

ABLE

A Better Learning Environment

Armstrong is renowned for its continued research and development into providing products that meet and exceed client needs and prides itself by consistently delivering innovative, sustainable, 'Best Value' architectural solutions.

With investment in education experiencing the highest levels in recent history, emphasis on delivering exceptional multi-functional teaching & community facilities is becoming ever more demanding. In providing such facilities, considerable emphasis has been placed on effective use. Recognising that teaching and learning are acoustically demanding activities; new guidelines have been published to ensure classroom intelligibility forms a basic requirement for any learning environment. After all, delivering a high standard of education is all about effective communication.

'Education is the Government's top priority'

Government figures project Capital investment to reach approximately £10 billion over the next two years, promising a total investment of at least £15 billion by 2007. In providing a programme of rebuilding & renewal, the Government has committed to ensure significant improvements within all primary & secondary schools throughout England.

Of the 21,500 Government-maintained schools in England, notably 85% were built more than 25 years ago and most, therefore, are reaching the end of their design lives.

With new approaches to capital investment and an increased number of new Government initiatives, Education is set to benefit from the guidelines and recommendations of 'Exemplar Designs' – the DfES compendium of exemplar designs for schools fit for the 21st century.



A Better Learning Environment

Building Schools for the Future

As part of the recently published 'Building Schools for the Future' (the Department for Education and Skills consultation on a new approach to capital investment), eleven of the country's top architects headed design teams appointed to develop exemplar designs for primary, secondary and all-through schools. The detailed 'core' brief required:

- Inspirational designs to stimulate both pupils and the school workforce;
- Flexibility to allow short-term teaching methods and the integration of ICT;
- Adaptability to suit long term changes in the size and number of rooms, and to provide a 'kit-of-parts' that could suit a variety of sites and types of schools;
- Inclusive designs for those with SEN or disabilities
- Community use outside the school day;
- Safe secure and sustainable designs;
- Suitability of designs for some off-site construction;
- Excellent environmental design to at least meet standards of Building Bulletins (BB) 87 & 93.

Building Bulletin '93 (BB93)

Representing a significant tightening of the regulation of acoustic design in schools and supported by research showing that teaching and learning are acoustically demanding activities; BB93 provides a regulatory framework for the acoustic design of schools in support of the Building Regulations.

Whilst providing support and advice for planning and design of schools, 'The overall objective of the performance standards in Section 1.1 (of BB93) is to provide acoustic conditions in schools that...facilitate clear communication of speech between teacher and student...and do not interfere with study activities.'*

* BB93, Section 1 - Specification of Acoustic Performance

In response to BB93, Armstrong World Industries, the World's leading supplier of acoustic ceiling solutions, have developed an initiative to assist in meeting the required performance standards for:

- indoor ambient noise levels
- absorption between spaces and corridors
- reverberation in teaching and study spaces
- speech intelligibility

The 'A.B.L.E.' initiative - 'A Better Learning Environment' - highlights Armstrong's market leading range of education specific acoustic ceilings products, emphasises our highly effective and innovative new i-ceilings Sound Field' solution (recommended in Section 6 of BB93) and offers educational, architectural & acoustic specifiers a complete package of advice, service and design assistance.

'Sound Field' - a Synopsis ...Its use and benefits in schools

i-ceilings includes a range of speaker systems using NXT technology to provide superior levels of speech intelligibility compared to existing traditional speaker systems.

Forming part of our A.B.L.E (A Better Learning Environment) initiative, the earlier pages refer to our 'passive' acoustic treatment as a solution to control sound effectively within the Education environment. i-ceilings loudspeaker technology provides the 'active' solution for improved levels of intelligibility and communication within the classroom environment.

Young people spend at least 45% of their school day engaged in listening activities, with today's classroom acting as a primarily auditory verbal environment.

However, a recent study in the journal of the American Medical Association showed that 14.9% of children aged 6 - 19 suffer from some degree of hearing impairment, either permanently or temporarily due to illness, infection or allergies.

Studies estimate that 80% of school children will have some form of hearing loss during an academic year and, with the importance of auditory learning in the classroom, the use of technology to enhance listening performance ultimately allows children to learn more efficiently.

One of the simplest and most effective solutions is a 'Sound Field Voice Re-inforcement System'.

Functioning like a mini public address system in harmony with the classroom acoustics, Sound Field Voice Re-inforcement features a wireless microphone, receiver, amplifier and between one and four loudspeakers (dependent upon the size of the classroom).



Studying the effectiveness of Sound Field

In a study of 8 - 10 year old students in the U.S. to test the effectiveness of Sound Field Voice Re-inforcement in the classroom, students showed an average improvement in identified spoken words of 45% using the systems. Furthermore, when tested without a Sound Field System, the children missed an average of 42% of the questions.

