

# NBRI

Ci/SfB			(P2)	BG/BOU
UDC	699.844			10
				1979

KEYWORDS: Noise, insulation

# INTRODUCTORY GUIDE TO QUIET IN THE HOME

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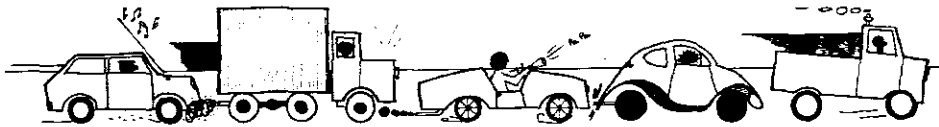
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of the CSIR P.O. Box 395 Pretoria 0001

ISBN 0 7988 1444 6

Printed in South Africa  
by the Graphic Arts Division of the CSIR

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**H**ome owners often complain that traffic noise disturbs their indoor peace and quiet.

It is difficult, expensive and probably unnecessary to make the whole house soundproof. To enable one to relax, chat and listen to music more easily in a quiet room, however, it is often worthwhile to take the trouble to protect one or two rooms from noise: the lounge and the main bedroom for example.

To appreciate and apply the practical tips that follow later, it is necessary to know some facts about acoustics and understand how and where sound penetrates the house.

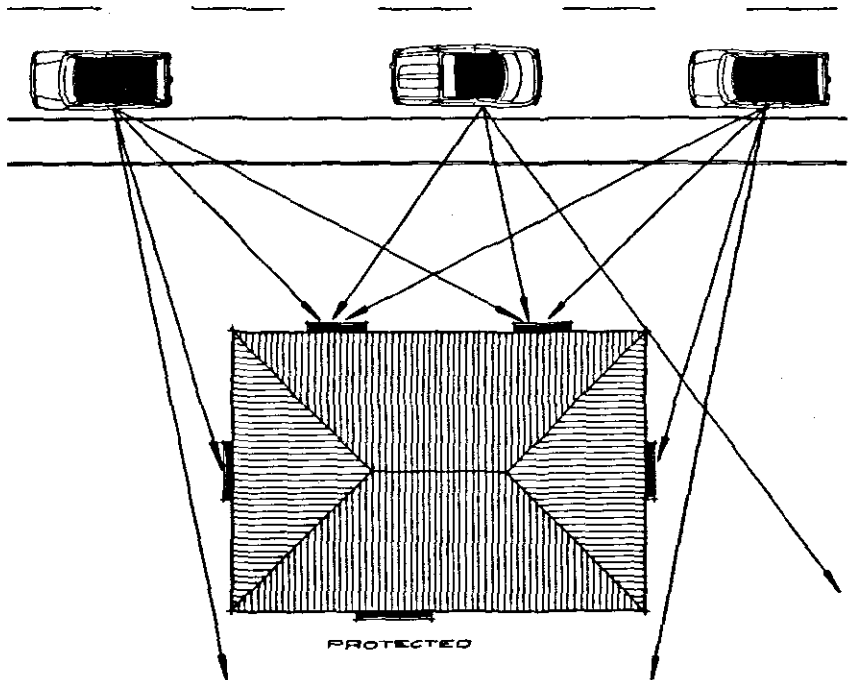
### **What you need to know**

- (a) Sound penetrates a room through windows, doors, roof and ceiling, airbricks and other openings such as chimneys. External walls, especially if built of brick, let through very little sound energy.
- (b) The bigger the window or door opening, for example, or other weak spots in the facade, the more sound energy is admitted.
- (c) If there are two equally large openings and only one is closed, the improvement will be barely noticeable. Unfortunately, this is how the human ear works; it becomes more sensitive as the level of sound is reduced. To reduce the loudness of noise penetrating openings or other weak spots by half, their area must be reduced by between 75 and 90 per cent.
- (d) To make a room relatively soundproof, all openings to outside noise must be closed. This could reduce the natural ventilation even if there is a door or window on the side away from the noise. The problem of ventilation is discussed later.
- (e) For good sound insulation, a partition must be massive and either very rigid (brick wall) or flexible (lead sheet). Two 3 mm thick, glass panes or two 3 mm thick hardboard sheets placed together but not glued together are more effective than a solid sheet of 6 mm thick glass or hardboard because the layered material is the more flexible.

