Acoustics for Schools

The SRS Guide to BB93 and Building Acoustics for Education

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THE SRS SCHOOLS PLEDGE:

FREE ACOUSTIC ADVICE, DESIGN AND SPECIFICATIONS FOR ALL UK SCHOOLS.

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SRS BB93 SRS Acoustics for Schools

Understanding the challenges of building acoustics for schools

Contents

Example Applications

Introduction

The construction standards of schools have been raised significantly to improve the environment that our children are taught in. An area of particular interest, which is maybe not immediately obvious, is that teaching and learning are both acoustically demanding activities. Detailed research has demonstrated that poor acoustics adversely affect both teaching and learning. Building Bulletin 93 (BB93) has been implemented to address these issues, promoting good acoustic design and construction of new school facilities.

In particular, BB93 offers guidance in these core areas;

- Target ambient noise levels for teaching areas
- Acoustic separation between adjacent spaces
- Lower reverberation time to promote speech intelligibility

This guide is intended to be an introduction to the aims of BB93, illustrating how each target can be met and demonstrating example constructions and installations. Sound Reduction Systems are the UK's leading independent innovator of high performance acoustic products, developed by our team of qualified, Institute of Acoustics accredited acousticians. Because

the requirements of each school are different, SRS offer bespoke solutions across the board from the refurbishment of a single classroom to assisting with complete projects.

Free Acoustic Advice, Design and Specification for all UK Schools

Sound Reduction Systems offer their industry leading knowledge and experience free of charge to help guide you to the best solution for your school, whether it is for BB93 compliance or just to improve the acoustics within your teaching environment. For your free consultation, please call **01204 380 074**, e-mail **bb93@soundreduction.co.uk** or apply via the website, **www.soundreduction.co.uk**.

Sound Reduction Systems – Committed to improving acoustic conditions within schools

BB93 Activity ratings

The core of BB93 is understanding how each space within the school is affected by acoustics, as summarised in the table below. Each area is addressed in the subsequent sections of the following brochure.

Type of room	Activity Noise	Noise tolerance	Upper limit for the indoor ambient noise level $L_{Aeq, 30min}$ (dB)	Maximum impact sound pressure level $L'_{nT(Tmf, max),w}$ (dB)	Reverberation Time, T_{mf} (seconds)
Nursery School Playrooms	High	Low	35	65	< 0.6
Nursery school quiet rooms	Low	Low	35	60	< 0.6
Primary school classrooms, class bases, general teaching areas and small group rooms	Average	Low	35	60	< 0.6
Secondary school classrooms, general teaching areas, seminar rooms, tutorial rooms, language laboratories	Average	Low	35	60	< 0.8
Open Plan					
Teaching areas	Average	Medium	40	60	< 0.8
Resource areas	Average	Medium	40	60	< 1.0
Music					
Music Classroom	Very High	Low	35	55	< 1.0
Small practice/group room	Very High	Very Low	30	55	0.6 – 1.2
Performance/recital room	Very High	Very Low	30	55	1.0 – 1.5
Recording studio	Very High	Very Low	30	55	0.6 – 1.2
Control room for recording	Very High	Low	35	55	< 0.5
Lecture rooms					
Small (< 50 people)	Average	Low	35	60	< 0.8
Large (> 50 people)	Average	Very Low	30	55	< 1.0
Classrooms designed specifically for use by hearing impaired pupils (including rooms for SLT)	Average	Very Low	30	55	< 0.4
Study rooms (individual study, withdrawal, remedial work and teacher preparation)	Low	Low	35	60	< 0.8
Libraries					
Quiet study areas	Low	Low	35	60	< 1.0
Resource areas	Average	Medium	40	60	< 1.0
Science laboratories	Average	Medium	40	65	< 0.8
Drama studios	High	Very Low	30	60	< 1.0
Design and Technology					
Resistant materials, CADCAM areas	High	Very Low	30	55	< 1.0
Electronics/control, textiles, food, graphics, design/resource areas	Average	Medium	40	60	< 0.8
Art rooms	Average	Medium	40	60	<0.8
Assembly halls, multipurpose halls	High	Low	35	60	0.8 – 1.2
Audio-visual, video conferencing rooms	Average	Low	35	60	< 0.8
Atria and circulation spaces used by pupils	Average	Medium	45	65	< 1.5
Indoor sports hall	High	Medium	45	65	< 1.5
Dance Studio	High	Medium	40	60	< 1.2
Gymnasium	High	Medium	40	65	< 1.5
Swimming pool	High	High	50	65	< 2.0
Interview/counselling/medical rooms	Low	Low	35	60	< 0.8
Dining rooms	High	High	45	65	< 1.0

