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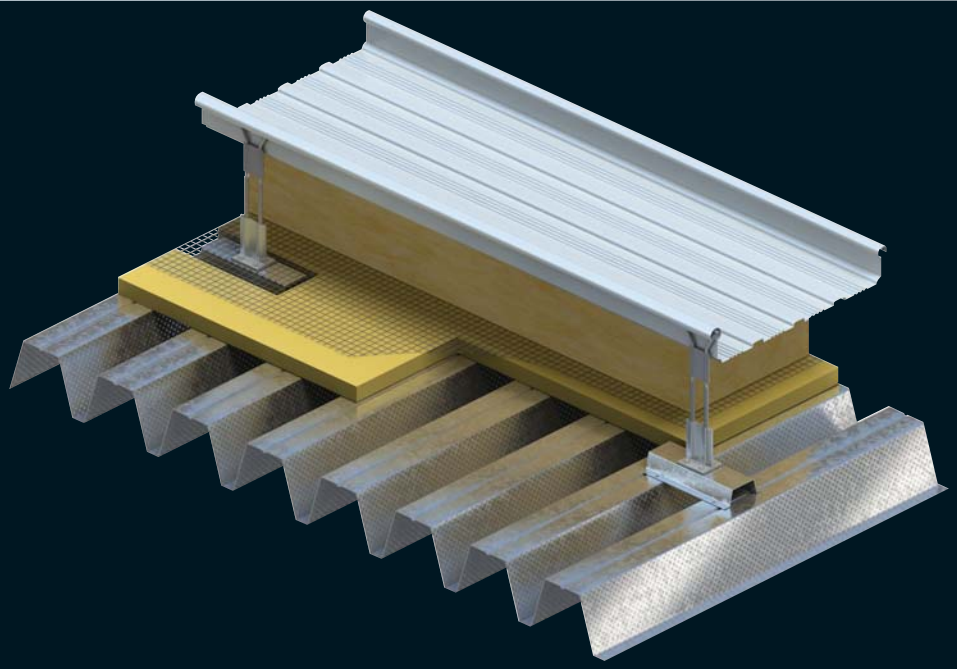
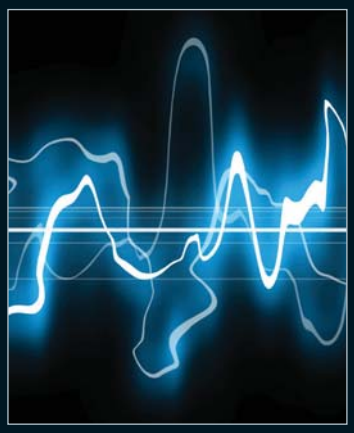
April 2010

ASHZIP™ Acoustic design of roofs





flexible standing seam roofing systems

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Introduction

Acoustic design is a major consideration in design of modern school buildings. With this in mind Ash & Lacy have produced this acoustic design guide to highlight the benefits of designed and independently tested acoustic systems using the Ashzip standing seam profile in an easy to understand way.

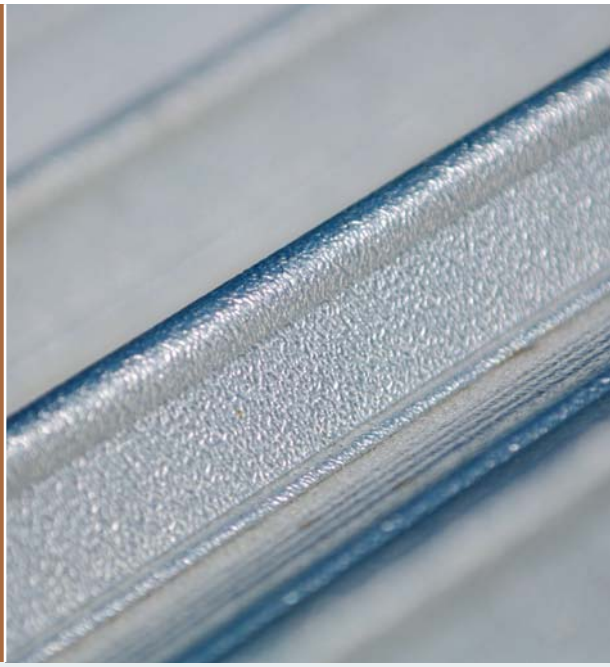
BB93 and BREEAM play a large part in the build of modern schools and an understanding of how these documents effect the design is critical to ensuring regulatory compliance is met.