- (f) It is not true that trees between the street and the house absorb noise, that acoustic tiles nailed to a door increase the sound insulation, that curtains in front of a window keep out noise or that sound striking a roof or wall at an angle does not penetrate easily.

Unless you know the basic principles of acoustics you should not try to apply 'common sense' to solve noise problems.

Only those windows and doors that cannot be seen from the street are protected from the noise of traffic by the building itself.



**FIGURE 1**

Street noise can enter the house on three sides

## How to start

Retire to the room you wish to make more quiet. LISTEN carefully to all noises and THINK. Close all doors and windows and listen again. Open them, one at a time, to establish which ones let in most noise. Read the practical tips that follow and decide whether they can be applied in your particular room. Read item (c) above once more.

All the following ideas have been used in practice and found to be successful.

## Practical hints

### Openings

Smaller openings such as airbricks can be plastered over on both sides or covered with 6 mm hardboard.

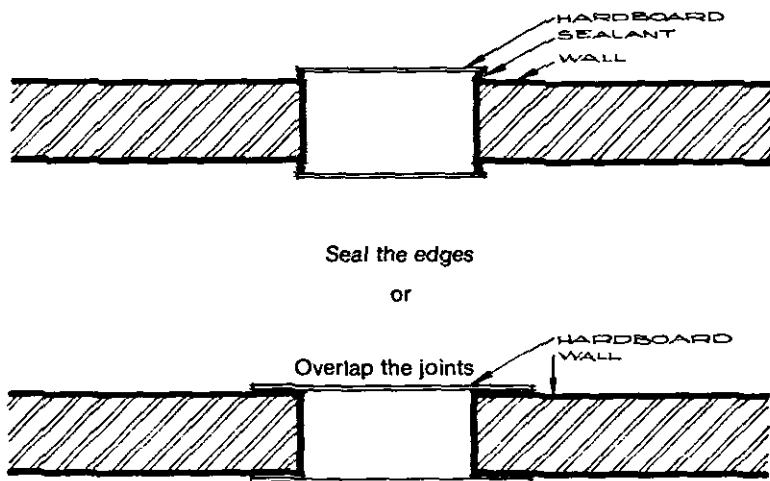


FIGURE 2

### Chimneys

Chimneys and similar sized openings must be covered with more massive panels. Two or three layers of hardboard will suffice. Chimneys no longer in use could be bricked up; the ventilating effect of the chimney will be lost, of course.

Very small openings and cracks only need a non-hardening filler (plasticene, Prestik or polysulphide as sold by hardware stores).

## Windows

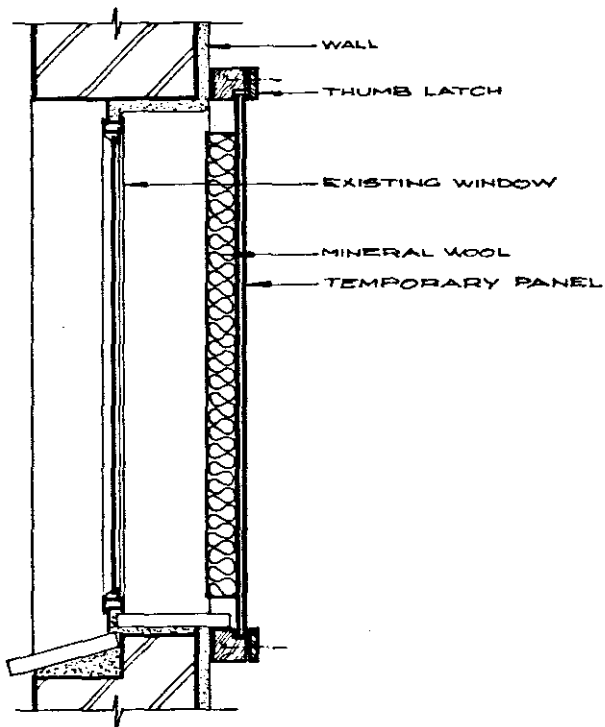
Normal windows offer little resistance to noise because the panes are large and thin, and modern steel frames are not airtight. Each of the following steps, taken in order, will improve the sound insulation. The degree of effectiveness will naturally depend on the loudness of the noise.

