Education Funding Agency

ACOUSTIC

PERFORMANCE STANDARDS FOR THE PRIORITY SCHOOLS BUILDING PROGRAMME

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1 INTRODUCTION AND SCOPE

1.1 Background

This document should be used in place of Section 1 of the Second Edition of Building Bulletin 93 (BB93), published in 2003 as the acoustic performance standards for the Priority Schools Building Programme (PSBP). For the purposes of Building Regulations submissions, any variations from the existing BB93 should be taken as Alternative Performance Standards approved by the Education Funding Agency for this programme.

EFA intend to go out to public consultation later in the year to adopt these standards as the replacement for BB93 as the normal means of compliance with Requirement E4 of the Building Regulations and with the Acoustic Requirements of the School Premises Regulations (2012).

The overall objective of the performance standards is to ensure that the design and construction of the building provide acoustic conditions in schools that (a) facilitate clear communication of speech between teacher and student, and between students, and (b) do not interfere with study activities.

This document should be read in conjunction with the *Acoustic Design of Schools – A Design Guide* (expected to be available from late 2012, to be published by the Association of Noise Consultants and/or the Institute of Acoustics), which will contain supporting information and additional design considerations. References to this guide are made throughout this document. Until such time as the new guide is published Building Bulletin 93 Section 2 and the following sections can continue to be used for further guidance. The parts of the new guidance on design of sports halls and open plan areas have been included at Appendix A ahead of publication of the Design Guide as these include some major changes to the guidance given in BB93.

1.2 Building Regulations

The acoustic conditions in schools are controlled by Part E of the Building Regulations and by the School Premises Regulations, which apply to new and existing schools. Requirement E4 from Part E of Schedule 1 to the Building Regulations 2010 (as amended by SI 2002/2871) states:

> "*Each room or other space in a school building shall be designed and constructed in such a way that it has the acoustic conditions and the insulation against disturbance by noise appropriate to its intended use."*

Approved Document E in support of the Building Regulations gives the following guidance:

> "*In the Secretary of State's view the normal way of satisfying Requirement E4 will be to meet the values for sound insulation, reverberation time and internal ambient noise which are given in Section 1 of Building Bulletin 93 'The Acoustic Design of Schools'*, produced by DfES." (Note DfES is now DfE).

1.3 School Premises Regulations (SPRs)

The School Premises Regulations contain similar statements to those in Requirement E4 of the Building Regulations, and apply to both new and existing school buildings. In addition to the design and construction standards covered by the Building Regulations, the School Premises Regulations cover the performance in use of schools:

"*The acoustic conditions and sound insulation of the schools must be suitable, having regard to the nature of the activities which normally take place therein.*"

To comply with the School Premises Regulations (but not the Building Regulations) open plan teaching and learning spaces in new and refurbished schools will need to provide adequate Speech Transmission Index. Operational noise levels (i.e. of equipment) in teaching and learning spaces will also need to be suitable for the activities taking place.

The Independent Schools Standards will mirror the Schools Premises Regulations when published in January 2013.

1.4 Areas covered by the regulations

1.4.1 Teaching and non-teaching spaces

Requirement E4 of the Building Regulations applies to teaching and learning spaces. School Premises Regulations apply to all areas of schools. The Regulations are not intended to cover the acoustic conditions in administration and ancillary spaces not used for teaching and learning except in as far as they affect conditions in neighbouring teaching and learning spaces. Therefore, consideration needs to be given to adjoining areas, such as corridors, which might have doors, ventilators, or glazing separating them from a teaching or learning space. The performance standards given in the tables for administration and ancillary spaces should however be adopted for the Priority Schools Building Programme.

1.4.2 Temporary buildings

Temporary buildings are exempt from Requirement E4 of the Building Regulations (but not from the School Premises Regulations). Temporary buildings are defined in Schedule 2 to the Building Regulations as those not intended to remain in place for longer than 28 days. What are commonly called temporary buildings in schools are classed as prefabricated buildings and are normally subject to the same Building Regulation requirements as other types of building. Many buildings in schools have only temporary planning permission, which usually lasts for two years. These buildings are subject to the Building Regulations.

Additional guidance on prefabricated buildings is given in Clause 0.6 of Approved Document E. These include, for example, a building created by dismantling, transporting and re-erecting sub-assemblies on the same premises or another premises. In these circumstances by virtue of the School Premises Regulations, the minimum standards for refurbishment and conversion of existing buildings apply.

1.4.3 New-build, conversion and refurbishment work

SPRs apply to refurbishment work, and the acoustic standards for refurbishment works given in this document apply. Where there is a need to upgrade the acoustic performance of an existing building or when refurbishment is undertaken for other reasons, then the building should as far as reasonably practicable aim to meet the acoustic performance given in these guidelines to satisfy the School Premises Regulations and the Disability Discrimination Act.

Although Building Regulations do not apply to all alteration and refurbishment work, it is desirable that such work should consider acoustics and incorporate upgrading of the acoustics as appropriate. In the case of existing buildings, Part E of the Building Regulations applies to material changes of use as defined in Building Regulations.

The values in brackets in the Tables apply to new elements fitted within a refurbishment.

Where there is a material change of use of the whole of a building, such work shall be carried out as is necessary to ensure that the building complies with the applicable requirements of Requirement E4 of the Building Regulations.

1.4.4 Nursery and community education

Part E of the Building Regulations covers rooms used for nursery and adult/community education within school complexes but does not apply to nursery schools which are not part of a school.

SPRs cover all types of schools, including nursery schools.

1.4.5 Universities and Colleges of Further Education

Part E4 does not cover sixth form colleges that have not been established as schools, or Universities or Colleges of Further and Higher Education[1]. However, many of the acoustic specifications are desirable and can be used as a guide to the design of these buildings. Part E4 does apply to sixth form units forming part of a school.

1.4.6 Planning requirements

Although Part E4 does not apply to other educational institutions, Building Bulletin 93 is often used as a design guide in the absence of more relevant criteria, both at Planning and Design stages.

BRE Global currently refer to compliance with BB93 as a means of attaining specific BREEAM credits, verified by site testing in accordance with the Association of Noise Consultants *Good Practice Guide – Acoustic Testing of Schools.* Compliance with specific BREEAM credits is often a requirement of Planning.

1.4.7 Performance in use

Schools Premises Regulations give guidance on operational noise of classroom equipment, e.g. computers, projectors, fume cupboards etc. Detailed information on typical noise levels and good practice design will be available in the Institute of Acoustics/Association of Noise Consultants document *Acoustic Design of Schools – A Design Guide*.