The main areas of consideration are:

- Rain noise (internal levels of sound)
- Sound reduction
- Sound absorption and reverberation

All of the above have been independently tested by Ash & Lacy at the UKAS accredited Sound Research Laboratories.

SRL
Sound Research Laboratories Limited
Consultants in Noise & Vibration



Terminology

dB (A)

Decibel level as measured with an A weighting network. This differentiates between frequencies of sound in a similar manner to the human ear.

f or frequency

The number cycles per second of an object vibrating

Hz or Hertz

Is the unit of frequency. This is equal to one cycle per second

$_{8}A_{eq,T}^{(dB)}$

This denotes the upper limit for the indoor ambient noise level over a specified period of time. Where T is the stated period of time. For example BB93 states 30mins

Sound reduction

Is the level of sound measured in dB from one side of a construction to another

Sound absorption

Is incorporated into a design to reduce the amount of surface reflected sound internally.

Impact sound

A type of sound created through impact of rain or hail on a surface that then transmits through a system

Reducing levels of sound

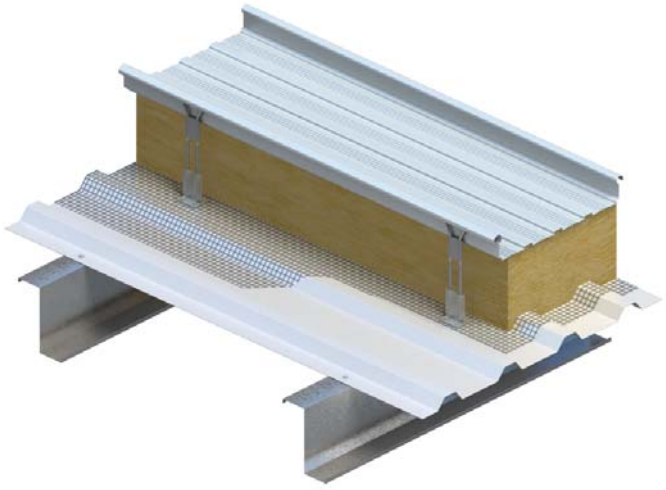
Rain generated impact sound

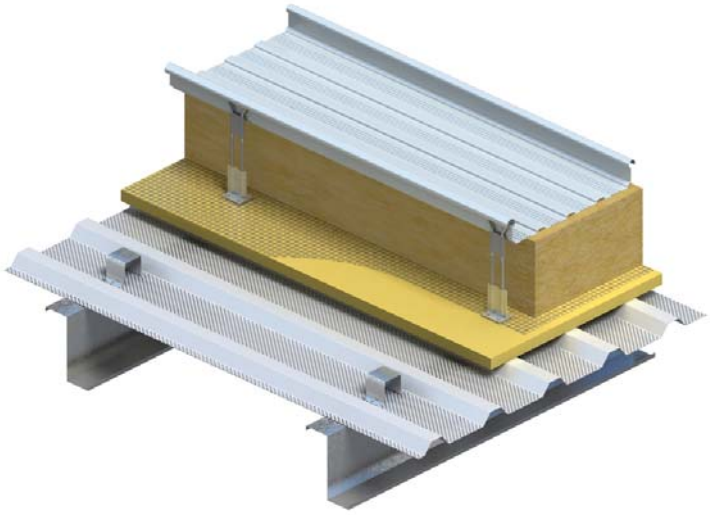
Rain noise can be a problem during teaching periods within a school. Ash & Lacy are able to offer an independently tested system to incorporate a rain noise reduction membrane bonded to the back of the Ashzip sheets.

Guidance notes for BB93 state that for rooms with ambient indoor noise levels of 35dB or less, the noise levels should not exceed 55dB ⅛Amax, F on a regular basis due to any foreseeable event which is likely to occur during a normal school day. This does not only relate to rain noise but also aircraft flyover or any other source of external noise, but the main concern is rain impact noise.

The standard Ashzip 400 system with glass fibre quilt to provide a 0.25 W/m2K U value and incorporating a rain noise reduction membrane will provide internal sound levels of 54.9dB as shown in test report C/08/8H/3525/R01. These figures can then be adjusted relative to actual room volume by the project acoustic consultant.

