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:
AC277-27-1

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 "Ceil Sound" screw-up acoustic ceiling panels (1200 x 1200 mm),
• with black tissue-faced 50 mm glass fibre behind, open to the cavity (Type E-200)

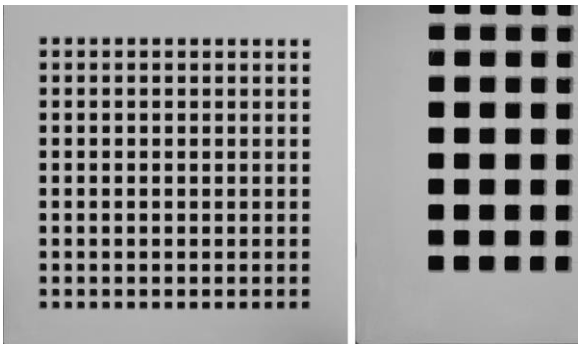
Panel and Batt Details[3]

- Moulded plaster ceiling panels designed to be screw fixed to ceiling battens above.
- Perforated with square holes with rounded corners; hole size approx 14.5 mm at the face, tapering to 13 mm at the rear. Holes were positioned at approx 22 mm spacing in four banks of 22 x 22 holes (484 holes per 600 x 600 mm quarter-panel; 1936 holes per 1200 x 1200 mm panel).
- Decorative effect of perforations was supplemented by orthogonal grooves between adjacent perforations within each bank).
- Open area percentage[4] (estimated): 27.2 % (based on mouth area at perforated face); 21.7 % (based on throat area at rear of panel, behind which lay the fibre batt and ceiling cavity).
- A layer of 50 mm thick semi rigid high-density CSR Bradford glass fibre material (nom 32 kg/m³), faced with a black tissue fabric was supported to the underside of the perforated panels during installation.

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

Installation

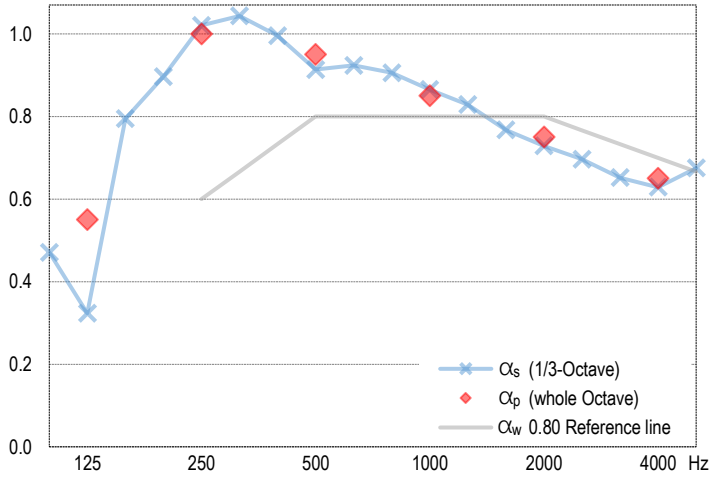
- The test specimen was installed as an upside-down ceiling on the floor of the chamber.
- A 200 mm deep enclosure (32 mm MDF timber, approx 23 kg/m², built to surround an area of 3600 x 3000 mm) was placed on the floor of the chamber at a 11° angle to the chamber walls (not parallel, as per AS ISO 354 cl6.2.1.2).
- A system of extruded aluminium profiles (all solid, not hollow) and plastic support pieces was set up inside the enclosure to support the panels with their exposed face nominally flush with the enclosure, and the tissue-faced glass fibre material against the rear surface of the panels. The cavity behind was a single undivided cavity without internal partitions.
- The glass fibre material was cut to size and laid on the supporting ledges formed by the aluminium extrusions, and the plaster panels laid on top; 6 x full panels and 3 x half-panels.
- All exposed edges/junctions/joins of panels, enclosure and the floor of the room were taped with masking tape.
- Specimen installation was carried out by laboratory staff.



Panel details – Left: perforations (quarter of a 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	0.47		0.09	5.38	2.93
125	0.32	0.55	0.06	6.62	3.88
160	0.79		0.11	6.51	2.41
200	0.90		0.08	5.85	2.15
250	1.02	1.00	0.08	5.07	1.88
315	1.04		0.09	6.15	1.98
400	1.00		0.06	6.24	2.05
500	0.91	0.95	0.05	5.82	2.12
630	0.92		0.04	5.75	2.09
800	0.91		0.04	5.38	2.07
1000	0.86	0.85	0.05	5.19	2.10
1250	0.83		0.05	4.65	2.05
1600	0.77		0.03	4.15	2.02
2000	0.73	0.75	0.04	3.67	1.95
2500	0.70		0.03	3.19	1.83
3150	0.65		0.04	2.78	1.73
4000	0.63	0.65	0.05	2.25	1.52
5000	0.68		0.04	1.80	1.27



Performance Indices[1,2]
α_w = 0.80 (L)
SAA = 0.88
NRC = 0.90

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:	26 Aug 2020	26 Aug 2020
Temperature & humidity:	17 °C, 51 % R.H.	16 °C, 50 % R.H.
Atmospheric pressure:	1019 mBar	1018 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' per whole panel.

Issuing Authority

Signed: .....
David Truett
Date: 9 September 2020

Instrumentation

Real time analyser: • Brüel & Kjær PULSE LAN-XI type 3160-A-4/2
Microphones/preamps: • 2 x GRAS type 46AR mic/preamp sets, and 2 x B&K type 4134 mics on B&K 2669 preamps, 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 a plasterboard 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