[1] Part E of the Building Regulations quotes the definition of school given in Section 4 of the 1996 Education Act. In the case of sixth form colleges Section 4 of the 1996 Act should be read in conjunction with Section 2 of the same Act, in particular subsections (2), (2A) and (4) which deal with the definition of secondary education.

If a sixth form college is established as a school under the 1998 School Standards and Framework Act then it will be classed as a school under Section 4 of the 1996 Education Act and Part E of the Building Regulations on acoustics will apply.

Therefore, most sixth form colleges are institutions in the Further Education sector and not schools, and Part E of the Building Regulations will not apply. In the case of a new sixth form college it will be necessary to contact the Local Authority to enquire if the sixth form college has been established as a school or as an Institute of Further Education.

1.5 Provision for children having Special Educational Needs

For the purposes of this document, Special Educational Needs include, but are not limited to, children:

- with permanent hearing impairment
- with speech, language and communication difficulties
- whose first language is not English
- with visual impairments
- with fluctuating hearing impairments caused by conductive hearing loss
- with attention deficit hyperactivity disorders (ADHD)
- with an auditory processing disorder or difficulty
- on the Autistic Spectrum

The Equalities Act 2010 places a duty on all schools and Local Authorities to prepare and implement accessibility strategies and plans to increase over time the accessibility of schools for disabled pupils. Schools and Local Authorities are required to provide strategies for:

a) Increasing the extent to which disabled pupils can participate in a school's curriculum.

b) Improving the physical environment of schools for the purpose of increasing the extent to which disabled pupils are able to take advantage of education and benefits, facilities and services provided or offered by the schools.

c) Improving the delivery to disabled pupils of information that is readily accessible to pupils who are not disabled.

This could mean provision of physical aids and acoustic improvements and aids for hearing impaired and other pupils.

When alterations affect the acoustics of a space then improvement of the acoustics to promote better access for children with special needs, including hearing impairments, should be considered. Approved Document M: 2004 – *Access to and use of buildings*, in support of the Building Regulations[5] includes requirements for access for children with special needs. See: BS 8300:2009 Design of buildings and their approaches to meet the needs of disabled people. Code of practice[6]; Building Bulletin 102*, Designing for disabled children and children with special educational needs - Guidance for mainstream and special schools [7]; and* Building Bulletin 96*: Meeting the educational needs of children and young people in hospital[8].*

1.5.1 Acoustic considerations

Pupils with special educational needs are generally even more reliant on good quality acoustic environments than others. Consequently, required reverberation times should be lower, sound insulation between adjacent spaces higher and indoor ambient noise levels (and the capacity for distraction) lower than environments for other pupils. This is reflected in the Tables contained within this document.

1.5.2 Visual considerations

Some pupils having Special Educational Needs, such as Autistic Spectrum Disorders, may require particular consideration in relation to the visual impact of

acoustic treatment. Regular ceiling grids and other patterns that may cause distraction to pupils therefore require careful consideration.

1.5.3 Durability and robustness

Where the physical behaviour of pupils requires a high level of robustness and durability from room finishes then due consideration should be given to the appropriate selection of materials in the acoustic design.

1.6 Alternative Performance Standards

For new buildings, alternative performance standards (APS) must only be adopted in exceptional circumstances.

No APS of a lower standard than those given for refurbishment should normally be permitted, other than in exceptional circumstances. The minimum standards for refurbishment are given in square brackets in the Tables.

Where the performance standard for refurbishment is proposed as an APS, a full and proper case must be made to justify this decision.

Any APS must be justified on the grounds of educational, environmental or health and safety need and the project Acoustician should make the Building Control Body and the Client body aware of the practical implications with respect to the operation of the space. The APS must be no worse than the refurbishment standards given in the Tables.

The procedure set out in this Section must be followed to ensure that the client and users of the school understand the effect of the reduction in standards.

Areas within existing or converted schools where performance values are unable to achieve the values for refurbishment given in square brackets in the Tables should be accompanied by a management strategy that enables the use of these spaces in a satisfactory manner, despite the sub-standard acoustic performance.

2 PERFORMANCE STANDARDS

In addition to the following minimum standards, the School Premises Regulations require that consideration must be given to the 'performance in use' standards for speech intelligibility and operational noise that are given in Section 2.8.

The Building Regulations require that all spaces should meet the performance standards for indoor ambient noise level, airborne and impact sound insulation, and reverberation time as specified in Tables 1, 2, 3, 4 and 5. Whilst these Tables cover commonly used room types, individual schools may have types not shown; a more comprehensive list will be available in the document *Acoustic Design of Schools – A Design Guide.*

To comply with the SPRs open plan spaces should additionally meet the performance standard for Speech Transmission Index in Table 6.

This section sets out the measurable acoustic performance standards. The normal way of satisfying Requirement E4 of The Building Regulations and School Premises Regulations is to demonstrate that all the appropriate performance standards in Section 2 have been met.

Section 3 sets out the preferred means for demonstrating compliance of the design to the Body responsible for verifying compliance.

Section 3 describes acoustic tests that can be used to demonstrate compliance with the in-situ performance standards in Section 2. It is strongly recommended that the client requires acoustic testing to be carried out as part of the building contract, because testing of the completed construction is the best practical means of ensuring that it achieves the design intent.

Further guidance will be included in the *Acoustic Design of Schools – A Design Guide*, available from late 2012. This will provide additional information on how to comply with these acoustic standards, on testing / commissioning procedures, and on the acoustic requirements and design of buildings for education purposes.

2.1 Indoor ambient noise levels in unoccupied spaces

2.1.1 Objectives and definitions

The objective is to provide suitable Indoor Ambient Noise Levels (IANL) for

(a) clear communication of speech between teacher and student

(b) clear communication between students and

(c) learning and study activities.

The IANL includes noise contributions from:

- external sources outside the school premises (including, but not limited to, noise from road, rail and air traffic, industrial and commercial premises).
- building services (e.g. ventilation systems, plant, drainage, etc.). If a room is naturally ventilated, the IANL is calculated and measured with ventilators or windows open as required to provide ventilation as described in Section 2.1.3. If a room is mechanically ventilated or cooled, the plant should be assumed to be running at its normal operating duty as described in Section 2.1.3.

