

OXFORD DIOCESAN GUILD OF CHURCH BELL RINGERS

Educational Leaflet

No. 6

SOUND CONTROL

by Stanley G. Scott
updated by Tony Crabtree and John Davidge on behalf of
the Towers & Belfries Committee - September 2011

1. INTRODUCTION

In our modern society it is sad that church bells, previously accepted as a part of the English scene, are now classified together with traffic and aircraft as 'noise'. The introduction of the Noise Abatement Act has made it easier for members of the public to register complaints against noise. This places a responsibility upon church councils to ensure that bells in their care do not constitute a nuisance.

This pamphlet outlines some of the principles of sound insulation and gives information on suitable materials which can be used to reduce sound levels ("external" sound control).

Some bells are excessively loud or occasionally too quiet in the ringing room and this matter is also considered here ("internal" sound control).

2. WHY SOUNDPROOF? ("external")

The reasons for soundproofing may determine the level of reduction needed, for example it may be necessary to reduce more in response to local complaints than if adverse public reaction is simply being anticipated. In any event, the full effects of soundproofing must be taken into account.

It is essential that an appropriate level of control is attempted. Only in the most exceptional cases should complete soundproofing be installed; do not spend a lot of money to achieve a small effect. Provided that "open", undiminished sound is maintained for church services and weddings and that sufficient reduction to avoid reasonable complaint is applied for practices, peals and ringers meetings then there should be no adverse effects from sound control. If, however, the sound is reduced too much the contrast with "open" ringing may result in more complaints during "open" ringing than were made before soundproofing was installed. Key factors are whether any work is being done as part of major works or adjustments to an existing installation and particularly, whether the bells have been rung at all in preceding decades. If there is a history of ringing, then the scale of change is a consideration.

While catering for the feelings of the minority who are sensitive to the sound of bells one must also allow for those who would miss the bells and complain if they were soundproofed too much. Feelings of indignation at the need to carry out the work at all are probably necessary to avoid overdoing the soundproofing! However, serious consideration should be given to moderating the sound of bells that "shout" down into the immediate vicinity and make conversation in the church yard impossible for parishioners, wedding photographers etc. Regardless of whether there have been complaints, it is reasonable to make the bells sound pleasant to everyone. This can be done without reducing the sound at a distance.

3. METHODS OF "EXTERNAL" SOUNDPROOFING

It is impossible to recommend a specific method of sound proofing without knowing the special problems of a tower, e.g. its dimensions, access, location of sound exits and many other factors. Often one course of action readily suggests itself as a result of tower layout, availability of materials and ability of individuals to do the work.

3.1 Sound lantern

Suitable circumstances are very rare, but where feasible the installation of a sound lantern, capable of being opened fully or closed partially, together with the complete bricking or blocking up of tower louvres is generally considered to be ideal. When the lantern is open the sound is thrown up and away from the immediate vicinity of the tower, thus avoiding distortion caused by sound reflections from surrounding buildings. In many cases this has resulted in bells being heard further away and more uniformly than before. Unfortunately this method is only possible in exceptional cases and is extremely expensive. Exactly the same effect can be achieved if the bells are rehung and the opportunity is taken to place them lower in the tower such that the lips of the bells when “up” are below the sill of the tower louvres.

3.2 Sound control flaps

The next best alternative to a lantern is the partial blocking of the existing louvres leaving an area fitted with adjustable doors (see Photo 1) or flaps lined with sound absorbent material. These permit sound to leave the tower when they are open and reduce the sound when closed. All the louvres should be evenly blocked to a point well above the lips of the bells in the "up" position. If this system is adopted it is important to make sure that the flaps or doors shut tight against a rubber cushion and that any gap in boarding is filled. The ideal installation should be capable of operation from the ringing chamber, making it simple to apply soundproofing when needed without clambering amongst the bells. Air flow should still be maintained in the belfry, but it need not be great.

A very efficient system is possible if you can install a floor above the bells or if there is a former bell frame above the current one able to support a floor below the cills of the louvres. In either event, the floor can be constructed with flaps controlled by ropes from the ringing room (see photo 2). This can be instead of or as well as works in the louvres.



Photo 1



Photo 2.