Reverberation Time

Reverberation Time

Why? Classrooms and teaching areas with lots of hard surfaces will inevitably have long reverberation times or echoes, this leads to a 'blurring' of sounds which particularly impedes speech intelligibility. Longer reverberation times also raise reverberant noise levels within a room; to compensate the natural reaction is to raise your voice level, exacerbating the problem. To avoid this vicious cycle, adding acoustic absorption to the walls and ceiling of the room will quickly reduce the reverberation time.

How? Sonata absorbent panels are designed to introduce effective sound absorption into a teaching area discretely and are produced in three versions. All utilise non-fibrous acoustic foam cores to eliminate fibre fallout and can be fitted during term time. Sonata products can be colour matched to any RAL colour or finished in a range of attractive fabric finishes adding visual impact.

Sonata Vario absorbers fixed to a ceiling.

Aurio absorbers are fitted flush to walls and ceilings and are designed to add good broadband absorption. Typically, Sonata Aurio absorbers are used in more confined areas, such as corridors and small classrooms. They can also used in larger areas in conjunction with other Sonata absorber products to achieve perfect broadband absorption.

Vario absorbers offer greatly enhanced absorption, particularly at low frequency, over directly bonded absorbers and are suspended from easy to install ceiling or wall brackets. Vario absorbers work very well in classrooms and general teaching areas.

Duo Absorbers are the ultimate solution to reverberation, a vertical suspended panel that absorbs sound and will also act as a baffle, helping to break up standing waves within a space. Used in areas with demanding reverberation requirements such as large classrooms and halls, Duo panels will achieve target reverberation times with fewer panels than other conventional systems.

Example application – Drama / Assembly Hall:
A drama classroom or assembly hall uses a large double height space, with lots of glazing to create a light and airy space. However, it becomes increasingly hard to understand speech across the room, particularly during group sessions when the children are split up into smaller groups to work independently.

BB93 suggests that a target reverberation time of <1.0 seconds should be achieved, but this proves to be challenging in a light airy classroom such as this with a hard floor finish and lots of glazing. Sonata Duo absorbers were suspended from the ceiling to add a large surface area of highly absorbent panels without changing the feel of the space.

PRODUCTS:

sonata

Airborne Sound Insulation

Why? Airborne sound is generated typically from sources such as voices and music and travels through the air into the structure of a building, and out again into adjoining rooms. Teaching and learning can be noisy activities, particularly in the case of music classrooms or areas where children are encouraged to work in groups and need to communicate. However, teaching and learning are also very sensitive to noise which can quickly distract children and increase teacher workload. Effective sound insulation allows teachers to maximise the potential of a space without disturbing neighbouring teaching areas.

How? The table on the preceding page rates the activity noise level of each room, and also its 'noise tolerance' level. This can then be used to suggest the standard of separation required, in terms of airborne noise, between two different activities/rooms using the following table;

Minimum $D_{nT(Tmf,\ max),w}$ (dB)		Activity noise in source room			
		Low	Average	High	Very High
Noise tolerance in receiving room	High	30	35	45	55
	Medium	35	40	50	55
	Low	40	45	55	55
	Very Low	45	50	55	60

Higher figures represent more stringent levels of separation, but it is important to highlight that these levels of performance are linked to meeting the appropriate level of reverberation in each room. High performance will be achieved using more sophisticated wall and floor structures, but this can be minimised by adjusting the layout of the school to minimise the instances of sensitive rooms being adjacent to spaces that generate higher noise levels.