The indoor ambient noise level excludes noise contributions from:

- teaching activities within the school premises, including noise from staff, students and equipment within the building or in the playground. Noise transmitted from adjacent spaces is addressed by the airborne and impact sound insulation requirements.
- equipment used in the space (e.g. machine tools, CNC machines, dust and fume extract equipment, compressors, computers, projectors, fume cupboards). However, to comply with the School Premises Regulations, noise from sources that are normally in use during teaching activities and cannot easily be switched off should be considered. See Section 1.4.7 and the *Acoustic Design of Schools - A Design Guide* document.
- rain noise. However, PSBP designs should demonstrate that lightweight roofs and roof glazing have been designed to provide suitable control of rain noise reverberant sound pressure level in a space (calculated using laboratory test data with 'Heavy' rain noise excitation as defined in BS EN ISO 140-18). Levels during Heavy rain should not be more than 25 dB above the appropriate indoor ambient noise level given in Table 1. For refurbishments, this only applies to new roofs (including roof lights) and does not apply to repairs to existing roofs.

2.1.2 Acoustic performance standards

Table 1 specifies upper limits for indoor ambient noise levels in terms of $L_{Aeq,30mins}$ during normal teaching hours. The values not in brackets apply to new buildings and to new extensions to existing buildings. The values in square brackets apply to conversions and refurbishments of existing buildings, and are also the upper limits for APS (see Section 1.6).

Where a type of room is not listed, the nearest approximation should be used. Where a room is used for more than one purpose, the most onerous condition should be used.

Noise from plant, machinery and equipment in teaching and learning rooms should not contain any significant tonal or intermittent characteristics. Noise from building services which are particularly distracting, e.g., sudden, tonal, or impulsive should be reduced to a level at least 5 dB below the relevant upper limit.

Table 1: Upper limits for indoor ambient noise level, $L_{Aeq,30mins.}$

Type of room	**Room classification for the purpose of airborne sound insulation in Table 2**		**Upper limit for the indoor ambient noise level $L_{Aeq,30mins}$ dB**
	Activity noise (Source room)	**Noise tolerance (Receiving room)**	
Nursery school rooms	Average	Medium	35 [40]
Primary school: classrooms, class bases, general teaching areas, small group rooms	Average	Medium	35 [40]
Secondary school: classrooms, general teaching areas, seminar rooms, tutorial rooms, language laboratories	Average	Medium	35 [40]
Open plan (See also Section 2.8)			
Teaching areas	Average	Medium	40 [45]
Resource/Breakout areas	Average	Medium	40 [45]
Music			
Primary music room	High	Medium	35 [40]
Secondary music classroom	Very high	Low	35 [40]
Small and large practice/group room	Very high	Low	35 [40]
Ensemble room	Very high	Low	35 [40]
Performance/recital room	Very high	Low	35 [40]
Recording studio	Very high	Low	35 [40]
Control room - for recording	High	Low	35 [40]
Control room – not for recording	High	Medium	35 [40]
Lecture rooms			
Small (fewer than 50 people)	Average	Medium	35 [40]
Large (more than 50 people)	Average	Medium	35 [40]
Teaching spaces specifically for students with Special Educational Needs (See	Average	Low	30 [35]

Section 1.5)			
Study room (individual study, withdrawal, remedial work, teacher preparation)	Low	Medium	40 [45]
Libraries			
Quiet study areas	Low	Medium	40 [45]
Resource areas	Average	Medium	40 [45]
Science laboratories	Average	Medium	40 [45]
Drama studios	High	Low	35 [40]
Design and Technology			
Resistant materials, CADCAM areas	High	High	40 [45]
Electronics/control, textiles, food, graphics, design/resource areas, ICT rooms, art	Average	Medium	40 [45]
Assembly halls, multi-purpose halls (drama, PE, audio/visual presentations, assembly, occasional music)	High	Low	35 [40]
Atria, circulation spaces used for circulation and socialising but not teaching and learning	Average	Medium	45 [45]
Sports hall	High	Medium	40 [45]
Dance studio	High	Medium	40 [45]
Gymnasium/Activity studio	High	Medium	40 [45]
Swimming pool	High	High	50 [50]
Meeting rooms, Interviewing/counselling rooms, video conference rooms	Low	Low	40 [45]
Dining rooms	High	Medium	45 [45]
Administration and ancillary spaces (for guidance only – not mandatory)			
Kitchens	High	High	50 [50]
Offices, medical rooms, staff rooms	Low	Medium	45 [45]
Corridors, stairwells, coats and locker areas	Average	Medium	45 [45]
Changing areas	High	High	50 [50]
Toilets	Average	Medium	50 [50]

2.1.3 Ventilation and Internal Ambient Noise Levels

All mechanical ventilation systems must meet the indoor ambient noise levels given in Table 1 (when measured in conjunction with noise break-in from external sources). Mechanical ventilation refers to systems (or parts of systems) that use mechanical fans or hybrid systems.

The IANLs given in Table 1 should be achieved with ventilation set to provide a carbon dioxide concentration of 1500 ppm or less for the design mid-season weather condition. The design mid-season weather condition is defined as an inside air temperature of 20 ^{o}C and an outside air temperature of 11 ^{o}C with an average external wind speed of 1.5 m/s.

For classrooms designed specifically for use by students who have Special Educational Needs the performance standards in Table 1 should also be met at the design summertime condition.

Where noise surveys show that the external noise level at a position representative of the window is no more than 13 dB (for single sided ventilation) or 18 dB (for cross-ventilation) above the design IANL, opening windows and vents are deemed to satisfy the acoustic requirement as long as the IANL inside the room with the windows closed does not exceed the IANL given in Table 1 and concentrations of carbon dioxide are within limits above. Single sided ventilation is defined as where air enters and exhausts from the same façade; double-sided ventilation is where air intake and exhaust are on different room elevations.

It should be noted that the above only applies where windows are top or bottom hung with 100 mm maximum opening. For side hung glazing the attenuation against external noise will depend on the hinge side in relation to the noise source; for other types of glazing such as horizontal/vertical sliding (sash) or in-line sliding, noise ingress may be significantly greater than top or bottom hung glazing. For these and other types of opening, calculations will be required to demonstrate than IANLs will be met.

At higher external noise levels mechanical ventilation or sound attenuated natural ventilation is required to meet the IANL with mechanical ventilation operating to provide 1000 ppm and natural ventilation operating to provide 1500 ppm in all teaching spaces.

