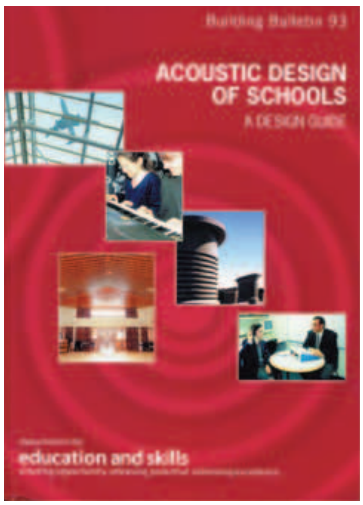

ACOUSTICS IN SCHOOLS
Building Bulletin 93

Recent studies have shown that many classrooms have poor acoustics. As a result, children with normal hearing are often unable to make out what is being said in class. While adults will guess at missing words, children find it much harder to fill in the gaps and their educational development can suffer.

Building Bulletin 93
Before 2003, Part E of the Building Regulations did not apply to schools. It now includes schools within its scope. It also requires sound absorption to entrance halls, corridors or hallways in multiple dwellings such as flats.

All school buildings are now subject to detailed design checks and on-site inspections by building control officers. Section 1 of Building Bulletin 93 describes the 'Specification of acoustic performance'. This section gives the performance targets for compliance with the Requirement from Part E of the Building Regulations 2000 (as amended):

"Each room or other space in a school building shall have the acoustic conditions and the insulation against disturbance by noise appropriate to its normal use."

Building Bulletin 93 aims to :

- Provide a regulatory framework for the acoustic design of schools in support of the Building Regulations.
- Give supporting advice and recommendations for planning and design of schools.
- Provide a comprehensive guide for architects, building control officers, building services engineers, clients and others involved in the design of new school buildings.

Unfortunately, a large number of classrooms in the UK currently suffer from poor acoustics.

Poor acoustic conditions in the classroom increase the strain on teacher's voices as most teachers find it difficult to cope with high noise levels. This often leads to voice problems due to prolonged use of the voice and the need to shout to keep control. Recent surveys in the UK and elsewhere show that teachers form a disproportionate percentage of voice clinic patients.

Historically, there have been a number of factors preventing good acoustic design and Building Bulletin 93 addresses these issues. Pressures on finances has meant in the past that acoustics came low on the list of design priorities. The acoustic design will now have a higher priority as it will be subject to building control. The overall objective of the performance standards in Section 1.1 is to provide acoustic conditions in schools that:

(a) facilitate clear communication of speech between teacher and student and between students.

(b) do not interfere with study activities.

Due to limitations of space in this leaflet, we will focus solutions to reverberation in teaching and study spaces and sound absorption in corridors, entrance halls and stairwells.

Why are some rooms acoustically bad?

There are three main reasons why rooms may be acoustically bad for speech:

- they may be too reverberant for the speech sounds produced in them
- they may be noisy because of weak resistance they offer to the penetration of noise from outside or from nearby rooms.
- They may be shaped so that the speakers are more or less screened from their audience or part of it.

Effect of reverberation on speech

Part of the sound from a teacher, the direct sound, passes directly to the ears of his/her pupils. Another part travels to the room surfaces and is reflected, eventually reaching the pupils ears from many directions at close intervals: this is called reverberant sound. If there is too much reverberant sound, the pupil is still receiving the reflected sounds of previous syllables when he is trying to cope with the direct sound of later syllables. The two then interfere, and speech is difficult to understand. The amount of reverberation is usually expressed as the reverberation time, which is the time taken for the sound to die away after its source has stopped. It is determined by the volume of the space and its capacity for sound absorption and is defined as the time taken for the sound to decay by 60 decibels. It may vary from half a second in an ordinary living room to 8 seconds or more in a large assembly hall or gymnasium.

A classroom or teaching space with a long reverberation time of several seconds will cause syllables to be prolonged so that they overlap and hence degrade speech intelligibility. Long reverberation times occur in large rooms with hard wall, floors and ceiling surfaces. Adding acoustic absorption panels or tiles will reduce the reverberation time and will improve speech intelligibility. Building Bulletin 93 specifies the reverberation times required for various teaching spaces ranging from classrooms to assembly halls.

Reflection and absorption of sound

Sound waves travel through the air until they hit a surface. When a sound wave reaches a surface it will be partly reflected off the surface back into the room and continue travelling in a new direction and it will be partly absorbed by the surface with the absorbed energy being dissipated as heat.

The amount of sound energy that can be absorbed by a surface is given by its absorption coefficient, α. The absorption coefficient can take values in the range 0 to 1. A surface that absorbs no sound (i.e totally reflective surface) has an absorption coefficient of 0 and a surface that absorbs all sound incident upon it has an absorption coefficient of 1. Thus the higher the value of α, the more sound will be absorbed.

