



# Basic Guide to Acoustic Terminology



By:  
**Paul Clayton, Technical Manager**

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**Sound Reduction** – May also be termed sound attenuation or sound insulation. Stated in decibels it is the ratio of the amount of sound energy incident upon a partition and the proportion of that energy which passes through the partition.

**dB** Decibel: a logarithmic scale applied to acoustic units such as sound pressure, sound intensity and sound power. It is also used to express sound reduction or sound insulation when the result is stated as a "decibel reduction". Audible sound ranges from the threshold of hearing at 0dB to the pain threshold at around 130-140dB.

**dB A** A-weighting: This is a filter process. Human hearing is less sensitive at very low and very high frequencies. To account for this, the noise is 'weighted' to provide results which conform approximately to the response of the human ear. Denoted as dB (A)

**R<sub>w</sub>** Weighted Sound Reduction Index: R values are measured in tests in octave or 1/3rd octave bands covering the range 100Hz to 3150Hz (tests actually cover a wider range). The resultant curve is adjusted so that any shortfall of the actual measurements below the standard curve, averaged over all the octave or 1/3 octave bands is not greater than 2dB. The resultant value of the curve at 500Hz is the R<sub>w</sub>.

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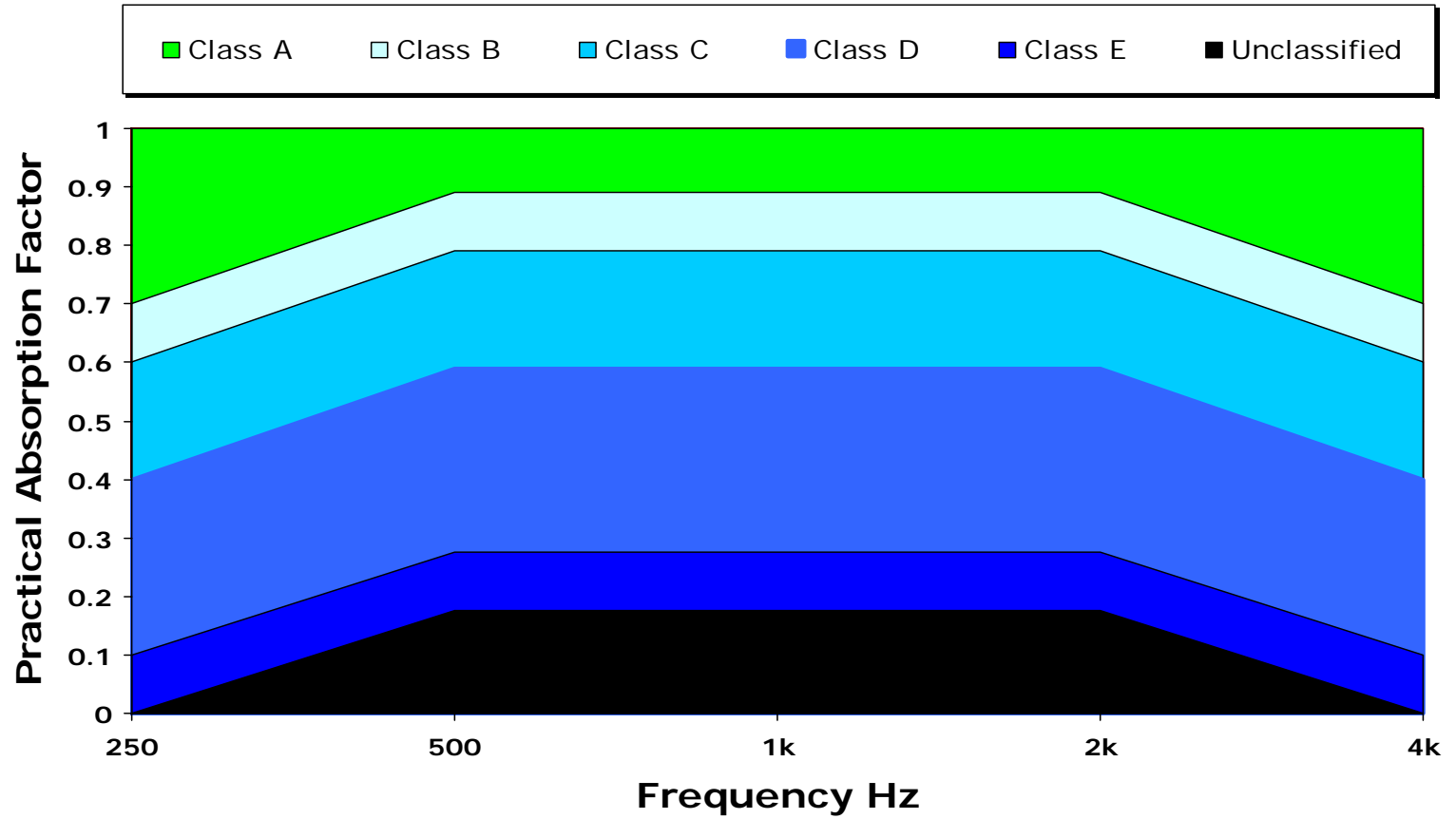


**Sound Absorption** – Sound in a space (both source sound and reflections of source sound) has its “lifespan” reduced by being absorbed rather than reflected. Both source sound and reflections of the source sound can have their “lifespan” in a space reduced by being absorbed. Absorption is effected by the sound frequency, the size of the room space and the surface finishes of the room space. Several terms are used to define performance:

**$\alpha$  Absorption Coefficient:** This represents the proportion of incident sound energy arriving from all directions that is not reflected back into the room. It ranges between 0 and 1, where 0 is reflective and 1 is totally absorptive.