It is recommended that during unusually hot weather a means is provided for the teacher to increase the air velocity in the room to improve comfort, for example, by opening windows, switching on local fans such as punkah fans or boosting the mechanical ventilation. Under these conditions higher noise levels are acceptable.

2.2 Airborne sound insulation between spaces

2.2.1 Objectives and definitions

The objective is to attenuate airborne sound transmitted between spaces through internal walls and floors. This includes the effect of internal glazing, doors, structure-borne and flanking transmission.

The sound insulation is to be assessed in terms of the standardised level difference D_{nT} in accordance with BS EN ISO 140-4:1998 and the results are to be weighted and expressed as a single-number quantity, $D_{nT,w}$ in accordance with BS EN ISO 717-1:1997. For the purposes of the assessment the reference reverberation time T is 0.5 seconds in all one-third octave bands from 100 Hz to 3.15 kHz

2.2.2 Acoustic performance standards

Table 2 shows the minimum airborne sound insulation required between rooms. These values are defined by the activity noise in the source room and the noise tolerance in the receiving room as given in Table 1.

The design assessment of $D_{nT,w}$ between two rooms must be carried out in both directions. See the *Acoustic Design of Schools – A Design Guide* that will include some example calculations.

Table 2: Performance standards for airborne sound insulation between spaces

Minimum $D_{nT,w}$ (dB)		**Activity noise in source room** (see Table 1)			
		Low	Average	High	Very high
Noise tolerance in receiving room (see Table 1)	High	Not applicable	35 [30]	45 [35]	50 [45]
	Medium	40 [30]	45 [40]	50 [45]	55 [45]
	Low	45 [35]	50 [40]	55 [50]	55 [50]

2.2.3 Exceptions

- Serving hatches between kitchens and multipurpose halls used for dining halls should be avoided if possible, and serveries should be placed between kitchens and dining areas wherever possible to avoid noise transfer during meal preparation. Where this is not possible, serving hatches should have a sound insulation of 18 dB R_w and the dining hall space will need to be timetabled so that noise sensitive activities, e.g., exams, do not take place in the hall when the kitchen is in use.
- Where for operational or safety purposes it is essential to link a pair of teaching spaces via an interconnecting door, this should be a doorset with a rating of at least 35 dB R_w. The surrounding wall containing the doorset should ha*v*e a sound insulation rating of at least 45 dB R_w.
- Where there is an operable wall or folding partition between a drama studio or other teaching area and a hall, the minimum $D_{nT,w}$ between the spaces shall be 45 dB. The end user needs to appreciate that the sound insulation performance of the operable wall may not facilitate simultaneous use of the spaces on either side.
- Where music practice rooms are accessed directly off a music classroom then the level of sound insulation will not meet design criteria. Where concurrent use of the spaces is required then partitions dividing the spaces should have a sound insulation of 50 dB R_w with a doorset of at least 40 dB R_w. Back-to-back doorsets may be required to achieve this level of sound reduction and meet opening weight restrictions.
- Vision panels between multi-purpose halls and control rooms require careful consideration. If visual communication only is required then the vision panel should provide at least 45 dB R_w dB, set within a wall rated at 55 dB R_w dB. This degree of sound insulation from a vision panel will require specialist design input. Alternatively, consideration should be given to the use of cameras instead of vision panels. Where visual and audio communication is required between the spaces then a sliding vision panel of only nominal acoustic performance may be appropriate, set in a wall rated at 45 dB R_w dB. The same considerations are required for vision panels between control rooms and Live Rooms for recording.

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2.3 Airborne sound insulation between circulation spaces and other spaces used by students

2.3.1 Objectives and definitions

The objective is to attenuate airborne sound transmitted between circulation spaces (e.g. corridors, stairwells etc.) and other spaces used by students, for the purposes of minimising disturbance to teaching and learning spaces. This applies where the separating construction contains doors and/or glazed elements, but does not include flank walls of classrooms that do not give direct access to circulation spaces (in which case values from Table 1 should be used).

Values in the tables are the minimum weighted sound reduction index R_w of doorsets and the minimum composite weighted sound reduction index of wall and glazing. The weighted sound reduction index is measured in accordance with BS EN ISO 140-3:1995 and rated in accordance with BS EN ISO 717-1:1997.

Sound insulation of ventilators are specified in terms of the weighted element-normalised level difference, $D_{n,e,w}$ -10logN, where N is the number of ventilators with airborne sound insulation $D_{n,e,w}$. The weighted element-normalized level difference is measured in accordance with BS EN 20140-10:1992 and rated in accordance with BS EN ISO 717-1:1997.

2.3.2 Acoustic performance standards

Table 3a shows the minimum permissible airborne sound insulation for the composite separating wall construction, for a separating wall that does not include ventilators in the wall. Values not in brackets apply to new buildings and to new extensions to existing buildings. The values in square brackets apply to conversions and refurbishments of existing buildings, and are also the minimum acceptable standards for Alternative Performance Standards in new buildings.

Table 3a Performance standards for airborne sound insulation between circulation spaces and other spaces used by students, with no ventilator in the wall

Type of space used by students	Minimum R_w dB	
	Composite R_w of wall and glazing with no ventilator.	Doorset
Music rooms Control rooms – for recording Control rooms – not for recording Drama rooms Multi purpose halls Teaching spaces for use by students with special hearing or communication needs	45 [40]	35
All other rooms used for teaching or learning	40 [35]	30

Table 3b Performance standards for airborne sound insulation between circulation spaces and other spaces used by students, with ventilators in the wall

Type of space used by students	Minimum composite R_w of wall, glazing and doors dB	Minimum $D_{n,e,w}$ – 10logN dB for ventilators
Music rooms Control rooms – for recording Control rooms – not for recording Drama rooms Multi purpose halls Teaching spaces specifically designed for use by students with special hearing or communication needs	38[35]	37
All other rooms used for teaching or learning	33[30]	32

2.3.3 Other considerations and exclusions

The total number or total area of ventilators used in a calculation must be as specified by the mechanical services designer to achieve the required ventilation.

Tables 3a and 3b exclude:

- service corridors adjacent to spaces that are not used by students
- lobby corridors leading only to spaces used by students that have a high tolerance to noise as defined in Table 1.

2.4 Impact sound insulation of floors

2.4.1 Objectives and definitions

The objective is to control impact sound (e.g. from footsteps and movement of furniture) transmitted into spaces via the floor above.