The figure of 54.9dB was obtained by testing for ***heavy*** rain noise generated sound in accordance with ISO 140-18.





Sound reduction

Sound reduction is a simple measurement of difference in sound levels from one side of the construction to another. When discussed in specification it normally relates to sound transmitted from outside to inside but can be considered from inside to out when looking at plant rooms and other such applications.

A range of standard constructions, with solid liner/deck have been tested, ranging from a standard 0.25W/m^2K build up with aluminium outer to 0.16W/m^2K build up with a steel Ashzip outer.

A standard Ashzip system would provide a sound reduction of 40dB+. In comparison to a composite panel or single ply membrane roof construction with rigid board and deck these would provide 25dB and 27dB respectively.

These differences not only have an impact on sound reduction but also performance under rain noise.

Sound reduction with perforated liner

A range of constructions has also been tested for sound reduction through systems with perforated liners. Whilst standard system build ups with perforated liners have a reduced effect on sound reduction, there can sometimes be a requirement to know what the sound reduction values are.

Please note that the perforated liner assists with reduction of internal reverberation (sound absorption).

A standard build up as shown below with a pan perforated liner will provide a sound reduction of 37dB.

To further enhance the above tested system, additional designs are available to incorporate high density membranes which can improve the sound reduction and increase performance up to a level of 44dB.

Sound absorption

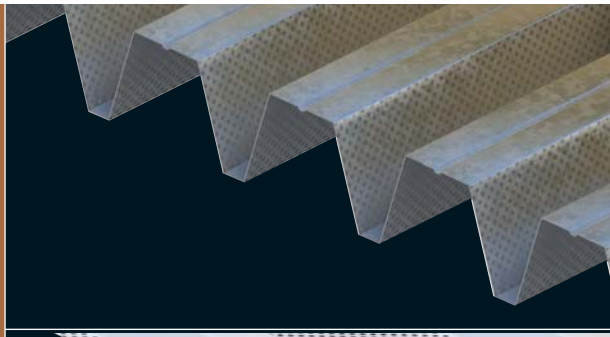
Sound absorption can be incorporated within the Ashzip system build up where the design objective is to reduce the undesired effect of reflected sound in the classroom below.

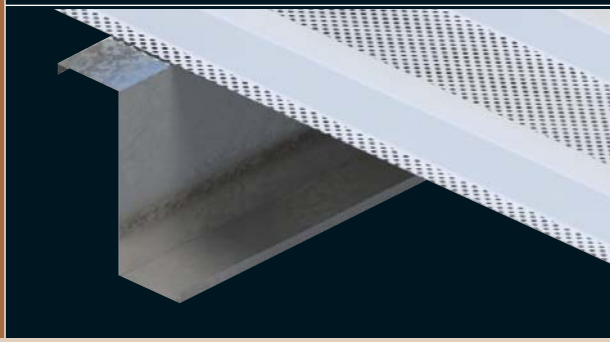
The amount of perforations within the liner profile or structural deck will have a direct effect on the levels of sound absorption that occurs. Long span structural decks are web perforated and have a lower percentage of open area compared to a liner profile.

The standard location for perforations on a liner profile is in the trough although fully perforated liners are available.

The following sound absorption coefficients are achieved

- Web perforated structural deck - 0.40
- Pan perforated liner profile - 0.45
- Fully perforated liner profile - 0.75





BREEAM points

Upto three credits are available for acoustic design in schools. Evidence should be provided that demonstrates all spaces in the building achieve the performance standards required by BB93.

For the most part many of these requirements for the first two points relate to sound reduction and absorption of sound between rooms which is not covered by Ashzip roofing systems.

However BREEAM guidelines state that a third credit is available where it can be demonstrated that the increase in indoor ambient noise level during heavy rainfall does not exceed the levels defined in BB93 by 20dB.

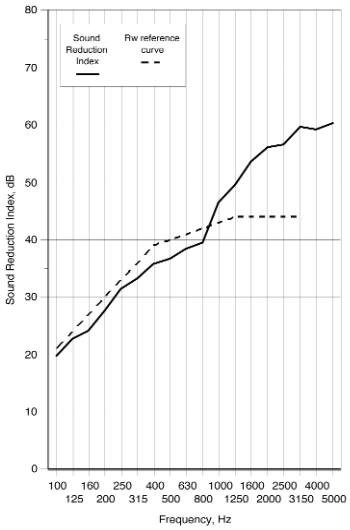
Rain noise test data is available for a range of Ashzip construction that incorporate rain noise reduction membranes and varying insulants.