Amount of acoustic absorption required.

In classrooms and other rooms for speech, large amounts of fixed acoustic absorption are often required particularly where rooms have high volumes, as often occurs in older buildings.

It is advisable to contact the technical department of Soundsorba Ltd so that the correct amount of sound absorption can be calculated for the space in question.

Distribution of absorbent panels and tiles.

The location of acoustic absorption within a room is important. The traditional calculation of reverberation time assumes that the absorbent surfaces in a room are reasonably evenly distributed. If this is not so, the reverberation time equation is not valid and undesirable local variations in the acoustics can occur, particularly in large rooms or halls. Large areas of acoustically reflective material can also lead to echoes, focusing and standing waves. Where absorption occurs only on the floor and ceiling, for example in a solution employing acoustic ceiling tiles and carpeted floors, users may experience an over-emphasis on sound reflections in a horizontal plane. This often leads to 'flutter echoes' between walls, which result in the actual reverberation time being considerably longer than the calculated reverberation time. A much better solution, especially in large rooms, is to distribute some of the absorptive panelling on the walls.

Hearing impaired pupils

Many hearing impaired pupils make use of low frequencies below 500 Hz to obtain information from speech. Therefore, for hearing impaired pupils to be included in classes alongside pupils having normal hearing, special care should be taken to minimise low frequency indoor noise levels. Sound absorbing panels offering very good sound absorption at low frequencies such as 'Echosorba' acoustic panels should be considered for these areas.

Corridors, entrance halls and stairwells

The Building Regulations Approved Document E also contains guidance on the addition of sound absorption to common areas in buildings containing multiple dwellings such as flats.

This gives two methods for the application of sound absorbers:

Method 1. A Class C performance absorber for entrance halls, corridors or hallways to cover an area equal to or greater than the floor area to be applied ,generally to the ceiling. The ECHOSORBA™ stick-on acoustic panel meets this requirement.

For stairwells or a stair enclosure, the requirement is to cover an area of at least 50% of the ceiling with a Class C absorber, (ECHOSORBA™ acoustic panel is a Class C absorber in 30mm thickness) of the combined area of the stair treads, the upper surface of the landings (excluding ground floor) and the top floor ceiling area.

Method 2. This needs detailed acoustic calculations to assess the amount of absorption required. Please contact Soundsorba Ltd for technical assistance on this method.

Solutions to acoustic problems in schools to meet BB93

ASSEMBLY HALLS

These spaces are increasingly used in schools for a wide range of activities and not confined to just assembly. Typical uses are drama, parents evenings, meetings hall, exam hall, sports use, audio/visual presentations etc. These normally have hard sound reflective surfaces and suffer badly from poor acoustics. Floors are normally wooden or vinyl. Walls are normally plastered or timber clad and ceilings are concrete/plasterboard or timber boarded.

Typical solution is to line high level wall surfaces with WALLSORBA™ acoustic panels and if necessary, add some ECHOSORBA™ acoustic panels on part of the ceiling.

Reverberation time of 0.8 to 1.2 seconds is required for assembly halls.

SPORTS HALLS

Sports halls are designed with robust and impact resistant constructions as these spaces will need to suffer years of long term use. Due to the need for durability, the interior surfaces tend to be chosen for those purposes. The floors are usually timber sprung, the walls are painted blockwork and the ceilings are plasterboard or profiled steel cladding. All these hard surfaces combine to produce an 'echo chamber' in the building. This makes conveying instructions to pupils very difficult as speech is unintelligible.

Solution to this problem is line the walls at high level, normally from doorhead upwards, with WALLSORBA™ acoustic wall panels. These are robust as they will withstand impact from indoor footballs and come pre-decorated in a range of 40 standard colours.

Reverberation time of less than 1.5 seconds is required for sports halls.

CLASSROOMS

These are the most numerous teaching spaces in any school and hence the most important. They tend to cater mainly for around 20 to 30 pupils and one teacher. Sometimes there may also be a teacher assistant. These rooms are reliant on the spoken word without any electronic amplified system. Therefore the intelligibility of the spoken word is paramount. This is particularly important as some of the children in the class may have hearing impairment.

The surfaces of classrooms can vary from school to school. Some classroom floors have carpets, some have timber, some have vinyl or other surface finishes. Other may have a combination of these. Walls in the modern schools will generally be plastered but older schools may have brick or painted blockwork. Ceilings may be concrete, plasterboard or even suspended 'office' type ceilings.

Acoustic solutions to these rooms can be the installation of WALLSORBA™ acoustic panels in a horizontal band at high level on the walls and/or ECHOSORBA™ acoustic panels on the ceiling or FOAMSORBA™ stick on acoustic tiles on the ceiling.