Values in the tables are the maximum permissible weighted standardised impact sound pressure level $L'_{nT,w}$ (dB). This is measured in accordance with BS EN ISO 140-7:1998 and rated in accordance with BS EN ISO 717-2:1997. For the purposes of the assessment the reference reverberation time is 0.5 seconds in all one-third octave bands from 100 Hz to 3.15 kHz

2.4.2 Acoustic Performance Standards

Table 4 shows the maximum weighted standardised impact sound pressure level, $L'_{nT,w}$, for receiving rooms of different types and uses. The values not in square brackets apply to new buildings and to new extensions to existing buildings. The values in square brackets apply to conversions and refurbishments of existing buildings, and are also the minimum acceptable standards for Alternative Performance Standards in new buildings.

2.4.3 Exceptions

It is usual under Building Regulations for impact criteria to be achieved by the structural floor without finishes. However, as floor finishes are fixed and are unlikely to be taken up and replaced with a lesser performing system, it may be possible to agree with the Building Control Body that floor finishes are taken into account in the design and this is the assumption for the PSBP schools.

Impact noise is defined for the purposes of controlling footfall and ‘minor’ impacts such as chairs scraping across floors. It does not therefore address issues such as slamming doors (where care should be taken to ensure doors are fitted with soft closers, wherever possible) or significant impacts such as dancing (where specialist advice will be required from the acoustician and structural engineer).

Table 4: Performance standards for impact sound insulation of floors

Type of room (receiving room)		**Maximum impact sound pressure level $L'_{nT,w}$ dB**
Nursery school rooms		60 [65]
Primary school: classrooms, class bases, general teaching areas, small group rooms		60 [65]
Secondary school: classrooms, general teaching areas, seminar rooms, tutorial rooms, language laboratories		60 [65]
Open plan Teaching and Resource areas		60 [65]
Primary music classroom		60 [65]
Secondary music rooms		55 [65]
Control room – for recording		55 [65]
Control room – not for recording		55 [65]
Lecture rooms		60 [65]
Teaching spaces specifically for pupils having Special Educational Needs (See Section 1.5)		55 [60]
Libraries		60 [65]
Science laboratories		60 [65]
Drama studios		60 [65]
Design and Technology - Resistant materials, CADCAM areas, Electronics/control, textiles, food, graphics, design/resource areas, ICT rooms, Art rooms		60 [65]
Assembly halls, multi-purpose halls (drama, PE, audio/visual presentations, assembly, occasional music)		60 [65]
Atria, circulation spaces used for circulation and socialising but not teaching and learning		65 [65]
Sports hall		60 [65]
Gymnasium, activity studio		60 [65]
Dance studio		60 [65]
Swimming pool		65 [65]
Meeting rooms, interviewing/counselling rooms, video conference rooms		60 [65]
Dining rooms		65 [65]
Administration and ancillary spaces (for guidance only – not mandatory)	Kitchens	65 [65]
	Offices, staff rooms, medical rooms	65 [65]
	Corridors, stairwells	65 [65]
	Coats and locker areas and changing areas	65 [65]
	Toilets	65 [65]

2.5 Reverberation in teaching and study spaces

2.5.1 Objectives and definitions

The objective is to provide suitable reverberation times (RTs) for

(a) clear communication of speech between teacher and student

(b) clear communication between students and

(c) music teaching and performance.

The reverberation time is quoted in terms of the mid-frequency reverberation time, T_{mf} . Except in teaching spaces for use by students with special hearing or communication needs, this is the arithmetic average of the reverberation times in the 500 Hz, 1 kHz and 2 kHz octave bands OR the arithmetic average of the reverberation times in the one-third octave bands from 400 Hz to 2.5 KHz.

For teaching spaces for use by students with special hearing or communication needs, this frequency range T_{mf} is defined as the arithmetic average of the reverberation times from the 125 Hz to the 4 kHz octave bands OR the arithmetic average of the reverberation times in the one-third octave bands from 100 Hz to 5 KHz.

These values are for rooms that are finished, furnished for normal use, but unoccupied.

2.5.2 Acoustic performance standards

Table 5 contains the maximum mid-frequency reverberation times for rooms that are finished, furnished for normal use but unoccupied. Research shows that by minimising the T_{mf} there are numerous operational and educational benefits.

The values not in brackets apply to new buildings and to new extensions to existing buildings. The values in brackets apply to conversions and refurbishments of existing buildings, and are also upper limits for Alternative Performance Standards in new buildings.

Table 5: Performance standards for reverberation time

Type of room	**T_{mf} seconds**
Nursery school rooms	≤0.6 [≤0.8]
Primary school: classrooms, class bases, general teaching areas, small group rooms	≤0.6 [≤0.8]
Secondary school: classrooms, general teaching areas, seminar rooms, tutorial rooms	≤0.8 [≤1.0]
Secondary school language laboratories	≤0.8 [≤0.8]
Open plan	
Teaching areas	≤0.5 [see Section 2.8]
Resource/Breakout areas	≤1.2 [see Section 2.8]
Music	
Primary music room	≤1.0 [≤1.0]
Secondary music classroom	≤1.0 [≤1.0]
Practice/group room, volume ≤ 30 m^3	≤0.6 [≤0.8]

Practice/group room, volume > 30 m^3		≤0.8 [≤1.0]
Ensemble room, Live room		0.6 – 1.2 [0.6 – 1.2]
Performance/recital room		1.0 – 1.5 [1.0 – 1.5]
Control room - for recording		≤0.5 [≤0.6]
Control room – not for recording		≤0.5 [≤0.6]
Lecture rooms		
Small (fewer than 50 people)		≤0.8 [≤1.0]
Large (more than 50 people)		≤1.0 [≤1.0]
Teaching spaces specifically for pupils having Special Educational Needs (See Section 1.5)		≤0.4 averaged from 125 Hz to 2 kHz octave band centre frequencies and <0.6 s in any octave band centre frequency in this range [≤0.4].
Study room (individual study, withdrawal, remedial work, teacher preparation)		≤0.8 [≤1.0]
Libraries		≤1.0 [≤1.2]
Science laboratories		≤0.8 [≤1.0]
Drama studios		≤1.0 [≤1.0]
Design and Technology Resistant materials, CADCAM areas, Electronics/control, textiles, food, graphics, design/resource areas, ICT rooms, art		≤0.8 [≤1.0]
Assembly halls, multi-purpose halls (drama, PE, audio/visual presentations, assembly, occasional music).		0.8 – 1.2 [0.8 – 1.2]
Atria, foyers, entrance halls, spaces used for circulation and socialising but not teaching and learning		≤1.5 [≤2.0]
Indoor sports hall		≤2.0 [≤2.0]
Gymnasium/activity studio		≤1.5 [≤2.0]
Dance studio		≤1.2 [≤1.5]
Swimming pool		≤2.0 [≤2.0]
Meeting rooms, Interviewing/counselling rooms, video conference rooms		≤0.8 [≤0.8]
Dining rooms		≤1.0 [≤1.5]
Administration and ancillary spaces (for guidance only – not mandatory)	Kitchens	≤1.5 [≤2.0]
	Offices, medical rooms, staff rooms	≤1.0 [≤1.0]
	Corridors, stairwells	See Section 2.7
	Coats and locker areas, changing areas	≤1.5 [≤2.0]
	Toilets	≤1.5 [≤2.0]