Test data

Data Sheet 1

Test Number :	3	**Air temperature:**	11 °C
Client:	Ash & Lacy	**Air humidity:**	58 %
Test Date:	03/12/04	**Receiving room volume**	115 m3
Sample length:	3.985 m	**Source room volume:**	48 m3
Sample width:	2.715 m	**Sample weight:**	11 kg/m2
Product Identification:	Roof consisting of 0.7mm steel / 200mm glassfibre / 0.9mm aluminium		

Freq f Hz	Sound Reduction Index, dB 1/3 Oct	1/1 Oct
50+	11.3	
63+	15.1	14.1
80+	19.7	
100	19.8	
125	22.8	21.8
160	24.2	
200	27.8	
250	31.5	30.3
315	33.3	
400	35.8	
500	36.7	36.8
630	38.5	
800	39.6	
1000	46.6	43.2
1250	49.7	
1600	53.7	
2000	56.1	55.3
2500	56.6	
3150	59.7	
4000	59.3	59.7
5000	60.3	
6300+	62.8	
8000+	64.5	63.9
10000+	64.6 *	
Average 100-3150	39.5	



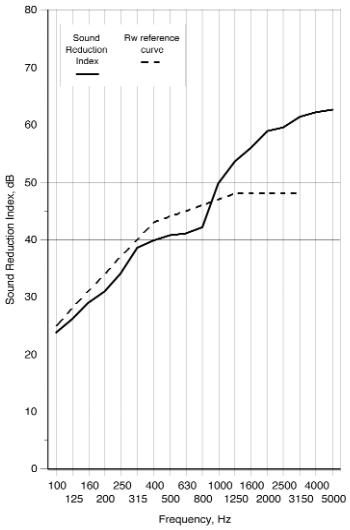
Rating according to BS EN ISO 717-1:1997
Rw(C;Ctr)= **40 (-1;-6)**dB

Notes * designates measurement corrected for background
designates limit of measurement due to background
+ designates frequency beyond standard and not UKAS accredited

Data Sheet 2

Test Number :	5	**Air temperature:**	11.3 °C
Client:	Ash & Lacy	**Air humidity:**	71 %
Test Date:	06/12/04	**Receiving room volume**	115 m3
Sample length:	3.985 m	**Source room volume:**	48 m3
Sample width:	2.715 m	**Sample weight:**	12.9 kg/m2
Product Identification:	Roof consisting of 0.7mm steel / 200mm glassfibre / 0.7mm steel		

Freq f Hz	Sound Reduction Index, dB 1/3 Oct	1/1 Oct
50+	14.7	
63+	16.0	16.5
80+	20.7	
100	23.9	
125	26.1	25.9
160	28.9	
200	31.0	
250	34.1	33.5
315	38.6	
400	39.9	
500	40.8	40.6
630	41.1	
800	42.1	
1000	49.8	46.0
1250	53.6	
1600	56.0	
2000	59.0	57.9
2500	59.6	
3150	61.5	
4000	62.2	62.1
5000	62.7	
6300+	65.3	
8000+	67.4 *	67.3
10000+	70.5 *	
Average 100-3150	42.9	



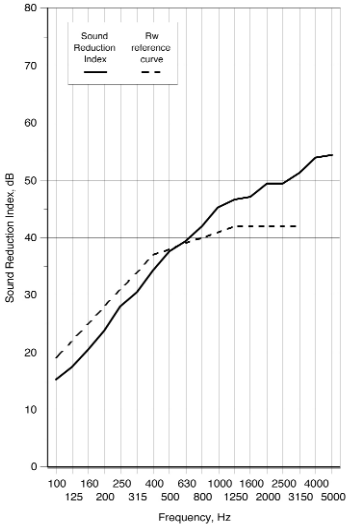
Rating according to BS EN ISO 717-1:1997
Rw(C;Ctr)= **44 (-1;-6)**dB

Notes * designates measurement corrected for background
designates limit of measurement due to background
+ designates frequency beyond standard and not UKAS accredited