3.3 Ringing chamber soundproofing (“internal”)

It should be remembered that containing sound within the tower may alter the sound in the ringing chamber. If this proves to be the case, then an intermediate

floor or the ringing chamber ceiling can also be soundproofed. Since most thermal insulation materials also act as sound insulators this can be achieved with a fibreglass or rocksil quilt. Offcuts of softboard (fibreboard) fixed to the belfry walls between louvres also help to absorb the sound of the bells. A frequent cause of excess noise in the ringing room is “tubes” between floors. These transmit sound out of all proportion to their size. If there is a sound problem, any tubes should be shortened, punctured, cut away or otherwise rendered less able to carry the sound. The Towers & Belfries Committee can advise on alternatives to tubes if there is a need to guide or protect the ropes.

A simple way to moderate the sound in a bare ringing room is to carpet the floor or add curtains which reduce echoes and sharpen the sound making the bells easier to pick out.

Because it has a direct impact on the amount of ringing we can do and whether or not we have irate neighbours beating on the door or cutting the ropes, rather more has been written about outside sound control than about controlling the sound in the ringing room. Fortunately, even at the worst, most ringing rooms are bearable, although reducing the sound level might well make the conductor’s life easier and ringing more pleasant. Another common problem is that, although the overall sound may be acceptable, individual bells may be either hard to hear or will dominate the others. At Chalfont St Giles, there were particular problems after augmentation because the bells of the original six were on two levels and the additional trebles had to be installed in a room underneath, creating a three-level installation.

Is it possible to do anything? The answer, frequently, is yes; and depending on the tower, and a small amount of DIY ability, often without huge expense. First of all though, it is useful to consider what sound is and how it behaves (people with scientific knowledge or background may well shudder at this point!)

Basically, sound is a variation in air pressure, which hits the eardrum and the brain then reacts and we “hear” the note. Loud sound is a big variation in pressure and a quiet sound is small. For high notes the variation in pressure is fast and for low notes, slow. Sound is normally either transmitted through the air (no sound in a vacuum!) or by vibration or reflection through or from a hard material. Since sound is pressure it will tend to behave like a gas or liquid and escape through any available hole or air gap. Because of the varying ways in which sound is transmitted and the differences in both tower layouts and the materials from which they are constructed, sound control is not an exact science and trial-and-error is usually required.

The first action taken in many towers to reduce the level of sound in the ringing room is to lay carpet under the bells. This is usually a very cost effective first step because not only does the carpet block any air gaps that there may be in the floor, it reduces the reflection of sound and also “traps” a proportion in the pile. However, it should not be used if rain or snow can get through the louvres in any quantity, since the carpet will hold the moisture which can eventually lead to rot. Carpet also has the effect of reducing the “harshness” because it tends to absorb the higher notes more than the lower ones. If the carpet can be laid in two thicknesses with the pile inwards, this will help when cleaning the belfry. Unless there is no alternative, addition of material to the belfry floor should be avoided. A floor covered with soft materials cannot be kept clean and is not

convenient for tying muffles or general maintenance access. A better solution is to add layers of wood in on a lower floor or as a false ceiling to the ringing room.

If the sound in the ringing room needs to be further reduced then look for and seal off any further air gaps. Weights chutes are frequently not enclosed and allow a large volume of sound down the tower. There are frequently gaps at the edges of the floor either because the floorboards do not accommodate the variations in the walls or because, the ends of large square floor beams have rotted, or been eaten, away leaving a large void. Small gaps are best filled with expanding foam, which can be obtained in an applicator from most DIY shops and is squeezed into the gaps where it reacts with the dampness in the air – expanding to about six times its original volume. Once set, it can be trimmed with a sharp knife. Large gaps need to be filled mechanically, either by thin ply cut to match the shape of the wall, or by rolls of material packed into the gaps. Really large holes may need bricks and mortar (consult your PCC/architect) or with plastic bags filled with dry sand. If these are used they should be relatively small (say 12” x 12” maximum), made of heavy grade plastic, and heat sealed. The advantages of plastic bags are that they are cheap and, being flexible, can be used to fill awkwardly shaped spaces.

In new installations where the bell chamber is directly above the ringing room, the best way of reducing sound transmission into the ringing room is by means of a double floor. If the upper floor is laid between the trimmer beams of the frame (i.e. at the base of the pits) the boarding should be of 1½” tongued and grooved planks, which should be a good fit, especially around the edges of the frame, to reduce air gaps. The lower floor should be of two thicknesses of ¾” waterproof ply laid with overlapping seams – if the upper floor is to be laid below the bell-frame then it can be of the same material. The purpose of the gap (which should be 18 – 24in) is to disperse and trap some of the sound coming through from the bells, so rope tubes should not be installed between the floors, as this will nullify the dispersal and *conduct* the sound downwards.

