CSIRO ACOUSTIC MEASUREMENT REPORT

Commonwealth Scientific and Industrial Research Organisation, Infrastructure Technologies
Acoustics Testing Laboratory, Gate 5, 2 Normanby Road, Clayton, Vic 3168 Australia

Report No:
AC277-17-1

Client: Bailey Interiors Pty Ltd
83-85 Boundary Road, Mortdale, NSW 2223

Measurement Type: Sound Absorption

AS ISO 354–2006 [R2016]: *Acoustics–Measurement of sound absorption in a reverberation room*
AS ISO 11654–2002 [R2016] (ISO 11654:1997): *Acoustics–Rating of sound absorption–Materials and systems*

Test Specimen

[Specimen area: 3.6 x 3.0 m (10.8 m²)]

Description: • Bailey "Cell Air" screw-up acoustic ceiling panels (1200 x 1200 mm),
• with black tissue-faced glass fibre batts behind, open to the cavity (Type E-200)

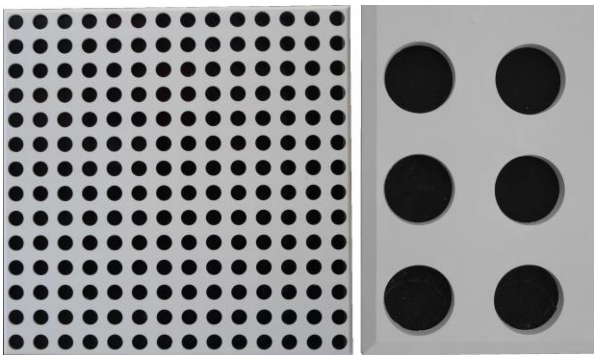
Panel and Batt Details[3]

- Moulded plaster ceiling panels designed to be screw fixed to ceiling battens above.
- Perforated with large circular holes; hole size approx 54.5 mm at the face, tapering to 53 mm at the rear. Holes were positioned at approx 85.5 mm spacing in a continuous array of 196 holes per panel (14 x 14 array).
- Open area percentage[4] (estimated): 31.8 % (based on mouth area at perforated face); 30.0 % (based on throat area at rear of panel, behind which lay the fibre batt and ceiling cavity).
- The perforated area of each tile was backed with a set of semi rigid high density glass fibre batts 20 mm thick, faced with a black tissue material (CSR Bradford product), (approx 42 kg/m³); the black tissue face being against the perforated rear face of the tile. Ordinarily, 550 x 550 mm batts would have been used, four batts to be factory-fixed (stapled) to the rear of each tile, but in this instance 500 x 500 mm batts were provided as separate items, and were positioned behind the perforated area of the tiles during test-installation (this necessitated cutting additional batts in order to ensure the entire perforated area of the panels was backed with the tissue-faced batt material).

Installation

- The test specimen was installed as an upside-down ceiling on the floor of the chamber.
- A 200 mm deep enclosure (32 mm MDF timber, approx 23 kg/m², built to surround an area of 3600 x 3000 mm) was placed on the floor of the chamber at a 11° angle to the chamber walls (not parallel, as per AS ISO 354 cl6.2.1.2). The junction of the enclosure and the floor was taped.
- A system of steel wall studs/track, and support struts was set up inside the enclosure to support the batts and tiles. The cavity behind was a single undivided cavity without internal partitions.
- 35 whole batts and approximately 6 batts cut into strips were carefully arranged on the support struts to align with the holes in the panels placed on top (3 x whole panels and 3 x half panels).
- All panel joins were taped with masking tape, as also was the junction between the enclosure and the perimeter of the test specimen panel installation.
- Specimen installation was carried out by laboratory staff.