Within the school utilised for the test, the principal, teachers and students completed questionnaires regarding Sound Field Systems. Most stated that overall attention spans improved, students followed the directions more easily and they showed less hesitation when beginning their work. The majority of students said it was easier to hear the teachers and that the teachers did not have to yell or raise their voices.

In striving to plan successful academic programmes, teachers need to consider the sheer numbers of students who may not hear well on any given school day. Sound Field Voice Re-inforcement Systems are an easy, cost effective way to address these issues, while also ensuring that all students listen and learn productively throughout the school year.



The Government Specification of Acoustic Performance in Schools

Section 1 of the Building Bulletin 93, the Government's Specification of Acoustic Performance sets the standards for the acoustics of new buildings and explains the requirements and solutions to "...provide acoustic conditions in schools that facilitate clear speech communication between teacher and students..."

"...The key aim of a (speech re-inforcement) system is to increase the loudness of the direct sound, particularly for more distant listeners, whilst keeping sound as natural as possible.

The distribution of loudspeakers and their directional characteristics is a key issue in achieving high speech intelligibility. For large teaching rooms and lecture theatres, loudspeakers can be distributed in the ceiling..."

Furthermore, within Appendix 9: 'Equipment Specifications for sound field systems in schools', the report states NXT Loudspeakers and names Armstrong i-ceilings as recommended solutions; "There are advantages in the use of these loudspeaker types, as they provide a better average sound coverage in a room and provide a better level of speech intelligibility under some conditions... Less NXT type loudspeakers are required and it may be found that one (loudspeaker) will suffice for the smaller classroom."



Armstrong i-ceilings - already proving highly successful in leading educational applications including York University Library, The University of Edinburgh Medical School, Blyth Community College and Loughborough University Sports Facility.



The further benefits of Armstrong i-ceilings within a Sound Field Voice Re-inforcement System

All children benefit from the improved speech clarity of a Sound Field System. Academic improvements are noted in:

- Task behaviour
- Attentiveness
- Understanding of instructions
- Less repetition required
- Better attendance
- Improved measures of verbal recognition

The application of Armstrong i-ceilings as a Sound Field Solution also provides a unique and completely 'invisible' loudspeaker solution, ensuring the clean, simple lines of the building's interior are maintained. This inability to identify the products also greatly decreases the possibilities of loudspeaker theft or vandalism.

i-ceilings exactly match over 90% of Armstrong suspended ceiling systems sold in the UK - the most prevalent ceiling solution in the educational establishment sector.

Furthermore, i-ceilings has proved in test after test to be installed up to 75% faster than conventional ceiling speakers.

Further de

Impact of Armstrong i-ceilings Sound Field to provide a better learning environment:

It is accepted that good speech intelligibility is a fundamental requirement when designing teaching environments. Whilst BB93 focuses on reverberation time, consideration is given to the other basic elements required to provide speech intelligibility.

Most students will be able to hear the teacher but not all can actually understand what is being said. The ability to communicate effectively within a classroom, or any space, depends on a few basic elements:

- Appropriate reverberation time (RT)
- Signal to Noise Ratio (SN)
- Appropriate sound pressure level (SPL)

Combined at the optimum levels these elements will produce a classroom that evolves into a communication tool rather than a facility built to simply 'meet-and-teach'.



- Speech Intelligibility (STI)

The speech transmission index is an objective measure defined in BS EN 60268-16:1998, accounting for all variables in room acoustics eg. room design, volume and surface materials. The index provide a guide to what RT is acceptable to create an effective communication space.

- Reverberation time (RT)

The RT index is used to determine how quickly sound decays in a room. The physical volume and surface materials used in the room dictate the RT characteristics.

Measured in time, high values represent more 'lively' resonating spaces - or increased 'echo'

Lower values indicated more dry spaces.

Classrooms environments are measures using the average value of RT from three specific octave bands centred at frequencies of 500Hz, 1000Hz & 2000Hz.

- Loudness (SPL)

SPL is an indication of the loudness of a source (noise). eg, Normal speaking voice is about 60 dB(A)
120dB is the "threshold of feeling"
130dB is artillery fire at 1 meter
140dB (threshold of pain) is a jet aircraft at 5 meters.

- Signal to Noise (SN): Dynamic range

Signal to noise ratio measures the difference in loudness between ambient noise (background sounds like air conditioning, whirring of computer fans or even external noise such as road or air traffic) and the signal (the speaker or person speaking). If the difference in loudness is too small, then background noise will disrupt the intelligibility of the speaker.

Graphs see following page demonstrate the value of considering both passive and active acoustical treatments in the design of classrooms.

Sound Field

Impact



Figure A. Typical Classroom
Minimum level of sound absorption is expressed as a lively space with excessive loudness.

