Acoustic materials

Research about different kinds of materials for traffic noise barriers

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Introduction

Millions of people are affected by constant traffic noise in their own home. In fact, traffic noise impacts more people than any other environmental noise source. Traffic noise can affect the ability to work, learn, rest, relax, sleep, etc. Excessive noise can lead to mental and physical health problems. If your home is near a major road or you are experiencing problems with traffic noise, you may be able to limit the impact on yourself and your family.

There are basically four options for controlling traffic noise: constructing (or increasing the height of) a barrier wall, increasing the isolation quality of the home, masking the noise, or controlling the noise directly at the source.

Barrier Walls

Constructing or increasing the height of a barrier wall could result in a noticeable decrease in traffic noise. However, certain guidelines must be met in order for the wall to be effective:

Material

The wall must be solid with no penetrations in order to be effective. Any penetration, opening or gate can degrade the effectiveness of the barrier. Concrete walls are preferred, but other types of walls can also be effective. A barrier does not have to be a wall; it could also be a large earthen berm. A common misconception is that typical landscaping or vegetation can act as an effective barrier for traffic noise. Unless the vegetation is 100' thick and very dense, it will provide very little if any noise reduction.

Measuring sound insulation

How can you compare the amount of sound insulation you get from different materials? There are several different measurements you'll come across.

Sound Transmission Class (STC)

In the United States, a common way of comparing sound insulation in buildings is using a measurement called STC (Sound Transmission Class), which describes how well or badly sound waves (broadly in the range of normal human voices, 125-4000 Hz) travel through ceilings and walls. A very bad partition wall through which you could hear more or less everything would score about 20-25, while a luxury hotel wall that blocks out virtually everything would notch up about 60.Most domestic walls rate somewhere in the middle from about 30-45. You can improve the STC of a partition wall by building it from a more dense material (sound insulation improves by about 5 decibels for every doubling of mass), by adding an air gap, or by adding sound absorbing material.

Sound Reduction Index (SRI)

In countries outside the USA, SRI (Sound Reduction Index) is a more common measurement. Typically, companies offering soundproofing products will suggest they can achieve an improvement of so many decibels (dB) sound reduction or SRI. Everyday materials have widely differing SRIs. A thin plane of glass would achieve about 20-25 dB, light concrete slabs would be about 40 dB, while two brick walls separated by a large air cavity would cut noise by 60-75 dB. Like STC, SRI measurements are highly dependent on sound frequencies: a material that gives a considerable improvement in sound insulation for human speech (cutting out conversation from your neighbors upstairs) is likely to be much less effective at cutting lower sound frequencies (so you may still hear the deep bass of their stereo).

Noise Reduction Coefficient (NRC)

While STC and SRC indicate how well noise passes through different materials, NRC (Noise Reduction Coefficient) measures how well materials stop sound from reflecting (how much sound they can absorb). The NRC is the percentage of sound that a surface absorbs (in other words, hits a surface and doesn't reflect back again into the room). So a carpet on rubber underlay could easily have an NRC of about 0.4 (it absorbs 40 percent of the sound hitting it and 60 percent bounces back), while a glass window might score only about 0.05 (it reflects 95 percent of the sound hitting it straight back again).

Wood

The wood has significant advantages of integration, durability notorious with conceptions of works and protection techniques adapted technologies that enable rapid and effective assemblies, control overall costs.

Acoustic properties

Wood can produce sound (by direct striking) and can amplify or absorb sound waves originating from other bodies. For these reasons, it is a unique material for musical instruments and other acoustic applications. The pitch of sound produced depends on the frequency of vibration, which is affected by the dimensions, density, moisture content, and modulus of elasticity of the wood. Smaller dimensions, lower moisture content, and higher density and elasticity produce sounds of higher pitch.