- (a) Place a thin strip of plastic filler around the frame. Cover this with a strip of thin plastic sheet to prevent adhesion to the closing section of the window. Close the window firmly and cut off the filler that is squeezed out. Foam rubber or foam plastic is too porous for this purpose.
- (b) *Once the frame is sealed properly, the insulation can be further improved by fitting thicker panes or double panes in contact with each other, or 6 mm laminated glass.*
- (c) Even more effective insulation can be achieved by fitting a second glazed window with a frame on the inside so that intruding sound is attenuated twice in succession. It is most important that the distance between the panes be more than 80 mm. Such a double window can be further improved by making the reveals (i.e. the faces of the sides, head and sill of the window opening between the two glazed portions) sound absorbent by lining them with a 25 mm thick layer of dense mineral wool that is covered with thin felt or carpeting. Finally, panes in one or both these windows can be made thicker as described in (b).
- (d) For temporary use, as in a bedroom at night, a removable panel of hardboard or plywood can be used instead of double glazing as described above. The sound absorbing material can be fixed to the window side of this panel instead of to the reveals of the window opening.
- (e) Some rooms have particularly large windows or external doors that no longer serve a useful purpose. If such openings are bricked up, soundproofing of the remainder becomes easier. The resulting reduction of summer heat penetration and winter heat loss could also improve thermal conditions in the room.

## Doors

Doors, especially the hollow core types, are often even worse than windows when one is trying to keep out noise.

Even with a solid, wood panel door, the problem of sealing the edges still



**FIGURE 3**  
Temporary window panel

remains. If the door or frame is warped, the opening cannot be sealed satisfactorily with foam rubber.

The frame must be built up with strips of wood, or plastic material that will harden, until it fits all round the opening tightly and evenly. A very thin soft rubber gasket can then be used to effect an airtight seal. The opening between door and floor creates another problem because floors often slope so that doors have to be shortened to clear the highest point of the slope. The old fashioned threshold or rebated cill are good solutions; but remember that this may cause a trip hazard. Alternatively, a sealing mechanism that drops as the door is closed, can be used.

Whatever the practical problem, remember that sound is ruthless. If a crack remains, sound will penetrate.

Just as with windows, double doors can be used to achieve very high sound insulation values.

It is unlikely that the large glass swing doors, often installed between a lounge and veranda, can be made sufficiently soundproof. If quiet is more desirable than easy access, the openings should be bricked up. As with windows, (see above) this might improve thermal conditions in the lounge.

### *The roof*

The roof proper is not a good barrier against external noise. Insulation can be improved by the ceiling. Sound penetration can also be reduced by plastering up any openings between the underside of the roofing and the walls.

### *The ceiling*

The ceiling must be of a hard, impervious material such as gypsum board, plasterboard or asbestos cement. It should fit tightly to the walls. If access is possible above the ceiling, the junction between ceiling and wall could be plastered. Heat insulating material such as mineral wool (40 mm thick) normally laid on the ceiling in the roof space to reduce solar heat gains to, and heat losses from the house, also improves the sound insulation because of its absorbing qualities.

The mass of a wooden ceiling is rather low and in drier areas the joints sometimes tend to open. If the ceiling can support extra mass, a plastic sheet with a thin layer of plaster on top would improve the ceiling's resistance to noise penetration. Perhaps an airtight membrane with a reasonable mass (2,5 kg m<sup>-2</sup>, such as bituminous felt protected against drying out, can be stretched over the ceiling joints. The joints must be well sealed.

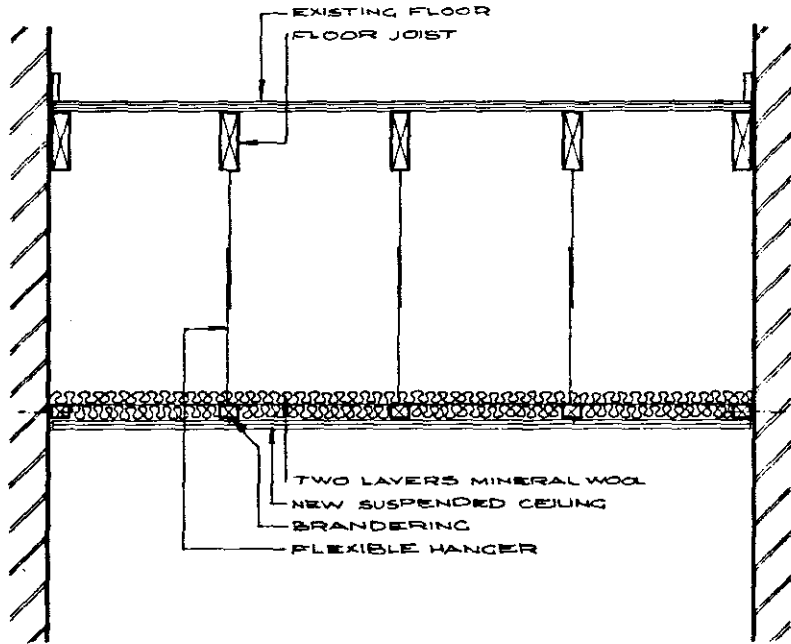
Porous or perforated acoustic ceilings let noise through like a sieve! The same remedial measures as for wood strip ceilings apply.

