-family dwellings like duplexes and apartment buildings.

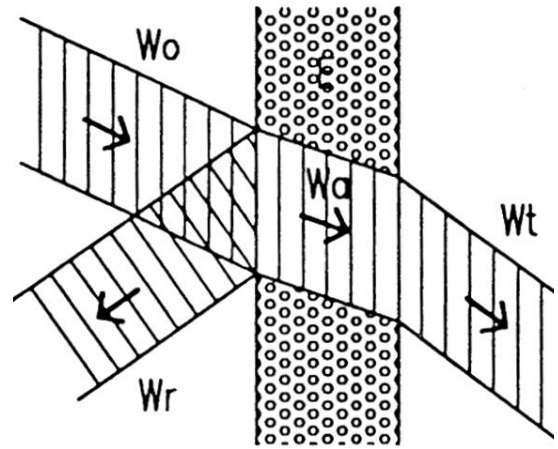
SOUND AGAINST A WALL: Basically a sound is reflected, absorbed, transmitted externally and internally reflected when the sound wave encounters an obstacle. Reflection and absorption are dependent on the wavelength of the sound. The total amount of sound transmitted through an obstacle depends on how much sound is reflected and how much is absorbed

R= reflected,
A= absorbed,
T= transmitted
R+A+T=1



SOUND INSULATING & SOUND ABSORBING MATERIALS

SOUND INSULATION MATERIALS : Sound insulation Materials are sort of soundproofing that prevent sound from entering or exiting an enclosed space that is, whereby a barrier is created between the interior and the exterior area. These materials are normally heavy and stiff in nature and are able minimize or reduce the transmitting of power or energy" Wt"



SOUND ABSORBING MATERIALS: These are materials which are cable of o transforming acoustical energy into some other form of energy, usually heat, sound Absorbing materials are used to absorb, minimizes, damp or block acoustical energy and are mostly Soft and porous in nature , "W_r".

THE SOUND REDUCTION INDEX R:

Sound Reduction Index, R dB, or Transmission loss, this is determine by how effective of a wall, floor, door or other barrier in restricting the passage of sound. The unit of measure of sound transmission loss is the decibel (dB). The higher the transmission loss of a wall, the better it functions as a barrier to the passage of unwanted noise, (t) which is the transmission coefficient is obtained by diving the transmitted power Wt and the incident power ***Wo***.

$$t = \frac{Wt}{Wo}$$

Where Sound Reduction Index, R is giving by

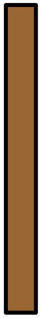
$$R = 10\log_{10}\left[\frac{1}{t}\right]$$

THE MASS LAW

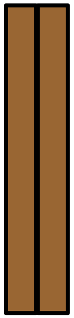
***The Mass Law** states that the sound insulation of a single-leaf partition has a linear relationship with the surface density (mass per unit area) of the partition, and increases with the frequency of the sound. whenever there is doubling in both the mass and the frequency of the wall , there is an increase 6 dB*

$$R = 20 \cdot \lg\left(s \cdot f\right) - 42.5 \qquad (\textit{theoretical})$$

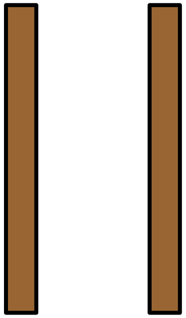
$$R = 20 \cdot \lg\left(s \cdot f\right) - 44.0 \qquad (\textit{practical})$$



Single Wall
R = 30 dB



Double Wall
R = 36 dB



Two separate walls
R = 60 dB

COINCIDENCE FREQUENCY: The frequency of a sound is important ,the human ear is not equally sensitive to sounds to sound of different frequency .it is most sensitive at about 3,000 Hz and become less sentive at the limits of the frequency range reached

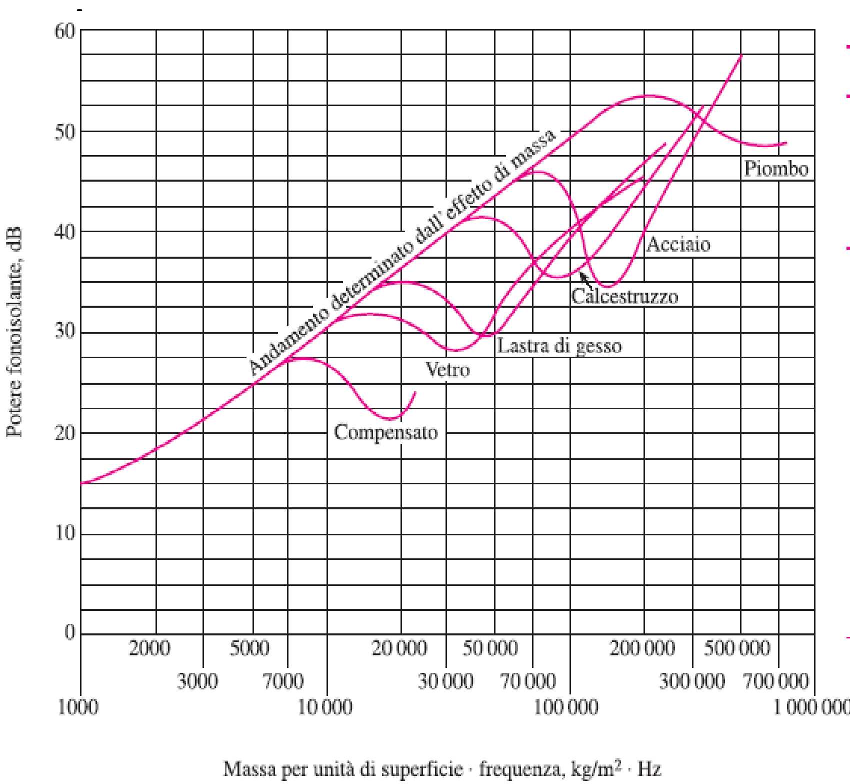


Tabella 14.4 Frequenze critiche per alcuni materiali

Materiale	Frequenza critica per massa per unità di superficie (Hz · kg · m²)	Massa per unità di superficie per unità di spessore (kg · m⁻² · mm⁻¹)
Piombo	600 000	11,2
Acciaio	97 700	8,1
Calcestruzzo armato	44 000	2,3
Mattone	42 000	1,9
Vetro	39 000	2,5
Perspex	35 000	1,15
Cemento-amianto	33 600	1,9
Alluminio	32 200	2,7
Masonite	30 600	0,81
Lastra di gesso	32 000	0,75
Compensato	13 000	0,58

Example: steel, F_{cr}=97700 Hz•m²/kg, σ□ = 8.1 kg/(m²•mm)

s = 10mm, hence σ = σ□•s = 8.1•10 = 81 kg/m²

$f_{coinc} = F_{cr}/\sigma$ = 97700/81 = 1206 Hz

Sound Reduction Index(R_w) and Sound Reduction Index(D_w)

These two parameters are normally used to describe the sound insulation of a partition, Dw and Rw. Dw **Sound Reduction Index** represents the sound insulation between rooms on-site. Since these figures determine the final site requirements, Dw **Sound Reduction Index** levels are specified by customers and Building Regulations. Rw represents the lab tested sound insulation of an element making up a partition wall/floor type. The conversion between Rw and Dw should always be calculated.

The Sound Reduction Index R is defined by:

$$R = 10 \times log \frac{1}{t}$$

The Sound Insulation D is defined by:

$$D = L_1 - L_2$$

This is how we fine the difference between R and D

$$R = L_1 - L_2 + 10 \times log \frac{S_{div}}{A_2}$$

$$R = D + 10 \times log \frac{S_{div}}{A_2}$$