Data Sheet 2

Test Number :	4	**Air temperature:**	14 °C
Client:	Ash & Lacy	**Air humidity:**	35 %
Test Date:	24/02/2006	**Receiving room volume**	50 m3
Sample height:	2.94 m	**Source room volume:**	55 m3
Sample width:	3.86 m	**Sample weight:**	24.7 kg/m2
Product Identification:	0.9 Aluminium with 0.7 steel perforated liner/deck		

Freq f Hz	Sound Reduction Index, dB 1/3 Oct	1/1 Oct
50+	9.9	
63+	11.5	11.6
80+	14.6	
100	15.3	
125	17.5	17.3
160	20.5	
200	23.8	
250	28.1	26.6
315	30.6	
400	34.2	
500	37.7	36.6
630	39.4	
800	42.0	
1000	45.3	44.2
1250	46.7	
1600	47.2	
2000	49.4	48.5
2500	49.4	
3150	51.4	
4000	54.0	53.1
5000	54.5	
6300+	57.3	
8000+	58.4	58.1
10000+	58.7 *	
Average 100-3150	36.2	



Rating according to BS EN ISO 717-1:1997
Rw(C;Ctr)= **38 (-2;-7)**dB

Notes * designates measurement corrected for background
designates limit of measurement due to background
+ designates frequency beyond standard and not UKAS accredited

Data Sheet 1
See SRL report C/05/5L/3226/1 for full details
The Laboratory Measurement of Random Incidence Sound Absorption to BS EN 20354:1993

Client:	Ash & Lacy	
Test Date:	28/04/2005	
Temperature:	14	°C
Humidity:	70	%RH
Sample Description:	Sound Absorption Test - Pan Perforated 33mm Liner	
Sample Area:	11.6	m2
Cavity Depth:	0	mm
Chamber Volume:	300	m3

Test 2

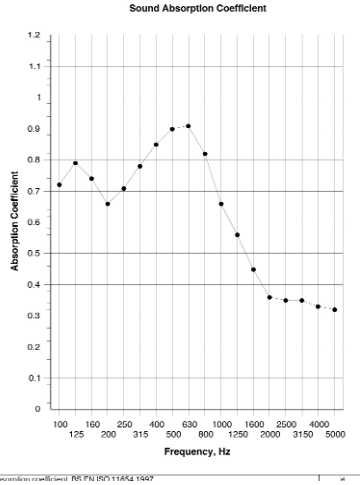
Freq Hz	T1 sec	T2 sec	Absorp Coeff	Practical Absorp Coeff #
*50**	*6.13*	*3.44*	*0.54*	
*63**	*3.92*	*2.04*	*0.99*	*n/a*
*80**	*5.31*	*2.50*	*0.89*	
100	5.87	2.92	0.72	
125	6.97	3.02	0.79	0.75
160	6.55	3.05	0.74	
200	7.53	3.44	0.66	
250	8.30	3.47	0.71	0.70
315	7.27	3.10	0.78	
400	6.60	2.82	0.85	
500	5.85	2.59	0.90	0.90
630	5.24	2.45	0.91	
800	5.65	2.69	0.82	
1000	6.11	3.11	0.66	0.70
1250	5.90	3.30	0.56	
1600	5.49	3.47	0.45	
2000	4.99	3.49	0.36	0.40
2500	4.33	3.18	0.35	
3150	3.57	2.75	0.35	
4000	2.90	2.36	0.33	0.35
5000	2.30	1.96	0.32	
*6300**	*1.97*	*1.71*	*0.32*	
*8000**	*1.37*	*1.26*	*0.27*	*n/a*
*10000**	*1.07*	*0.99*	*0.32*	

α_w 0.45(LM)
Calculated to EN ISO 11654:1997

NRC 0.65
Calculated to ASTM C 423-01

** Denotes frequencies outside the range covered by BS EN 20354:1993 and not UKAS accredited*

T1, empty room reverberation time
T2, room reverberation time with sample



Practical absorption coefficient BS EN ISO 11654:1997

For further acoustic data please visit our website ashandlacy.com

ACOUSTIC DESIGN CASE STUDY
– Sisters of Mercy West of Ireland

The main acoustic requirement from the project architect was to meet a sound reduction level of 40dB and to provide an amount of rain noise attenuation. Because of the complexities of the tapered Ashzip roof above timber trusses and the requirement for strict air sealing standards to be acheived, a profiled steel liner was not able to be used due to the tapered setting out.