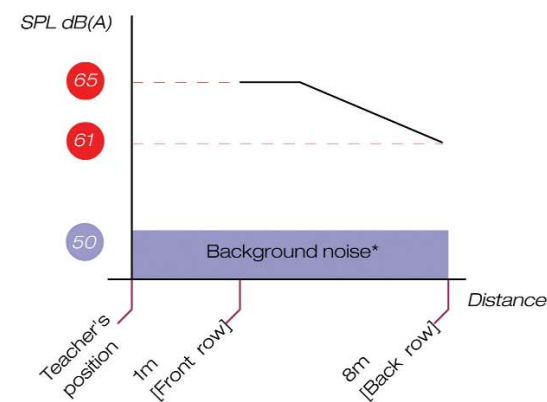


Figure B. Typical classroom with ceiling/passive acoustics treatment
When the sound level (loudness) difference between the teacher's voice and the intruding noise is less than 10 Db(A), intelligibility is degraded

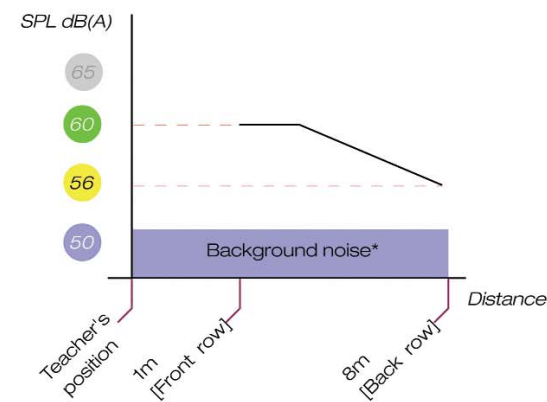
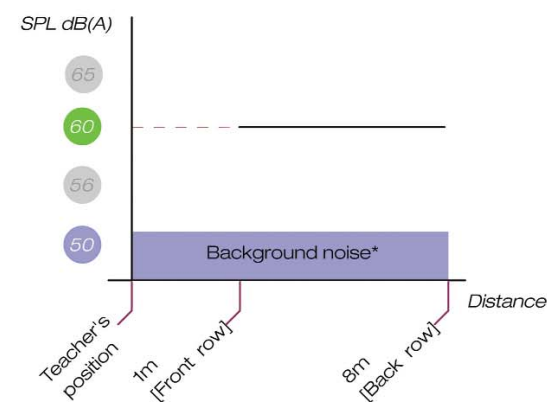


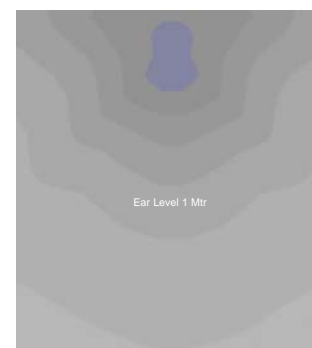
Figure C. Typical classroom with passive acoustics + sound field
The i-ceilings sound field system provides even sound pressure levels across the room with maintained intelligibility



The impact of Armstrong's Sound Field solutions...

Being widely accepted as the largest single area used to passively control room acoustics, Armstrong has conducted extensive acoustical modelling to assess the impact of global acoustic treatments, suspended ceilings & i-ceilings, in learning environments.

> Sound pressure levels (1000Hz)



Uneven listening conditions

Typical Classroom with i-ceilings



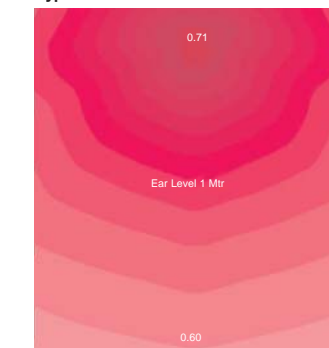
Uniform listening conditions

How much ceiling absorption is required in your design scheme?

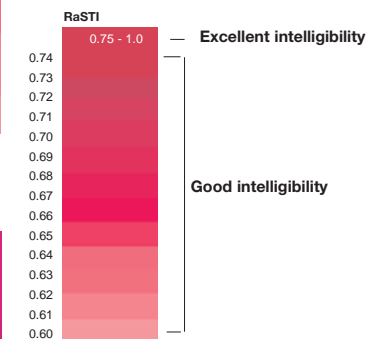
Results featured below express that in a typical classroom, the i-ceilings sound reinforcement system enhances the room's acoustical conditions by producing more equal 'loudness' with overall increased intelligibility. This configuration offers even levels of listening conditions throughout the room as opposed to a 'seat dependant' situation where the back half of a classroom may be penalised.

> Speech transmission index (STI) (average 500/1000/2000Hz)

Typical Classroom



Typical Classroom with i-ceilings



* Background noise accounts for occupational noise (pupils, HVAC, Audio Visual equipment) and noise break in. Background noise sound pressure levels fluctuate below a peak level considered at 50dB(A).