

Technical Information Paper

TIP-401

Acoustics

Acoustics is a very complex subject, which often needs the input of a professional acoustical engineer to provide advice and guidance on frequencies, indexes, and ratings.

The roof and vertical wall cladding on a building can be used to restrict sound entering buildings, such as aircraft / traffic noise and sound leaving buildings, such as preventing factory noise that may disturb local residents; roof and wall cladding in these cases are providing Sound Resistance or Sound Insulation. The cladding might also be used to control the sound inside the building, by reducing unwanted sound reflections or echoes (such as in sports halls, swimming pools or theatres), thereby reducing the internal sound level; the cladding is then providing acoustic absorption.

There is no minimum level of acoustic performance defined in the Building Regulation Approved Document E, however Local Planning Officers, Environmental Health Officers, Building Control Officers and Factory Inspectors may stipulate particular levels of performance for a building. This technical information paper explains acoustic performance generally and the achieved results in relation to the CA Building Products (CABP) roof and wall cladding systems.

Sound Reduction

Sounds propagate through the air as a pressure disturbance or wave. The range of sound pressures is very large, approximately in the ratio 1 to 10 million, from the quietest to the loudest sounds, so sound (noise) is measured using a logarithmic scale with units of decibels (dB), to give more manageable values. For example, the sound pressure level in a quiet residential area at night might be 40dB, and in a busy street or workshop it might be 80dB, with a jet aircraft taking off likely to be in the region of 120dB. The minimum threshold of hearing is 0dB.

Sound inside a building can escape to the outside (or vice versa) by transmission through the walls, windows, roof etc. The reduction in sound level provided by the building elements is called sound reduction or sound insulation. The performance of a particular construction element such as a roof can be accurately measured in an acoustic laboratory, and the result obtained is referred to as the Sound Reduction Index (SRI). This varies with frequency, but for convenience can be expressed as a single figure, known as the Weighted Sound Reduction Index (expressed as R_w).

These laboratory tests provide the basic acoustic performance data for a construction, and generally indicate the best that can be achieved on a fully constructed building.

Sound insulation measurements on a completed building may be lower because of flanking (sound bypassing the element), features of the building, and workmanship. In general, the denser the structure, the more sound insulation it provides. In light weight metal cladding constructions, the sound insulation is improved by minimising any rigid connection from inside to out, having separate liner and outer sheets, with a soft mineral fibre infill is a distinct advantage (as per CABP roof and wall cladding systems). Furthermore, because the systems are site assembled, the individual layers can be tailored in design to achieve a particular level of sound reduction.

Various modifications to the basic cladding system are possible to achieve a particular acoustic performance, but this performance cannot be predicted with certainty, and it is essential to carry out laboratory tests to determine the performance accurately.

Sound Absorption

Sound pressure waves can be absorbed by materials such as carpets, soft furnishings, and mineral fibre insulation, whereas hard smooth surfaces will reflect sound; this will have an adverse effect on the acoustic performance inside a building because the reflections can increase the internal sound level. Sound absorption therefore is used to reduce noise levels inside a building.

The sound absorption performance of a material can be measured using the same laboratory procedure as mentioned in Sound Resistance, and the result is expressed as the Sound Absorption Coefficient, across the range of frequencies. This varies from 0 (total reflection) to 1 (total absorption).

Standard profiled metal liners do not have a good absorption coefficient, however, can be perforated so that the sound can enter the core of the construction and be absorbed by the layer of mineral fibre insulation. A separate vapour control layer **MUST** be incorporated into the construction in this case, sandwiched between the acoustic insulation and the thermal insulation layer. Air leakage requirements may dictate that the VCL is to be located directly over the perforated liner panel, which in turn will reduce the sound absorption performance of the system. Perforating the liner will reduce the sound reduction performance of the system in comparison to an unperforated liner.



Rain Noise

A common issue relating to acoustics is the noise created during intense rainfall. Laboratory tests can be conducted in accordance with BS EN ISO 140-18. Sound Intensity Levels (Li) for generic twin-skin systems are circa 50dB in comparison to insulated panels circa which are in the region of 62dB; In terms of rain noise, the lower the result the better the performance of the system which is different to sound reduction where the higher results dictate better performance. CABP have undertaken some tests on the roof cladding systems, the results can be found further in this document.

Noise Ratings

Noise Ratings or NR Values are often confused with Sound Insulation Values. There is no relationship between Noise Ratings (NR) and Weighted Sound Reduction (Rw).

Noise ratings were developed in the 1950's by Kosten and van Os and are used by building services engineers in the design of air conditioning systems. The calculations are used to assess the acceptability of noise in any area served by the mechanical services systems.

Acoustic Design

Acoustics are a complex subject and the building designer should not rely solely on the cladding manufacturer for expert advice on the overall acoustic performance of the building. If acoustics is an important issue, it is essential to have an acoustic consultant on the design team.

Testing of CA Building Products' Systems

CABP roof and wall cladding systems have been tested at the Building Research Establishment (BRE), Watford.

For constructions / specifications with multi-layers, structural trays, structural decks and / or perforated lining, please consult CA Group Technical Department.