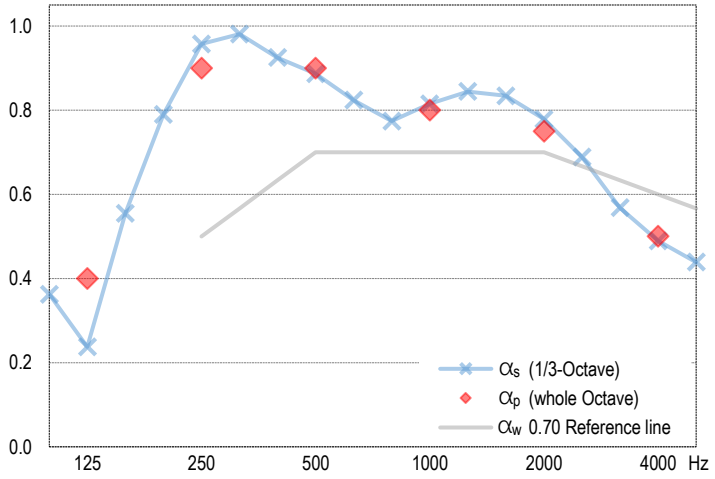
Test specimen installed for testing (image inverted to depict ceiling installation)



Panel details – Left: whole panel, Right: close-up view

Measurement Details & Results

Freq	Absorption coefficients			Reverberation times, T_{60} (sec)	
Hz	α_s	α_p	95% Conf (δ)	Empty room	with Specimen
100	0.36		0.06	5.79	3.42
125	0.24	0.40	0.06	6.33	4.22
160	0.55		0.11	6.21	2.90
200	0.79		0.06	5.62	2.28
250	0.96	0.90	0.09	5.11	1.95
315	0.98		0.06	6.01	2.04
400	0.92		0.06	5.96	2.11
500	0.89	0.90	0.07	5.54	2.11
630	0.82		0.05	5.26	2.16
800	0.77		0.03	5.09	2.20
1000	0.82	0.80	0.06	4.98	2.12
1250	0.84		0.04	4.40	1.97
1600	0.83		0.03	3.95	1.89
2000	0.78	0.75	0.03	3.59	1.87
2500	0.69		0.04	3.21	1.86
3150	0.57		0.03	2.88	1.89
4000	0.49	0.50	0.03	2.41	1.77
5000	0.44		0.03	1.95	1.57



Performance Indices[1,2]
α_w = 0.70 (L)
SAA = 0.84
NRC = 0.85

The required 12 spatially independent decay curves came from ensemble averaging 10 successive decays with each of 3 different source loudspeaker positions, all sampled by 4 fixed microphones, using linear averaging.

Measurement Conditions	Empty room	with Test Specimen
Date of measurement:	28 Jul 2020	28 Jul 2020
Temperature & humidity:	17 °C, 61 % R.H.	19 °C, 65 % R.H.
Atmospheric pressure:	1008 mBar	1008 mBar

Notes, Deviations etc

1. Shape indicators (L, M, and H), if any, following the α_w index, indicate α_p values above the reference contour by ≥ 0.25 in the Low, Medium or High frequency ranges respectively; it is strongly recommended to use this single number rating in combination with the complete sound absorption coefficient curve.
2. SAA and NRC are defined in ASTM C423; laboratory requirements for which differ from AS ISO 354.
3. Physical characteristics of materials may be as per client or supplier's advice; not necessarily verified by CSIRO.
4. Open area estimates are based on 1200 x 1200 mm of ceiling area being 'treated' by each panel.

Issuing Authority

Signed: .....
David Truett
Date: 4 August 2020

Instrumentation

Real time analyser: • Brüel & Kjær PULSE LAN-XI type 3160-A-4/2
Microphones/preamps: • 4 x GRAS microphones (types 40AR & 40AP, 2 ea) on GRAS & B&K preamplifiers, in 4 fixed positions as per AS ISO 354
Noise source: • Room populated with three dodecahedron loudspeakers; (2 x Norsonic NOR276 & 1 x B&K 4296), driven in turn by a Norsonic NOR280 power amplifier.
Calibration: • Analyser: July 2018 (NATA cal)

Laboratory Construction

Reverb room: • 300 mm thick concrete (closed off from the adjoining room by an MDF wall) • parallelepiped with dimensional proportions 1:1.3:1.6 for distribution of room modes • approx 202 m³ total room volume • approx 215 m² surface area excluding diffusers
Diffusers: • 20 stationary diffusers, approx 40 m² total surface area
Absorption area: • in accordance with AS ISO 354, unless noted otherwise