Reverberation time of less than 0.6 or 0.8 seconds is required for classrooms

MUSIC ROOMS

Of all the spaces in a school, music rooms are going to present the greatest difficulties when is comes to dealing with their acoustics. This is because they generate the highest level of sound and are the most sensitive to noise intrusion to and from others areas. As space in schools is always limited, these rooms tend to end up smaller then desired. Not only are high sound levels a problem, but the frequency of the sounds generated can contain a significant amount of lower bass frequencies. Parallel walls should be avoided by angling some of the walls to diffuse the sound and reduce standing waves.
Particular attention should be paid to the doors as they are generally light weight.

Normal acoustic treatment is to install WALLSORBA™ acoustic wall panels on the walls and FOAMSORBA ICE™ acoustic tiles on the ceiling/wall. If extra low frequency absorption is required then ECHOSORBA™ panels can be installed in selected areas.
DOORSORBA™ acoustic doorsets can be used to deal with sound transmission problems.

Reverberation time of less then 1.0 seconds is required for music classrooms and less than 0.8 seconds for small practice /group rooms

DINING ROOMS

These rooms are designed to take a lot of punishment and all the surfaces are hard and cleanable. Floors are normally ceramic tiles or vinyl or timber. The walls are mainly plastered and painted. The ceilings are a mixture of surfaces such as plasterboard, timber boarding, metal profiled decking and other surfaces.

Compared to other school spaces like classrooms, drama halls etc, children entering dining rooms feel free to let off 'steam' as they feel they are in a less formal area. It is a time for them to relax and play and joke with their friends during their lunch break. Hence dining rooms tend to be very noisy and the clatter of cutlery and screeching of chairs is very noticeable as well as the general verbal noise from the children. It is important in these spaces that acoustic absorbers are kept at high level, well away from reach by hands etc. ECHOSORBA™ acoustic panels and WALLSORBA™ acoustic wall panels are ideal for these areas. In some situations, BAFFLESORBA™ hanging absorbers will be suitable

Reverberation time of less than 1.0 seconds is required for dining rooms.

MUSIC RECORDING ROOMS

BB93 requires sound insulation through wall structure of music practice rooms. All spaces used by students except music rooms require a minimum sound insulation value of Rw 30dB for doorsets. Note should be made of the term doorset. This comprises the door leaf, doorframe, acoustic and fire seals, door threshold and hinges. It is the correct combination of all these combined components which go to achieve the desired acoustic performance.

DOORSORBA™acoustic doorsets are manufactured and offered in two acoustic ratings. One is 35dB and the second is 44dB and therefore both meet the sound insulation performance of BB93 standard.

Music practice rooms require a minimum sound insulation value of Rw35dB.

SWIMMING POOLS

Pools are very reflective to sound due to tiled walls and floors. The floors have ceramic tiles. The walls are also generally part ceramic tiled and part windows. The ceiling is normally concrete, or profiled steel cladding. One of the largest sound reflective areas in the swimming pool is the water itself which reflects 99% of the sound which hits it.

The fun environment of swimming pools encourages children to shout and scream as they enjoy their swimming sessions. With all the sound reflective surfaces, the sound is amplified to high levels which makes instructions very difficult to hear. Even more importantly warning shouts for safety can go unheard. Therefore good acoustics in swimming pools is critical and but often ignored in the past..

Practical solutions to soak up the reverberant noise levels are to apply BAFFLESORBA™ hanging absorbers or FOAMSORBA™ acoustic tiles with large shadow gaps between the tiles.

Reverberation time of less then 2 seconds is required for swimming pools.

Soundsorba Acoustic Products are used in schools and universities throughout the United Kingdom. A few are listed below :-

Dr Challoners School
Lossiemouth High School
Kings Langley School
Warwick High School
Grantham High School
Monmouth School
Dartmouth Grammer School
Caterton School
Sir Thomas Riches School
Croxteth Comp School
St Mary's School
Woldingham School
Neston County School
Headington School
University College London
South Bank University
Kent College
Cambridge University
Edinburgh University
University of Birmingham
University of Coventry
Middlesex University
Brunel University
Westminster College
Reading College of Art
Dudley College
Lanzies Academy Glasgow
London School of Economics

Soundsorba's technical department will be pleased to assist with sound absorption solutions and acoustic problems in school buildings.

Please contact us on telephone number **01494 536888** or email us with your problem at **info@soundsorba.com** or fax us on **01494 536818.**

Acoustic product details are available immediately on our website which is **www.soundsorba.com**

All information contained in the details is given in good faith but without any warranty

SOUNDSORBA®

SOUNDSORBA LIMITED, SHAFTESBURY STREET, HIGH WYCOMBE, BUCKS HP11 2NA TEL: 01494 536888 FAX: 01494 536818 www.soundsorba.com