**Class “X” Absorption Class:** Classification applied to a material or system defined by EN ISO 11654. Class A is the best classification representing the highest level of absorption between 250 and 4000Hz, and Class E offers the lowest classification.

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## Sound Absorption

**RT** Reverberation Time: A measure of the echoic nature of a room. Normally measured in 1/3rd octave or 1/1 octave bands by creating a noise and measuring the time it takes for that noise to decay by 60dB. The longer the reverberation time, the more 'echoey' a room sounds.

In schools performances recommended by BB93 fall between RT's of 0.6 and 1.5. The RT performance of a room with given finishes can be calculated using the volume of the room, the areas of each finish and their Absorption Coefficients ( $\alpha$ ).

A calculation may demonstrate that the roof system alone can achieve the required RT for BB93.

This offers savings in the potential provision of other absorptive materials ie acoustic wall or ceiling tiles.

Project acousticians may run calculations for each project using the absorption data provided for Elite Systems and for other room finishes.

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## Sound Absorption

**RT Calculations** – Using data from our extensive test programmes we have run calculations to establish the performances of our tested systems in various common school applications under BB93 RT requirements. These will be published in our forthcoming Acoustic Handbook.

The calculations contain limited data on typical wall, floor and glazing elements from Sound Research Laboratories database.

**Using the most onerous examples for wall and floor finishes it has been possible to demonstrate the ability of our acoustic roof systems 4.25A2, 4.20A1, 3.25A2 & 2.25A2 to meet many of the requirements of BB93 without the need for further space treatment ie acoustic wall tiles etc.**

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## RT Calculations

Perforated structural deck based systems eg 5.20A typically perform less well because the area of perforation is more limited and absorption less efficient. Using a typical sportshall example a deck based system would need some additional absorption provided by other elements ie small areas of carpet, wall treatment with tiles or fibreboard etc.

As a rough guide the Absorption Class is a good starting point, with better classification feeding directly into better RT performance.

**Room size and other finishes also very specifically affect the RT performance and a specialist acoustician should be consulted for each project to seek fully detailed advice. However, the data required by project acousticians is readily available from Euroclad and we are happy to guide and assist. It will not always be possible to meet the RT requirements with the roof alone.**

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Date: Oct 5th 07 Calc. run by: P. Clayton Project ref.: Inmingham School Sports Hall

**Reverberation Time Calculation**

Room Dimensions			
Length (m):	36.00	Volume (m³):	4410.0
Width (m):	18.00	Surface Area (m²):	2002.0
Height (m):	7.00		

Floor:	Area (m²)	Sound Absorption Coefficient for each Octave Band (Hz)					
		125	250	500	1000	2000	4000
Concrete painted	630.00	0.01	0.01	0.01	0.02	0.02	0.02
Boarding on Beams or Concrete	0.00	0.12	0.25	0.11	0.12	0.05	0.05
<b>Total Area (m²):</b>	<b>630.00</b>	<b>OK</b>					

Walls:	Area (m²)	Sound Absorption Coefficient for each Octave Band (Hz)					
		125	250	500	1000	2000	4000
Blockwork, unparted	742.00	0.02	0.03	0.03	0.04	0.05	0.07
Timber Paneling on Beams	0.00	0.30	0.30	0.15	0.10	0.10	0.12
Medium Curtains (0.5kg/m²) draped	0.00	0.10	0.25	0.40	0.60	0.70	0.70
Fibre/Soft Board fixed direct to plasterboard	0.00	0.15	0.10	0.15	0.25	0.30	0.30
<b>Total Area (m²):</b>	<b>742.00</b>	<b>OK</b>					

Ceiling/Roof System:	
System 4.25 A2 (Strag. inc. BSAC2)	630
System 5.2A (Strag. inc. BSMA4)	0
<b>Total Area (m²):</b>	<b>630.00</b>

Reverberation time, in octave frequency bands (Hz)						
	125	250	500	1000	2000	4000
RT (sec.)	1.40	1.30	1.20	1.10	1.10	1.00

T<sub>avg</sub> (sec.) 1.1

**Notes:**  
 Client requirement <1.9.  
 BB93 Recommends < 1.5 for School Sportshalls.  
 Wall and floor finishes chosen as representing a very onerous case, ie no materials included which would contribute to better absorption performance such as curtains, drapes, carpet, hollow wood floors etc.  
 This demonstrates that the roof systems absorption properties are largely achieving the requirements.