2.5.3 Exceptions

- Vocational spaces (in excess of 500 m^3) such as workshops may accommodate a higher T_{mf} of up to 1.5 seconds, providing that the space is primarily used for practical work and not didactic teaching

2.6 Reverberation and acoustic absorption in sports halls

2.6.1 Objectives and definitions

The objective is to provide suitable reverberation times (RTs) for

(a) clear communication of speech between teacher and student

(b) clear communication between students

The reverberation time is quoted in terms of the mid-frequency reverberation time, T_{mf}. Except in sports halls specifically for use by students with special hearing or communication needs, this is the arithmetic average of the reverberation times in the 500 Hz, 1 kHz and 2 kHz octave bands OR the arithmetic average of the reverberation times in the one-third octave bands from 400 Hz to 2.5 kHz.

2.6.2 Acoustic performance standards

Sports halls shall be designed to achieve a mid-frequency reverberation time T_{mf} of ≤2.0s.

Absorption fixed to the walls must be evenly distributed, i.e. spread along the lengths of the wall surfaces, and fitted as low above finished floor level as practicable within the room. Absorption via the soffit alone will not meet the performance target.

See Appendix A for a worked example of the design calculation for absorption in a sports hall.

2.6.3 Other considerations

Due to the nature of activities carried out in sports halls, internal finishes must be robust. The types of sound absorbers used in other areas of the school may therefore not be appropriate.

Bodies such as Sport England have criteria that will have an impact on the acoustic design, such as walls needing to be flush and limitations on absorbent panels within 3 m above the floor.

2.6.4 Demonstrating compliance

For sports halls, compliance with the reverberation time criterion given in Table 5 may be demonstrated by either design in accordance with Appendix A, or measurement of mid-frequency reverberation time in accordance with the ANC good practice guide.

Evidence of compliance can be provided by submission of the acoustic model results or design calculations together with acoustic laboratory test data (where available) for all sound absorbing finishes used in the sports hall construction showing that the installed finishes can achieve the design objective. Where laboratory test data is not available then assumptions for values used in calculations should be given and justified. Following this method and correct installation of the materials in accordance with the design calculations, commissioning measurements of the reverberation time would not be required.

2.7 Sound absorption in corridors and stairwells

2.7.1 Objectives and definitions

The objective is to absorb sound in corridors, entrance halls and stairwells so that it does not interfere with teaching and study activities in adjacent rooms.

The requirement is to provide additional sound absorption in corridors, entrance halls and stairwells. The amount of additional absorption should be calculated according to Approved Document E, Section 7. This describes two calculation methods, A and B, for controlling reverberation in the common internal parts of domestic buildings. Either of these methods can be used to determine the amount of absorption required in corridors, entrance halls and stairwells in schools.

2.7.2 Exceptions

Corridors and stairwells that do not give direct access to teaching and learning spaces are not covered by this requirement. Refer to the *Acoustic Design of Schools – A Design Guide* that will contain further advice.

2.8 Open plan teaching and learning

In order to comply with the School Premises Regulations it is necessary to consider the speech intelligibility in open plan spaces.

For enclosed teaching and study spaces it is possible to achieve good speech intelligibility through specification of the indoor ambient noise level, sound insulation and reverberation time. Open plan spaces require additional specification as they are significantly more complex acoustic spaces. The main issue is that intrusive noise arising from activities in adjacent learning areas and circulation spaces significantly increases the background noise level, which in turn decreases speech intelligibility and causes distraction. Occupants working and talking within the space tend to raise their vocal effort as the background noise level increases, resulting in a spiralling increase in noise levels unless sound absorbent finishes are provided.

Open plan teaching and learning spaces require the commitment of end users to co-ordinate and manage activities in adjacent teaching and learning spaces and circulation areas in order to control intrusive noise levels. Users of the space cannot reasonably expect to use open plan spaces in the same way as cellular types, whilst maintaining the same degree of privacy.

2.8.1 Objectives and definitions

The objective is to control the build-up of occupancy noise, provide clear communication of speech within teaching groups, and provide sufficient speech privacy between teaching groups.

The expected open plan layout and activity plan should be agreed with the Client at an early stage of the design as the basis on which compliance with the Speech Transmission Index (STI) performance standard can be demonstrated.

An activity management plan should be used to establish (via a computer prediction model) the overall noise level due to all activities in the open plan space.

2.8.2 Acoustic performance standards

Table 6 gives basic performance criteria for open plan spaces, to be achieved in conjunction with the values given in other Tables. Additional criteria are suggested in Appendix 2.2

Table 6: Performance standard for speech intelligibility and privacy in open plan spaces – Speech Transmission Index (STI)

	Speech Transmission Index (STI)
Instruction or critical listening activity, within a group	≥0.6*
Between groups (during critical listening activities)	≤0.3

*It should be noted that a higher STI value may be more appropriate for very young students, students with English as an Additional Language and students with hearing impairments (see *Appendix A* for further information).

The STI should be calculated in accordance with EN 60268-16 (see *Acoustic Design of Schools – A Design Guide or BB93* for further information).

A computer prediction model should be used to calculate the STI in the open plan space. The background noise level used in the STI calculation should be the overall occupancy noise level (established from a prior computer prediction model) for the expected open plan layout and activity management plan (see Section 2.8.4). The background noise level is the overall noise level due to all activities in the open plan space (including teaching and study from adjacent classbases, but excluding the relevant speech signal).

Computer prediction software capable of simulating an impulse response should be used to create a three-dimensional geometric model of the space, comprising surface materials with scattering coefficients and sound absorption coefficients for each octave frequency band. The model should allow for the location and orientation of single and multiple sources with user-defined sound power levels and directivity.