Maxiboard is a very high performance building board that can be used to upgrade stud partitions and masonry walls to much higher specifications without taking up space or causing any more disruption than a standard dry lining system. Maxiboard is particularly robust and suited to the demanding school environment and can also be used to create high performance ceiling systems to improve timber and concrete floor structures.

Where suspended ceiling systems are specified, SoundBlocker tiles can be use to achieve a range of different levels of performance levels.

Maxiboard fixed to a wall

Example application – Music Rooms:

Maxiboard is used to create a high performance partition between music practice rooms, allowing both to be used concurrently, and Sonata Vario absorbent panels have been used to control the reverberation time. Refering back to the table on page 3, the separating partition must achieve a minimum performance of 55 dB $D_{nT(Tmf,\ max),w}$, and each room must have a maximum mid frequency reverberation time of 0.8 seconds.

Reverberation control is achieved by calculating the reverberation time of the rooms, and then adding absorption to the calculation until the time is brought to an acceptable level. Sonata Vario absorbent panels are the natural choice for this environment as they can be easily fixed out of reach on the ceiling, whilst quickly introducing effective absorption.

PRODUCTS:

maxiboard soundblocker sonata

Please see individual product datasheets for installation guidance, acoustic data and physical properties. Available on request or from www.soundreduction.co.uk

Impact Noise Insulation

Impact Noise Insulation

Why? Just as airborne noise can cause disruption, impact noise (the sound of foot fall or furniture being moved in rooms above) can also be a significant problem. This can be particularly apparent when rooms are used for dance or drama, or when lessons change and students move around.

How? The most effective way to reduce impact noise is to create a floating floor, a floor surface that is isolated from the structure below by introducing a resilient layer. Depending on the structure of the floor and the floor finish specified there are different ways to achieve this, generic solutions that work with any floor finishes introduce inevitable compromises. Concrete floor screeds can be isolated using 5mm Impactafoam between the floor slab and the screed. Impactafoam can achieve impact noise improvements of up to 22 dB ΔL_w. Timber and concrete floors can benefit further from Acoustilay, a high performance acoustic underlay, which can achieve an impact noise improvement 42 dB ΔL_w, and in the case of timber floor structures Acoustilay can also offer additional airborne sound insulation too. Acoustilay can accept a wide range of floor finishes.

Acoustilay - High performance acoustic flooring

In addition to improving the floor surface using isolating materials, upgraded ceilings can further reduce impact noise. Maxiboard can be used to create high performance ceiling, and SoundBlocker can be used to upgrade suspended ceiling systems.

Example application – General Classrooms:
One classroom directly below another in secondary school suffers from excessive impact noise through the concrete cast in situ floor, particularly from chairs scraping against the floor surface upstairs.

Acoustilay 3 is used as the solution, bonded to the concrete slab and then overlaid with a thin layer of 9mm tongue and grooved MDF boarding. The thin carpet can then be refitted (and replaced as required) without disturbing the isolation layer below it. Acoustilay creates a simple and yet very effective floating floor, impact noise is greatly reduced particularly during period changes.

PRODUCTS:

impactafoam soundblocker

acoustilay maxiboard

Please see individual product datasheets for installation guidance, acoustic data and physical properties. Available on request or from www.soundreduction.co.uk

Ambient Noise Levels

Why? Noise is all around us, from adjacent classrooms to planes flying over head it is imperative that teaching areas have low an ambient noise levels so that children can easily follow instructions from teaching staff. Children can easily be distracted by external sources destroying their concentration levels which in turn disrupts teaching and places extra burdens on the staff. Typical recommended ambient noise levels for teaching spaces are around 35dB $L_{Aeq\ 30\ mins}$, though more demanding spaces such as music practice rooms should achieve 30dB and less critical spaces such as kitchens can tolerate levels as high as 50dB.