When sound waves of extrinsic origin strike wood, they are partly absorbed and partly reflected, and the wood is set in vibration. The sound can be amplified, as in violins, guitars, organ pipes, and other musical instruments, or it can be absorbed, as in wooden partitions and barriers. Normally, wood absorbs a very small portion of acoustic energy (3–5 percent), but special constructions incorporating empty spaces and porous insulation boards can increase absorption to as high as 90 percent. The speed of sound in wood is about 3,500–5,000 meters (about 11,500–16,400 feet) per second axially and 1,000–1,500 meters (3,300–4,900 feet) per second transversely; the axial value approaches the speed of sound in iron and is 10 times higher than that in air. The velocity of sound in wood is reduced by moisture, which therefore contributes to faster damping of sound. For musical instruments, a preference exists for selected spruce wood, but fir, pine, maple, and tropical woods also are used. Abnormalities such as decay affect acoustic properties; use of this fact is made in nondestructive testing of wood.

Concrete

In general, increasing the mass of a wall or floor improves the sound insulation of a room; hence concrete and masonry offer a good barrier to airborne sounds, while impact sound is easily controlled with appropriate floor and ceiling finishes. A range of 'Robust Details' (RD) for both masonry and concrete walls and concrete floors have been agreed by the Building Regulations Advisory Committee. These offer approved construction choices for both party walls and separating floors and include aspects of the external wall in controlling sound between dwellings.

Good acoustic properties can also be achieved for multi-occupancy residences using a range of concrete options. One example is tunnel form construction (in which the walls, floors and ceilings are made from cast in-situ concrete using specialist reusable formwork) that was used for a residential block at the University of East Anglia. Two separating floors in the new block, consisting of 250mm of concrete with a stuck-down carpet and no ceiling finish beneath, were tested. They both exceeded the regulations by more than 5dB for both airborne and impact sound insulation and therefore met the levels required by Robust Details.

- Concrete walls provide a buffer between:
  Outdoor noise and the indoor environment in a building.
- Road noise and residential areas with a sound barrier.
- Indoor noise between adjoining apartments or other spaces as a separating wall.

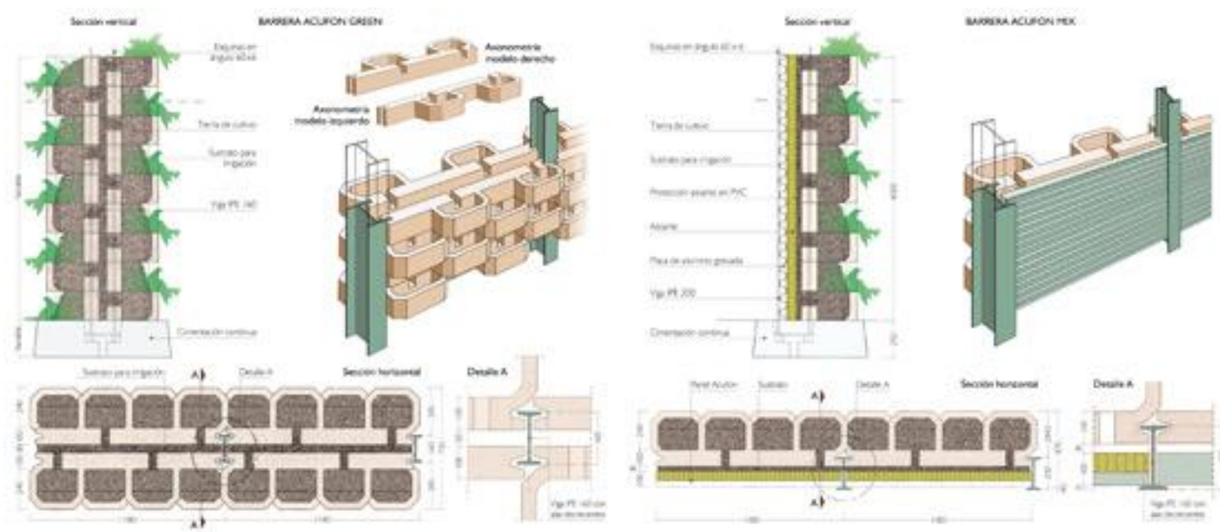
A study in America reported in the PCA bulletin No. 15434 proved that:

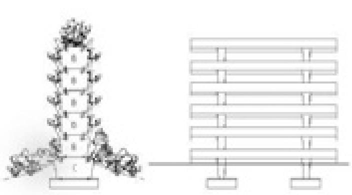
"...The greater mass of concrete walls can reduce sound penetrating through a wall by over 80% compared with wood or steel frame construction. Although some sound will penetrate the windows, a concrete building can be two-thirds quieter than a wood or steel frame building. Concrete panels also provide effective sound barriers separating buildings from highways or industrial areas from residential areas..."

Concrete and vegetation

The engineering of these walls acoustic absorbents basa composción in the walls of two modules in which concrete is introduced along with the vegetation and topsoil must retainer of water to provide moisture between the two there is an air chamber which further contributes to the sound insulation required.

These walls are walls gardener who are composed of reinforced concrete prefabricated elements. Put some elements over others to reach the height needed project. Following is carried out planting any kind of flowers and plants, according to the criterion of landscape engineer, although in most cases are used seeds of native plants that do not require maintenance.





The weight of the barrier is higher than 1500 kg / m (> 30Kg / m), which can be considered negligible direct transmission through the barrier.

The level of noise received by reflection, measured according to DIN 52212, is 8 dBA, and may therefore be fully absorbent.

Noise barriers can be overcome only by diffraction and to avoid or reduce it to acceptable levels, just to give the necessary height.

Glass

The effectiveness of glass as a sound barrier has been known for many years. For example, increasing the thickness of glass will reduce sound transmission through the glass. Because glass is a very dense material, the added weight of thicker glass creates economic and structural concerns that make using thick sheets of solid glass an unattractive choice for most applications. As it turns out, glass is not a good thermal insulator, so in exterior applications the most common glazing choice is dual-pane or "insulated glazing." Insulated glazing is typically fabricated from two sheets of glass that are separated by a continuous metal spacer placed around the perimeter, then sealed air-tight for all eternity. The sealing process is especially important for exterior applications, because the window may fog up from moisture condensation in the air space if the seal is lost or broken. In the "old days" the typical air gap for an insulated window was about 1/4 in. The optimum air space from a thermal insulation point of view is about 5/8 in. Research has shown that air recirculation between the two panes of glass begins to reduce the thermal insulation value when the air space is much larger than 5/8 in. According to many window manufacturers, maintaining a good seal betwoon the two panos of glass becomes increasingly difficult as the air space gets larger. As a result, spacer bars greater than 1/2 in. are uncommon, and spacer bars greater than 3/4 in. are generally not available with a warranty from the manufacturer. More detailed information relating to the acoustical performance of insulated glazing will be provided later.

Another technique for improving the acoustical performance of glass is to laminate two layers of glass together with a clear, plastic material. The plastic inner layer bonds to both pieces of glass creating what appears to the naked eye as a single pane of glass. Automobiles have laminated glass primarily for safety reasons, to minimize the possibility of glass fragments injuring passengers during a collision. As it turns out, the plastic inner layer (or laminate) provides a significant amount of internal structural damping to the glass. This damping effect has a major impact on the sound transmission properties of glass at high frequencies, especially near its critical frequency. The critical frequency is the acoustic frequency at which the wavelength of bending waves in the glass surface equals the wavelength of sound in air. At frequencies in the vicinity of the critical frequency, sound waves will pass through the glass much more readily than at other frequencies. This effect (reduced sound isolation in the region of the critical frequency) is called the coincidence effect. The critical frequency for glass depends only on the thickness of the glass. Thicker glass will have a lower critical frequency than thinner glass. For example, 1/8 in. thick glass has a critical frequency of 4800 Hz, while 1/4 in. thick glass has a critical frequency of 2400 Hz, and 1/2 in. thick glass has a critical frequency of 1200 Hz. Laboratory tests have shown that the reduction of sound as it passes through laminated glass in the coincidence frequency region is much greater than with regular (non-laminated) glass. That is to say, laminated glass provides better sound control than regular glass (of the same total thickness), but the improvement occurs only in the frequency range of the coincidence effect.