In an existing installation, if after sealing all gaps and laying insulation material under the bells, the sound is still too loud, then it may be possible to fit “ropeway silencers” (photo 3) under the bells but above the ringing room. These silencers are merely three boxes to trap the sound, which can be lined with foam, or not, as required. At the time of writing they are installed at Amersham, Bray, and Chalfont St Giles, where they have been found to reduce sound levels by up to half.

The silencers have been designed so that they can be easily made and assembled by people with limited carpentry skills, being constructed of either ¾” (20mm) waterproof ply or Medium Density Fibreboard (MDF) and screwed together. Foam (if fitted) should be ¼” (6mm) upholstery foam. If bosses are fitted to the floor where the silencer is to be installed they should be re-installed on the top surface.

The plan for a silencer, and a photograph showing the components of a foam lined silencer, and a partially and fully assembled one, are shown on the following pages.

If there is an intermediate room between the ringing room and the bell chamber, then it is unlikely that silencers will be required. However, close attention should be paid to ensuring that air gaps at floor edges and around doors are fully sealed and it may be advantageous to lay carpet on the floor. In some towers it may be necessary to fit sound absorbing materials to the walls of the intermediate chamber to reduce internal sound reflection.

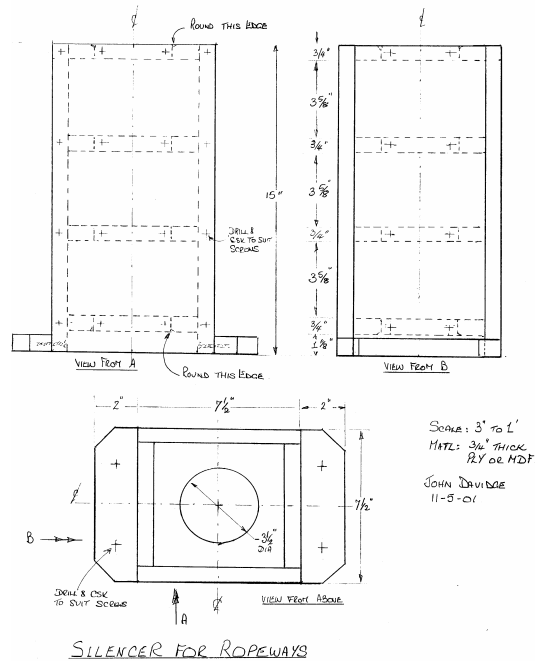


Photo 3

3.4 General points

CARE MUST BE TAKEN TO ENSURE THAT NO PART OF THE WORK CAN COLLAPSE AND CAUSE DAMAGE TO THE BELLS. Panels and actuating mechanisms must be well clear of swinging bells. Advice from the manufacturer of the chosen material should always be sought on its weather and fire resistance and on the best fixing adhesives.

Always make sure that the necessary permission to undertake work in the tower is obtained from the incumbent and PCC and that where necessary a faculty is obtained. Also check that there is adequate insurance cover for those doing the work.

Advice can also be sought from the Towers and Belfries committee when particular problems can be surveyed and reported on.

4. MATERIALS

The following materials are suitable for soundproofing and some notes are given on their application. In order that comparisons can be made an approximate indication is given of the sound reduction that each material produces. This reduction is measured in decibels (dB) - a unit of sound intensity or energy. Any sound reduction of 15 dB or more is considered worthwhile. Typical noise levels experienced in every day life include:-

Pneumatic drill, noisy car or motor cycle	100db
Orchestra or hi-fi at dynamic range	90db
Noisy office, vacuum cleaner	60db
Restaurant	50db
Low radio music, average office, conversation	40db
Whispering, rustling leaves	20db

The sound intensity adjacent to bells ringing certainly exceeds 100 dB but does not reach the threshold of pain at 130 dB.

4.1 Blocks and bricks

<u>Clinker/concrete blocks</u>	Sound Reduction
75mm thick (rendered one side)	44db
<u>Brickwork</u>	
100mm thick (rendered or plastered)	43db
200mm thick	48db
<u>Hollow Clay Blocks</u>	
Double skin of 75mm blocks with 50mm cavity and wall ties	40db
<u>Breeze Blocks</u>	
Double skin of 75mm blocks with 50mm cavity, no wall ties	50db

The thicker the brickwork or blockwork the better the results and the greater the mass, the greater the effect. Rendering will give additional sound reduction. Gypsum products should not be used externally or where there is any dampness. Thermalite or similar lightweight blocks (50mm-150mm thick, 450mm x 200mm) are better than concrete or breeze and easier to cut.