### *Intermediate floors in double storey buildings*

A concrete slab, 200 mm thick and with a mass of 480 kg m<sup>-2</sup> will take care of airborne (speech, music) and impact noise (footsteps, moving of furniture). Thinner slabs will probably not be adequate against impact noise. Although a carpet will help, its effect is usually overrated.



Wooden floors on beams are never satisfactory sound barriers. The mass of such floors is so small that it is not practical to increase it sufficiently. A floating floor on top of a light structure is also unsatisfactory. The only remedy is to fit a floating ceiling below, and structurally separated from the floor structure. The ceiling can be suspended from the floor joists by flexible ceiling hangers, although better insulation is possible if the ceiling frame is self supporting and fixed to the walls only.



**FIGURE 4**  
Resiliently suspended ceiling

Use two layers of gypsum board with staggered joints for the ceiling. Make the gap between ceiling and floor as deep as practical and put two 25 mm layers of heat insulating mineral wool in the gap.

### Acoustic tiles

Acoustic tiles fixed to a door do not reduce the amount of energy that penetrates the door in the form of sound. Such tiles and other sound absorbing materials, such as carpets, heavy curtains and upholstered furniture, do absorb sound after it has entered the room or has been generated in the room. However, to make a significant reduction, the amount of absorption already present must at least be doubled. In an empty room, when there is little absorp-

tion, this is easy; in a bedroom or well furnished lounge it becomes impractical. The sound reduction that can be achieved by absorption is strictly limited. No absorption can ever make a sound inaudible.

Another warning. Many so-called acoustic tiles hardly deserve the name. The fact that the National Building Research Institute or the South African Bureau of Standards has tested a product does not mean that it has been found to be satisfactory. These organizations merely give the *objective results of tests* on certain properties of a product. The user must decide whether the product meets his requirements and also whether the *properties in which he is interested* have in fact been tested.

### *Barrier walls*

A wall between the street and the house can reduce traffic noise by as much as 15 dB, provided that the wall is close to the street or the house and high enough, long enough and without openings and gaps. It does not need to be either thick or very massive. Asbestos cement roof sheeting would be quite effective. Because of the many variables, it is not possible to make generally applicable recommendations. Each case has to be investigated separately.

### *Ventilation*

Sealing all external openings could solve the noise problem but would interfere with natural ventilation. If the room has a window in a wall facing away from the street or noise source, and has one or more doors leading into the house, the ventilation may still be adequate even with all the openings on the noisy side sealed. Remember that we ventilate to remove heat and odours; by comparison much less fresh air is required for life.

Airconditioners installed below sealed windows defeat the *purpose of sealing* the window because noise penetrates through the new opening. Such a unit could be fitted to a quiet wall if there is one. Most airconditioners generate more noise than is acceptable. The only types worth considering are those which, according to the SABS code of practice, have a noise level of N1 or less.

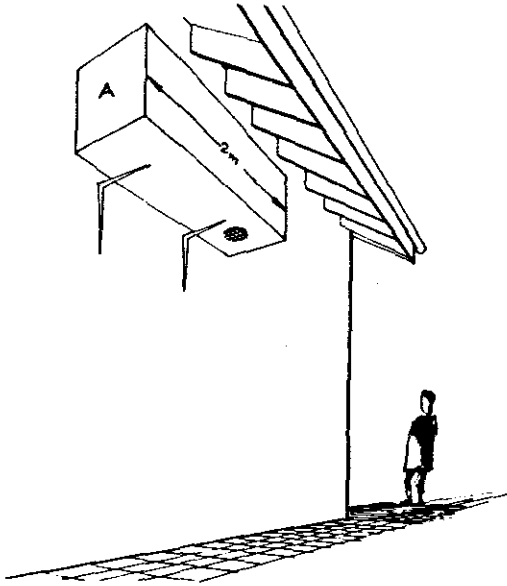
A cheaper solution is a fan with an acoustic filter between the fan and the air outlet into the room. The filter attenuates both traffic and fan noise. Such

units are used extensively in England, especially near Heathrow airport, but their capacity is inadequate here because of our warmer climate. The *Standard building regulations* require a fresh air supply of 0,5 cubic meters per minute per person, but not less than 3 cubic meters per minute per room.