Brick

Natural clay brick:

Great acoustic and thermal performers, they are strong, safe, long lasting, low maintenance and recyclable, with color that never fades.

Metal

Metal barriers have some advantageous compared to conventional concrete barriers. These metal barriers have narrow and lightweight construction which enables these barriers to be built in confined spaces, bridges and flyovers. They have pleasing look and are also found to be less obtrusive to the surrounding areas.

Steep Foundations for

- Panelized Sound Walls
- Precast Concrete Walls
- Noise Barriers
- Temporary Walls

[Installation Video]

Simple Equipment

- No drill rigs, cranes or concrete trucks needed
- Skid steer for small projects, track hoe for larger projects
- Less equipment = smaller crew

Easy Setup & Clean-up

- Attaches to standard torque motors
- Custom engineered for quick installation on every job
- Easily setup on confined job sites
- All-weather setup and installation
- Produces no drill spoil

Rapid Installation

- Installs in minutes
- Mounting plate ready to receive post
- Post position and plumbness easily adjusted
- Installs through groundwater, caving soils & cobble

Faster Foundation Installs

- LOAD READY
- NO CONCRETE CURING DELAYS
- Removable/reusable for temporary walls
- Low noise and vibration installation
- DOT Approved in Many States



Noise Reduction Coefficients (NRC) for Common Building Materials:

Material	NRC
Brick, painted	.00 - .02
Brick, unpainted	.00 - .05
Carpet, indoor-outdoor	.15 - .20
Carpet, heavy on concrete	.20 - .30
Carpet, heavy on foam rubber	.30 - .55
Concrete (smooth), painted	.00 - .05
Concrete (smooth), unpainted	.00 - .20
Concrete (block), painted	.05
Concrete (block), unpainted	.05 - .35
Cork, floor tiles (3/4" thick)	.10 - .15
Cork, wall tiles (1" thick)	.30 - .70
Drapery, light weight (10oz.)	.05 - .15
Drapery, medium weight (14oz.), velour draped to half	.55
Drapery, heavy weight (18oz.), velour draped to half	.60
Fabric on Gypsum	.05
Fiberglass, 3-1/2" batt	.90 - .95
Fiberglass, 1" Semi-rigid	.50 - .75
Glass	.05 - .10
Gypsum	.05
Linoleum on Concrete	.00 - .05
Marble	.00
Plaster	.05
Plywood	.10 - .15
Polyurethane Foam (1" thick, open cell, reticulated)	.30
Rubber on Concrete	.05
Seating (occupied)	.80 - .85
Seating (unoccupied), metal	.30
Seating (unoccupied), wood	.30
Seating (unoccupied), fabric upholstered	.60
Seating (unoccupied), leather upholstered	.50
"Soundboard" (1/2" thick)	.20
Sprayed Cellulose Fibers (1" thick on concrete)	.50 - .75
Steel	.00 - .10
Terrazzo	.00
Wood	.05 - .15

Useful links:

http://www.efunda.com/materials/common_matl/Common_Matl.cfm?MatlPhase=Solid&MatlProp=Acoustic#Acoustic

http://www.explainthatstuff.com/soundproofing.html

http://www.nrcratings.com/nrc.html

http://www.stcratings.com/masonry.html

http://www.engineeringtoolbox.com/accoustic-sound-absorption-d_68.html

http://www.metrolight-es.com/eng_catalogo-barreras-antiruidos.htm

http://www.britannica.com/EBchecked/topic/647253/wood/26165/Acoustic-properties

http://findarticles.com/p/articles/mi_qa4075/is_200402/ai_n9355083/