How? Ambient or background noise sources will fall into two categories, external and internal noise sources. Internal noise sources in schools are varied, separation from other teaching areas is covered in the table on page 5, but care should be taken to specify appropriate glazing and ventilation. External noise, such as from nearby roads or railway lines can be minimised early on in the project planning by identifying the noise sources and modifying the placing and layout of the school to minimise its exposure to noise. Rainfall is a significant source of external noise, particularly on profiled metal roofs over assembly halls, gymnasiums and class rooms. RainCheck can be used as an unobtrusive damping material adhered directly to the underside of the roof profile to achieve demonstrably significant reductions in rainfall noise, as measured to ISO 140-18, RainCheck is currently the only product tested to this standard. In addition, SoundBlocker panels can be used to upgrade suspended ceiling systems to further reduce noise passing into shared ceiling voids

Sonata Vario installed on a ceiling

Example application – Gymnasium:

A large gymnasium has a profiled metal roof, and is used to teach PE and sports to classes of approximately 30 children. The space is extremely reverberant, especially when it rains, to the extent that the children cannot hear the teacher.

The solution was to introduce Sonata duo absorbent panels hanging high up out of harm's way close to the roof. Following an assessment of the anticipated reverberation levels of the gym (based on the construction and dimensions of the space) it is possible to accurately calculate how much absorption is required to achieve the target RT of <1.5 seconds.

Applying RainCheck to the roof soffit to approximately a 60% coverage will significantly reduce the noise from heavy rain so the space becomes useable in any weather.

PRODUCTS:

raincheck soundblocker sonata

Glossary of terminology

Acoustic **Absorption** (not to be confused with insulation) – *The quality of a material to absorb echoes, reducing reverberation but not used as 'soundproofing' to reduce noise in adjacent spaces.*

Acoustic **Insulation** (not to be confused with thermal insulation) – *The quality of a material to reduce or stop noise passing from one side to another, typically through thick, heavy constructions*

Performance Criteria

Reverberation time (RT) – *The reverberation time, in seconds, is quoted in terms of the mid-frequency reverberation time, T_{mf}, the arithmetic average of the reverberation times in the 500 Hz, 1 kHz and 2 kHz octave bands.*

Airborne Sound Insulation $D_{nT(Tmf,\ max),w}$ (dB) – *The standardised level difference with reference to the mid frequency reverberation time in the receiving room*

Impact sound insulation $L'_{nT(Tmf,\ max),w}$ (dB) – *The standardised level measured in the receiver room with reference to the mid frequency reverberation time of the receiver room.*

Ambient noise levels - $L_{Aeq,\ 30min}$ (dB) – *An averaged ambient or background noise measurement over a period of 30 minutes and 'A' weighted to mirror the response of the human ear.*

Useful Links

www.soundreduction.co.uk
www.ioa.org.uk
www.association-of-noise-consultants.co.uk

About SRS

Sound Reduction Systems have 25 years of experience developing and producing high performance materials to address a wide range of acoustic challenges. We maintain excellent dialogues with the leading acoustic consultancies and architects to offer the best solutions available. In every instance, we would be delighted to work with you to help clarify the potentially mystifying field of acoustics, to understand the requirements presented and then assistance to selecting the most appropriate specification. All our products are backed up by ISO standard independent testing, details of which are available on request.

As well as schools and education, Sound Reduction Systems have experience with residential buildings, meeting part E of the building regulation, hospitals and healthcare, offices and industrial acoustics and commercial applications.

Sound Reduction Systems Ltd
Adam St, Off Lever St, Bolton BL3 2AP

Tel: +44 (0)1204 380074 · Fax: +44 (0)1204 380957
E-mail: info@soundreduction.co.uk · Web: www.soundreduction.co.uk