Date: Oct 5th 07 Calc. run by: P. Clayton Project ref.: Inmingham School Sports Hall Elite 5.207

**Reverberation Time Calculation**

Room Dimensions			
Length (m):	36.00	Volume (m³):	4410.0
Width (m):	18.00	Surface Area (m²):	2002.0
Height (m):	7.00		

Floor:	Area (m²)	Sound Absorption Coefficient for each Octave Band (Hz)					
		125	250	500	1000	2000	4000
Concrete painted	630.00	0.01	0.01	0.01	0.02	0.02	0.02
This carpet (Strag) on beam underlay	30.00	0.02	0.09	0.25	0.40	0.50	0.50
<b>Total Area (m²):</b>	<b>630.00</b>	<b>OK</b>					

Walls:	Area (m²)	Sound Absorption Coefficient for each Octave Band (Hz)					
		125	250	500	1000	2000	4000
Blockwork, unparted	300.00	0.02	0.03	0.03	0.04	0.05	0.07
Fibre/Soft Board fixed via battens to Masonry	252.00	0.36	0.35	0.20	0.20	0.25	0.30
Medium Curtains (0.5kg/m²) draped	100.00	0.10	0.25	0.40	0.60	0.70	0.70
Empty	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Total Area (m²):</b>	<b>742.00</b>	<b>OK</b>					

Ceiling/Roof System:	
System 5.2A (Strag. inc. BSMA4)	630
System 5.2A (Strag. inc. BSMA4)	0
<b>Total Area (m²):</b>	<b>630.00</b>

Reverberation time, in octave frequency bands (Hz)						
	125	250	500	1000	2000	4000
RT (sec.)	1.00	1.00	1.10	1.60	1.90	2.00

T<sub>avg</sub> (sec.) 1.5

**Notes:**  
 BB93 Recommends < 1.5 for School Sportshalls.  
 The roof systems absorption properties alone are not enough to achieve the requirements. Additional absorption can be provided by adding absorbent materials to wall or floor areas.  
 In this example adding Fibre/Soft Board on timber battens over the end walls with 100M² of medium weight curtains brings the figure very close to the recommended level.  
 Further guidance should be sought from specialist acousticians. Sound Research Laboratories (Tel 01787 247595) have a large database of wall and floor finishes tested, as well as the Euroclad tested systems and can offer a consultancy service if required.



## Sound Absorption

### Some less commonly used terms:

**$\alpha_p$**  Practical Absorption Factor: A frequency dependent value of sound absorption coefficient based on measurements in one-third-octave bands in accordance with ISO 354 and which is calculated in octave bands in accordance with EN ISO 11654 : 1997. This helps to even out some of the possible anomalies which can crop up in test data ie it is quite possible to have absorption coefficients greater than 1 from the tests, the  **$\alpha_p$**  helps to clarify this.

**NRC** Noise Reduction Coefficient: Actually a sound absorption value, the noise reduction coefficient of a material is the average, to the nearest multiple of 0.05, of the absorption coefficients at 250Hz, 500Hz, 1kHz and 2kHz.

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## Rain Noise

The impact of rain on roof materials (particularly metal roofs) and the potential internal noise generated has been highlighted "to be considered" in schools (in BB93).

**LI** Sound Intensity Level: measured in Db across frequency range 50 to 5000Hz according to ISO 15186-1.

**LIA** A-weighted sound intensity level: Sound intensity measured and weighted for response of the human ear across frequency range 100 to 3150Hz. The LIA for Elite System 1.25 was 50.2 dB, well below the 61.5 dB generated by 80mm PIR foam with 0.5 and 0.4mm steel skins. This was actually the poorest performing of the Elite systems tested. All of the tests on Elite 4 type constructions (using Euroseam external sheet and MW5 liner) returned measurements only across a limited range of frequencies and therefore generating the weighted average between 100 and 3150Hz was not possible. A single skin profiled steel sheet returned measured levels between 55 and 65 dB Sound Intensity Level across the range of frequencies.

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## Rain Noise

**LAeq, T** "A" weighted equivalent continuous sound pressure level. This may be thought of as the "average" sound level over a given time T.

There is no actual limit that has to be achieved for rain noise, but BB93 suggested that levels as high as 70dB LAeq could be generated by rain impact and these may have a dramatic effect on speech intelligibility.

Converting Sound Intensity Levels to LAeq needs to be done by the project acoustician or acoustic consultant as it will involve calculation including room size and reverb time. An assessment of the acceptability of noise levels and the time factor allocated to the LAeq needs to be made on a project specific basis.

The test method employed to measure rain noise by Euroclad in conjunction with Rockwool used a simulated "heavy rain" type which is onerous, in the UK this flow rate happens only a few times a year and then only for limited periods.

The test results showed that the performance of built up systems was very good, particularly in comparison with foam cored composite. Compressed Rockwool quilt provides some damping to the external sheet and can be enhanced by the addition of Rockwool Acoustic Membrane if this is felt necessary.

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