Further information on input data to this model will be available in the document *Acoustics Design of School – A Design Guide and can be found in BB93*.

Other methods of estimating STI may also be applicable.

2.8.3 Exclusions

In some instances, open plan designs may not be intended for critical listening activities, or multiple and simultaneous independent instruction. For example, critical listening activity may only occur as a single, plenary session (i.e. having negligible intrusive noise from adjacent areas), followed by 'breakout' activity sessions. These breakout sessions may only involve less critical personal listening activities (for example one-to-one or small group instruction, paired or small group work) or individual study.

Further information on assessing the potential acoustic risks will be available in *Acoustics Design of School – A Design Guide* and can be found in BB93

2.8.4 Demonstrating compliance

The designer should clearly demonstrate how the open plan space will meet the criteria contained in Table 6, by means of layout plans and activity management plans (see Appendix 2.2 for further detailed). All calculations should be based on a computer model as defined above.

The open plan layout should identify:

- The positions at which teachers will typically instruct, or carry out other critical listening activities (e.g. presentations, large group discussions, seminars, etc.)
- The seating plan for the students and teachers
- Maximum communication distances for instruction or other critical listening activities
- Furniture, fittings and equipment plan

The activity management plan should include:

- The number, size and location of teaching groups where 'critical listening' activities occur (e.g. large group instruction, presentations, large group discussions, seminars, etc.), if applicable
- The number, size and location of teaching groups where instruction or other critical listening activities may occur simultaneously, if applicable.
- A description of other simultaneous activities which may occur in adjacent areas during critical listening periods, e.g. quiet individual work, paired work, group work, one-to-one or small group instruction, or social time.
- The number of teachers instructing or carrying out other critical listening activity at any one time
- The number of students in each teaching group
- Circulation routes to other parts of the building that may be used during teaching and study period
- Any equipment (e.g. engraving machines, CNC machines, dust and fume extract equipment, data projectors, computers, printers, AVA etc.) operating in the open plan space.

3 DEMONSTRATING COMPLIANCE

3.1 Procedures

The preferred means of demonstrating compliance with Building Regulations on acoustics is to submit to the Building Control Body a set of plans, construction details, material specifications, and calculations, as appropriate for each area of the school that is covered by Requirement E4 of the Building Regulations. There is no requirement in Building Regulations for acoustic commissioning although it is strongly recommended that this should be specified for contractual purposes.

The preferred means of demonstrating compliance with Schools Premises Regulations is by pre-completion testing in line with the Association of Noise Consultants publication *Good Practice Guide – Acoustic Testing of Schools*.

To demonstrate compliance with contractual requirements and fitness for purpose, acoustic commissioning should normally be required.

3.2 Information to be submitted pre-construction

Demonstration should be provided by a competent person (defined as a Corporate Member of the Institute of Acoustics) that spaces for teaching and learning comply with the performance criteria given within this document.

3.3 Alternative Performance Standards

In some circumstances alternative performance standards may be appropriate for specific areas within individual schools for particular educational, environmental or health and safety reasons (see Section 1.6). In these cases, the following information should be provided to the Building Control Body:

- a written report by a specialist acoustic consultant, clearly identifying (a) all areas of non-compliance with the performance standards (b) the proposed alternative performance standards and (c) the technical basis upon which these alternative performance standards have been chosen
- written confirmation from the educational provider (e.g. school or Local Authority) of areas of non-compliance, together with the justification for the need and suitability of the APS in each space.

3.4 Acoustic commissioning

To ensure that the performance standards are met, it is recommended that the client should include a requirement for acoustic testing in the building contract.

Pre-completion testing and subsequent reporting should be carried out by a competent person (as defined in Section 3.2 above) in line with the Association of Noise Consultants publication *Good Practice Guide – Acoustic Testing of Schools*.

Appendix A

A1 Design of Sports Halls

Achieving acceptable reverberation times in sports halls requires a good distribution around the roof surfaces of absorptive finishes, together with diffusion provided by irregular surfaces. Without these factors taken into consideration, reverberation times are likely to be high and reflections between large, parallel surfaces such as opposing walls can manifest as flutter echoes.

It is usual for the underside of the roof to be used as the primary method of providing absorption. A perforated trapezoidal roof liner having mineral wool laid directly over can provide significant absorption, assisted by the large surface area compared with the overall roof area. Generally, where perforations occur in flat or sloping sections only, absorption performance will be Class C; where perforations are in both flat and sloping sections then up to Class A performance is possible, although structural integrity is less, requiring additional support.

In addition to the roof liner, location of absorptive wall panels at high level can be effective, but requires significant coverage. Generally, the closer to the floor the absorbent treatment can be provided, the less the coverage required.

Successful recent designs have included fair faced blockwork (having Class D absorbent finish) from ground floor up to 3 m, in addition to a Class C perforated roof liner. This provides adequate distribution of absorption and diffusion within the listener plane, in addition to an impact resistance finish.

A2 Design of open plan spaces

A2.1 Physical factors

Open plan teaching and learning spaces should generally be provided with acoustically absorbent ceilings and floor coverings such as carpets and the reverberation time (T_{mf}) should be less than 0.5 seconds. Where possible, a maximum floor to ceiling height of 3.5 m is recommended.

Acoustic screens of between 1.6 m and 2 m height, i.e. high enough to block the line of sight, should be located between competing activities. Higher screens, whilst more effective acoustically, are usually too difficult to move. A horizontal ceiling or suspended absorbent acoustic raft positioned within 600 mm of the top of the acoustic screens can provide useful local sound attenuation between competing activities. The design of screens, horizontal acoustic absorbent plane and the physical separation of activities should aim to achieve at least 20 dB sound reduction between adjacent listening areas.

In practice, fully open plan spaces (e.g. without fixed divisions or walls between different classbases) will necessitate a highly sound absorbent ceiling or suspended horizontal acoustically absorbent raft (Class A rated in accordance with BS EN ISO 11654: 1997), in addition to a soft floor covering and acoustically absorbent screens, of height 1.6 m to 2 m, to divide and contain adjacent teaching or learning clusters in the same open area. The height of the sound absorbing ceiling or suspended raft should be limited to 3.5 m in order to provide effective sound attenuation between spaces. Due care and attention must be given to the ceiling surface to ensure grazing reflections are minimized. Consideration should also be given to the type of luminaires used, and flat lens types should be avoided due to their high sound reflectance. The horizontal absorbent plane provides privacy, minimises direct reflection and reduces reverberant sound. Small pod like structures can also effectively contain small groups within a much larger space.