4.2 Boards

<u>Woodwool slabs</u>	Sound Reduction
Available usually in 50mm and 75mm thicknesses	Up to 50 dB for 75mm
<u>Fibreboard (Softboard)</u>	
12, 20 and 25mm thick	20 dB for 12mm
<u>Plasterboard</u> (only to be used where no dampness exists)	
10mm and 15mm thick	Up to 25 dB

Glass

Single pane 3mm glass	28dB
Single pane 6mm glass	30dB
Double glazing at 25mm spacing	43dB (3mm glass)
Double glazing at 50mm spacing	46dB (3mm glass)
Double glazing at 150mm spacing	60dB (6mm glass)

Large panes of thin glass can vibrate in certain conditions and shatter. Unless in small pieces the thicker the glass the better, but cost is probably the deciding factor. Toughened or laminated glass can cost over £20 per square metre. Plate glass, or georgian cast 6mm thick can be placed in reasonably large panes (preferably in wooden frames) at lower cost.

Fibreboards:

Medium or Soft varieties are preferred to Hardboard which tend to "drum", although the tempered grade may be suitable as an external skin to other softer boards. Some types of medium boards are suitable for external exposure but being less dense should be covered with a roofing felt as a precaution. Some building boards are bitumen bonded or impregnated and are suitable for exposed places. Standard Insulating board - made from wood or sugar cane fibres - is only suitable for internal use.

Acoustic Boards and Tiles can be drilled or grooved, fully or partially perforated, with tongued joints and bevelled or plain edges; many decorative patterns are available.

Composite boards comprise many variations of sandwich construction, hardboard, mediumboard and softboard with rockwool, compressed straw and expanded polystyrene, felt covered in some cases.

Note: boards fixed to softwood battens can be more effective than fixing direct to brickwork or stonework.

4.3 Other Materials

Mineral fibres:

Fibreglass is difficult to handle and some people are allergic to it. BY LAW SAFETY PRECAUTIONS MUST BE TAKEN AND MASKS, GOGGLES AND GLOVES SHOULD BE WORN WHILE WORKING. Rocksil is easier to handle than fibreglass. Both are available in rolls of varying widths and thicknesses (25-75mm generally). They are non-combustible, non-corrosive, moisture & vermin resistant.

Expanded Polystyrene:

CARE SHOULD BE TAKEN WITH THIS MATERIAL AS SOME VERSIONS OF IT ARE FLAMMABLE. FLAME RETARDANT BOARDS ARE OBTAINABLE BUT USE SHOULD BE RESTRICTED TO APPLICATIONS WHERE WEIGHT IS THE MAIN CRITERION. Always consult a reliable supplier, the manufacturer or the Building Information Centre for information on this (and other insulating materials).

Vicuclad:

A non-combustible board, vermiculite based.

Cork: Available in slab or tile form but expensive. Particularly suitable for floors.

Sand: Washed dry sharp sand sandwiched between floors can be very effective. It should be placed in plastic bags or sacks for ease of placement. This will entail forming a secondary floor a few inches above the intermediate floor to be sound proofed, ensuring that the rope holes are masked with tubes to retain the sand-bags. Note that the tubes should be discontinuous or the tubes may transmit as much sound as the sandbags have absorbed thus achieving nothing. This system would normally be considered only where there is excessive noise from the belfry to the ringing chamber. Care must be taken not to exceed the safe floor loading; dry sand weighs approximately 1700 Kg/m³.

Timber and plywood

Thin plywood tends to vibrate and may aggravate the situation.

Timber studding (a sawn timber framework with hanging panels of hardboard covered with 50mm fibreglass between the "studs" or vertical members) can form a very effective damper.

5. CONCLUSION

This pamphlet gives some basic information on materials and "rules of thumb" for the installation of sound control in a tower. The scheme chosen will depend upon local circumstances, manpower and materials. **REMEMBER - THE BEST SCHEMES ARE USUALLY THE SIMPLEST AND ARE BASED ON COMMON SENSE.**

Although soundproofing should only be installed where it is really necessary to avoid nuisance, it must be said that there are side benefits. By excluding inclement weather and condensation, the belfry becomes drier, warmer and cleaner; fittings last longer and maintenance can be carried out in comfort. The ringing chamber and lower floors are also warmer as sound insulation also improves thermal insulation.