The Ash & Lacy technical team proposed a high density 3mm bitumous membrane positioned directly above the rafters. This component was combined with 150mm of rockwool insulation compressed into a small insulation void to form a deadening layer to the underside of the Ashzip sheets. The membrane was dense enough not to sag between the rafters and maintain the high level of compressed insulation to act as the deadening layer.

This proposal combined with the insulation at joist level and the plasterboard ceiling met the required acoustic criteria.

Whilst this system was not a tested one, Ash & Lacy provided anticipated sound reduction level calculations for appraisal by the project acoustic consultant.

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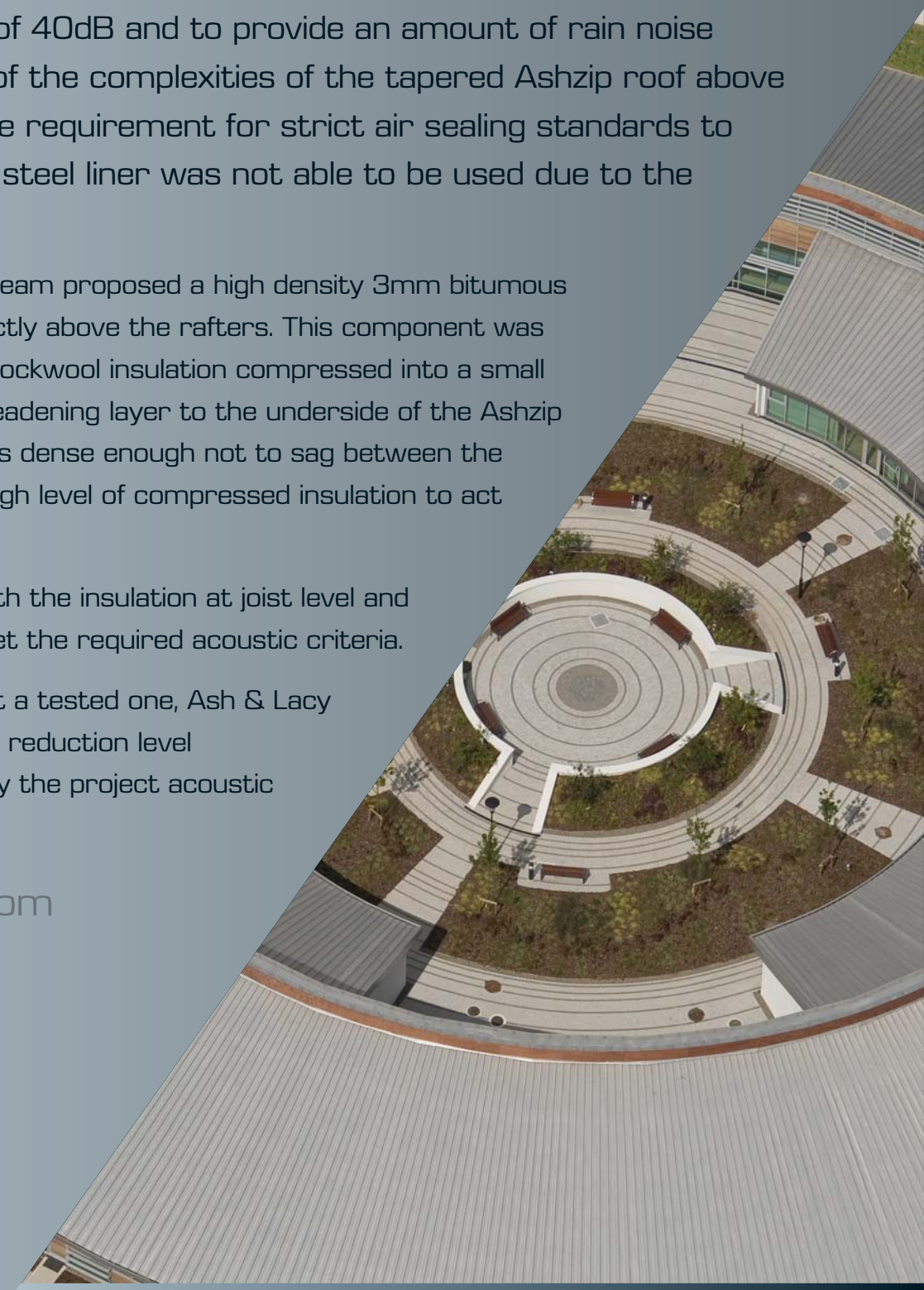

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