The NBRI will cooperate with any manufacturer wishing to market a locally made unit.

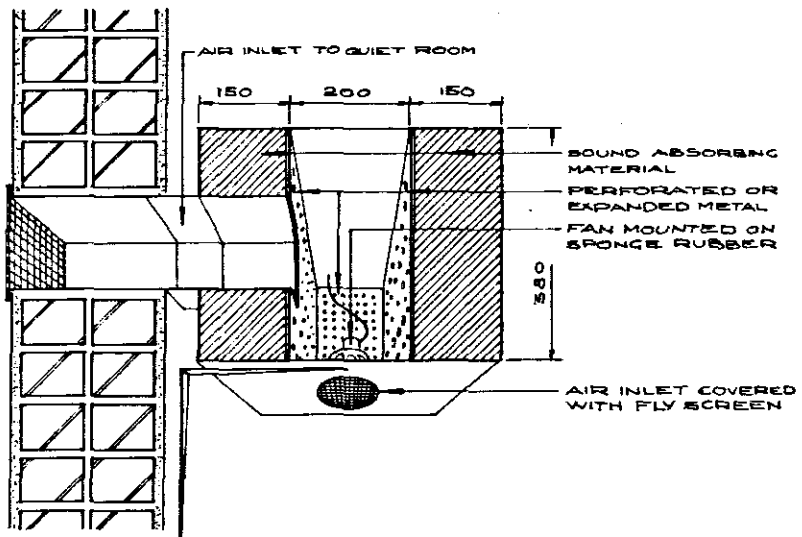
#### *A homemade ventilator*

A simple but effective fan and noise filter is shown in the diagram. The size of the casing is determined in part by the size and the noise properties of the fan.



**FIGURE 5 - A**  
A Do-it-yourself ventilation unit

- (a) The sides of the casing can be of 2 mm (14 gauge) metal sheet or 6 mm tempered hardboard.
- (b) All edges must be hermetically sealed.
- (c) The absorbing material is high density or tightly compacted mineral wool. The denser material is resin bonded and can be spray painted to prevent erosion of the fibres. The compressed wool must be covered by perforated sheet metal with at least 20 per cent perforations.



**FIGURE 5 - B**  
Inside the ventilator

- (d) The end pieces - A on the sketch 5A - have a 50 mm thick layer of mineral wool on the inside.
- (e) If the diameter of the fan exceeds 200 mm, the absorbent material can be bevelled on either side of the fan to make room for it.
- (f) The height of the channel - 380 mm on the sketch - and the size of the opening in the wall are chosen so that the free air path through the 'box' is about as large as the fan's free area.
- (g) The fan is mounted on sponge rubber or springs to reduce vibration of the case.
- (h) As some fans are noisier than others there is no guarantee that these sound absorbers will be adequate in every instance. The sketch is intended rather as a guide for the do-it-yourselfer.
- (i) The fan must supply the required air volume while operating against the pressure loss in the filter. The capacity of fans designed to be mounted in a wall is usually drastically reduced when working against the back pressure of a filter.
- (j) A second inlet or outlet opening is required in the room. If it is in the external wall it must be fitted with a similar filter. An opening to another room, such as a door that does not close tightly or that can be left ajar, works well in practice and costs nothing.

### *Internal noise problems*

Noise, such as children's music, is often disturbing. With the above mentioned advice in mind, measures to control this need only be touched on.

- (a) Try to keep the noise within the room by tightly closing the doors and openings that lead to the rest of the house.
- (b) Improve the sound reduction properties of the ceiling in the noisy room and, if necessary, also in the room where quiet is wanted.
- (c) If possible, choose a room as far from the others as you can.
- (d) If a piano disturbs people in a room below, it helps considerably to place each leg on a 150 - 150 mm wood block under which 3 or 4 pieces of foam rubber have been pasted. The thickness of the rubber must be such that it is compressed by about 5 mm by the weight of the piano. If the leg fits into a hollow in the block, it will not slip off. A platform that rests on foam rubber legs can be made for a cello.