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Sound Reduction Testing Results

Twin-Therm® Roof Incorporating 0.4mm thick CA 17 1000L Liner Profile			
MatriX Bracket	Therma-quilt Insulation Depth	U-value (W/m²K)	Tested R _w
MX180	180mm	0.23	43dB
MX200	200mm	0.21	-
MX220	220mm	0.19	-
MX240	240mm	0.18	45dB
MX260	260mm	0.16	-
MX280	280mm	0.15	-
MX300	300mm	0.14	45dB

Twin-Therm® Roof Incorporating 0.7mm thick CA 32 1000RL Liner Profile			
MatriX Bracket	Therma-quilt Insulation Depth	U-value (W/m²K)	Tested R _w
MX180	180mm	0.25	44dB
MX200	200mm	0.22	-
MX220	220mm	0.20	44dB
MX240	240mm	0.18	45dB
MX260	260mm	0.17	-
MX280	280mm	0.16	-
MX300	300mm	0.15	46dB
MX320	320mm	0.14	-
MX340	340mm	0.13	-
MX360	360mm	0.12	-
MX400	400mm	0.11	-

Twin-Therm® Roof Incorporating Therma-light Rooflight T-light 17 1000 Liner Rooflight CE24 (2.44kg/lm) – Intermediate Core – T-light 32 1000 CE18E (1.83kg/lm)					
Intermediate Core Code	MatriX Bracket	Therma-quilt Insulation Depth	U-value (W/m²K) Horizontal Plane	U-value (W/m²K) Vertical Plane	Tested R _w
TC10-MX-17	MX180	180mm	1.50	1.30	34dB

Therma-light Rooflight T-light 17 1000 Liner Rooflight CE24 (2.44kg/lm) – Intermediate Core – T-light 32 1000 CE18E (1.83kg/lm)					
Intermediate Core Code	MatriX Bracket	Therma-quilt Insulation Depth	U-value (W/m²K) Horizontal Plane	U-value (W/m²K) Vertical Plane	Tested R _w
TC10-MX-17	MX180	180mm	1.50	1.30	25dB



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Twin-Therm® Wall Incorporating 0.5mm thick External Wall Profile			
MatriX Bracket	Therma-quilt Insulation Depth	U-value (W/m²K)	Tested R _w
MX120	120mm	0.33	42dB
MX140	140mm	0.29	-
MX160	160mm	0.25	-
MX180	180mm	0.23	44dB
MX200	200mm	0.21	-
MX220	220mm	0.19	44dB
MX240	240mm	0.17	-
MX260	260mm	0.16	-
MX280	280mm	0.15	-
MX300	300mm	0.14	45dB

Twin-Therm® Wall Incorporating 0.7mm thick External Wall Profile			
MatriX Bracket	Therma-quilt Insulation Depth	U-value (W/m²K)	Tested Rw
MX120	120mm	0.33	43dB
MX140	140mm	0.29	-
MX160	160mm	0.25	-
MX180	180mm	0.23	45dB
MX200	200mm	0.21	-
MX220	220mm	0.19	45dB
MX240	240mm	0.17	-
MX260	260mm	0.16	-
MX280	280mm	0.15	-
MX300	300mm	0.14	46dB



Enhanced Acoustic Specification Testing Results

In addition to the standard constructions noted, the following information pertains to multi-layer constructions that have been laboratory tested / assessed / predicted by acoustic engineers.

Twin-Therm® Roof – 0.7mm CA 32 1000RL Liner Profile, 10kg/m ² Acoustic Barrier Mat			
MatriX Bracket	Therma-quilt Insulation Depth	U-value (W/m ² K)	Tested R _w
MX220	220mm	0.20	48dB
Twin-Therm® Roof – 0.7mm CA 32 1000RL Liner Profile, 50mm Thick 100kg/m ³ Rock Fibre Slab and 0.7mm CA 32 1000RL Perforated Liner (underdrawn)			
MatriX Bracket	Therma-quilt Insulation Depth	U-value (W/m ² K)	Tested R _w
MX220	220mm	0.20	48dB
Twin-Therm® Roof – 0.7mm CA 32 1000RL Liner Profile, 10kg/m ² Acoustic Barrier Mat, 50mm Thick 100kg/m ³ Rock Fibre Slab and 0.7mm CA 32 1000RL Perforated Liner (underdrawn)			
MatriX Bracket	Therma-quilt Insulation Depth	U-value (W/m ² K)	Tested R _w
MX220	220mm	0.20	52dB
Twin-Therm® Wall – 0.7mm CA 32 1000RL Liner Profile & 0.7mm CA 32 1000W External Profile			
MatriX Bracket	Therma-quilt Insulation Depth	U-value (W/m ² K)	Tested R _w
MX220	240mm	0.19	45dB



Image 1 - Enhanced Acoustic Specification inc. Underdrawn Perforated Liner



Rain Noise Testing Results

Twin-Therm® Roof – 0.4mm CA 17 1000L Liner Profile			
MatriX Bracket	Therma-quilt Insulation Depth	U-value (W/m²K)	Tested L _{IA}
MX180	180mm	0.23	53.9
Twin-Therm® Roof – 0.4mm CA 17 1000L Liner Profile + 3x50mm PVC Foam Pad			
MatriX Bracket	Therma-quilt Insulation Depth	U-value (W/m²K)	Tested L _{IA}
MX180	180mm	0.23	53.1
Twin-Therm® Roof – 0.4mm CA 17 1000L Liner Profile + 6x50mm PVC Foam Pad			
MatriX Bracket	Therma-quilt Insulation Depth	U-value (W/m²K)	Tested L _{IA}
MX180	180mm	0.23	51.8





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