In new buildings and where extensive refurbishment is occurring, detailed modelling of the speech intelligibility in the space and design in accordance with the following guidance is recommended.

A2.2 Detailed design considerations

Open plan spaces are generally designed for high flexibility in terms of the layout of teaching and study spaces. However, achieving maximum flexibility in a learning area usually requires provision of a mixture of both open and enclosed space, to provide appropriate listening conditions for the diversity of learning activities and learners' needs. Open plan teaching and learning spaces require the commitment of end users to co-ordinate and manage activities in adjacent teaching and learning spaces and circulation areas, in order to control intrusive noise levels. Users of the space cannot reasonably expect to use open plan spaces in the same way as cellular types of accommodation, whilst maintaining the same degree of privacy. Therefore, at an early stage in the design, the designer must establish the expected open plan layout and activity management plan with the client and furniture/fit out designers.

A2.3 Demonstration of design

The open plan layout should identify:

- The positions at which teachers will typically instruct or carry out other critical listening activities with groups of students
- The seating plan for the students and teachers
- Maximum communication distances for instruction or other critical listening activities
- Furniture, fittings and equipment plan

The activity management plan should include (where applicable):

- The number, size and location of teaching groups where 'critical listening' activities occur (e.g. large group instruction, presentations, large group discussions, seminars etc.)
- The number, size and location of teaching groups where multiple independent instruction or other critical listening activities may occur simultaneously.
- A description of other simultaneous activities that may occur in adjacent areas during critical listening periods, e.g. quiet individual work, paired work, group work, one-to-one or small group instruction, or social time.
- The number of teachers instructing or carrying out other critical listening activity at any one time and the number of students and the size of the groups they could be working in at any one time
- Circulation routes to other parts of the building that may be used during teaching and study periods and any equipment (e.g. engraving machines, CNC machines, dust and fume extract equipment, data projectors, computers, printers, AVA) operating in the open plan space.

The expected open plan layout and activity management plan should be agreed as the basis on which compliance with these guidelines can be demonstrated to the Client

The activity management plan should be used to establish the overall noise level due to the combination of the indoor ambient noise level, all activities in the open plan space (including teaching and study), and transmitted noise from adjacent spaces. A computer prediction model should be used to calculate the Speech Transmission

Index (STI) in the open plan space, using the overall noise level as the background noise level. Other methods of estimating STI may also be applicable.

The recommended performance standards for speech intelligibility in open plan spaces are described in terms of the Speech Transmission Index in the table below. These performance standards apply to speech transmitted from teacher to student, student to teacher and student to student.

Performance standard for speech intelligibility in open plan spaces – Speech Transmission Index (STI)	
	Speech Transmission Index (STI)
Instruction or critical listening activity – within group	≥0.6
Less onerous for secondary school age	≥0.55
Within a zone or minimum number of preferential locations suitable for vulnerable listeners	>0.6
Between independently instructed groups during critical listening activities	≤0.3
Between independently instructed groups during non-critical listening activities	≤0.4

The performance standards in the table above are intended to see that open plan spaces in schools are only built when suited to the planned activities and layout, and users are actively committed to adopting the activity management plan in order to avoid noise conflict. With some activity plans, room layouts and open plan designs it will not be possible to achieve these performance standards. At this point in the design process, the decision to introduce an open plan space into the school should be thoroughly re-assessed, either by altering the design and open plan layout or revisiting the activity management plan. If, after re- assessment, there is still a need for the open plan space, then the inclusion of moveable walls between learning bases should be considered. These moveable walls will form classrooms and be subject to the airborne sound insulation requirements in Table 2. It is not appropriate to simply adjust the activity management plan until the performance standards for speech intelligibility are met.

Computer prediction software capable of simulating an impulse response should be used to create a three-dimensional geometric model of the space, comprising surfaces with scattering coefficients and individually assigned absorption coefficients for each frequency band. The model should allow for the location and orientation of single and multiple sources with user-defined sound power levels and directivity. Further information on input data to this model will be available in the document *Acoustics Design of School – A Design Guide*.

Assumptions to be made in the assessment of speech intelligibility are:

- for students, when seated, the head height (for listening or speaking) is 0.8 m for nursery schools, 1.0 m for primary schools and 1.2 m for secondary schools

- for students, when standing, the head height (for listening or speaking) is 1.0 m for nursery schools, 1.2 m for primary schools and 1.65 m for secondary schools
- for teachers, when seated, the head height (for listening or speaking) is 1.2 m
- for teachers, when standing, the head height (for listening or speaking) is 1.65 m
- The background noise level is the overall noise level due to all intrusive noise activities (including teaching and study from adjacent classbases, but excluding the relevant speech signal) in the open plan space. Research has shown that this may typically be around 56 dB(A) but whatever value is used in the design should be appropriately justified.

In some instances, open plan learning areas may not be intended for multiple and simultaneous independent instruction or critical listening activities. For example, critical listening activity may only occur as a single, plenary session, followed by 'breakout' activity sessions. These breakout sessions may involve more personal listening activities (for example one-to-one or small group instruction, paired or small group work), or individual study. For personal listening activities, speech intelligibility is usually less critical, owing to one or more of the following:

- Reduced communication distance
- Reduced message urgency
- More opportunity to repeat spoken message
- Reduced occurrence of speech communication (e.g. for individual work)

The acoustic objectives for this scenario are *a*) to ensure sufficient speech intelligibility during the plenary session, and *b*) during breakout sessions, to control the build-up of speech noise caused by raising vocal effort above the background noise level (known as the Lombard effect).

In this case, to demonstrate compliance, the following must be carried out for compliance:

- STI should be predicted for the plenary session (as above)
- The space may be deemed satisfactory for breakout session mode if criteria given in Table 6 can be demonstrated

For open plan arrangements that require multiple groups to be instructed independently (or other simultaneous critical listening activity), semi-open plan designs (where teaching areas are separated by walls, with openings onto a shared area) are generally more effective at controlling intrusive noise and are preferable acoustically. The number of teaching groups contained within an open plan unit should be carefully considered, to enable teams of teachers to co-ordinate and manage adjacent activities and limit circulation to and from other parts of the building. In practice, this may involve limiting shared open plan to a common subject base, or for similar class ages (e.g. two- or three-form entry in a primary school setting). Open plan classbases opening onto large atria should be discouraged unless the client is committed to actively managing noise arising from the shared circulation space.