



Soundproof Marquees - Mitigation Strategy

Project. Tournerbury Woods Estate DRAFT

Proposal No. 388/001

Proposal For: Tournerbury Woods Estate

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Proposal for Tournerbury Woods Estate - Soundproof Marquee Mitigation

Direct Acoustic Solutions

Direct Acoustics specialise in controlling amplified music in noise sensitive locations. Our team are experienced in the bespoke design, manufacture and installation of anti-vibration products and isolation mass barriers for architectural noise control in both airborne and structure-borne scenarios. Using our technical knowledge we assist entertainment venues in obtaining licences and gaining planning consent in noise sensitive locations.

Direct Acoustics manufacture, install, service and manage equipment & mitigation strategies to obtain maximum volume levels whilst abiding by specific Institute of Acoustics (IOA) guidelines and environmental health law.

Using the experience we have gained working exclusively with noise sensitive venues, we are able to make a unique offering to Tournerbury Woods Estate by developing and designing a bespoke soundproof mitigation strategy for their specific environmental conditions.

Brief

Direct Acoustics were invited to propose a suitable acoustic envelope design to attenuate noise emitting from an events marquee venue located at Tournerbury Woods Estate, Hayling Island.

The design and construction method is required to have the capacity to control and attenuate the breakout of noise from Tournerbury Woods Estate until 02:00 hours.

The predominant sound source will be amplified music, both live and recorded.



Figure 1

Historic Acoustic Documentation

Tournerbury Woods Estate commissioned Mr Owen Clingham BSc (Hons) MIOA FRSA of Auracle Acoustics on the 17th October 2013 to undertake a noise assessment establishing the impact that amplified music from the existing venue has on the nearest noise sensitive receptor (NSR).

Analysis of the report has provided Direct Acoustics with a clear understanding of how sound propagates within the environment between the venue and the NSR, situated 385 metres to the South-East.

Auracle Acoustics gathered underlying ambient data measuring $24.1 \text{ dB } L_{Aeq \text{ t15min}}$ and $21.2 \text{ dB } L_{A90 \text{ t15min}}$. Propagation over distance calculations with a conventional point source PA in operation are considered to be excessive and therefore the use of a directional array was suggested.

On site real world testing with a directional array was undertaken as part of the Auracle Acoustics report. Considering the data obtained, additional attenuation provided by trees in the summer months and property facade reductions, it was considered that internal noise levels in noise sensitive dwellings would be $15 \text{ dB } L_{Aeq}$ and therefore inaudible for local residents.

Background Information

Tournerbury Woods Estate are currently applying for retrospective planning on the existing wedding venue (APP/18/00943). Within the application comments have been made referring to amplified music being audible, as well as patron noise being a disturbance.

The purpose of this technical proposal is to outline potential reasons for disturbance and discuss the scheme of mitigation that has been undertaken to ensure Tournerbury Woods Estate objectively comply with relevant acoustic criteria and that subjective disturbance does not take place.

A directional array was installed into the Tournerbury Woods Estate marquee in April 2014 and has been regularly serviced and calibrated by Direct Acoustics each year to ensure that music noise levels do not exceed the $95 \text{ dB } L_{Aeq}$ dancefloor level recommended by Auracle Acoustics.

When visiting acts solely operate through the directional array, noise levels have been deemed acceptable in accordance to pertinent criteria, however, an issue has been established when bands bring in their own equipment, which live acts require to perform.

These are as follows:

- Drum kit – non amplified;
- Guitar amplifiers – amplifies signal from guitars;
- Stage wedge monitors - speakers pointing at the musicians.

All of the above emit sound like a conventional point source system, and the volume these operate at are at the sole control of band members. Due to these speakers emitting sound omnidirectionally, each individual piece of equipment could cause disturbance if played at an excessive level.

To contain the on stage noise generated by visiting live music acts, reduce the impact of patron noise and contain the residual sound emitted from the directional array, Direct Acoustics have employed traditional soundproofing techniques in the form of a 12m x 6mm acoustic enclosure. Further details on the attenuation composites utilised can be seen below.

Mitigation - Soundproof Enclosure

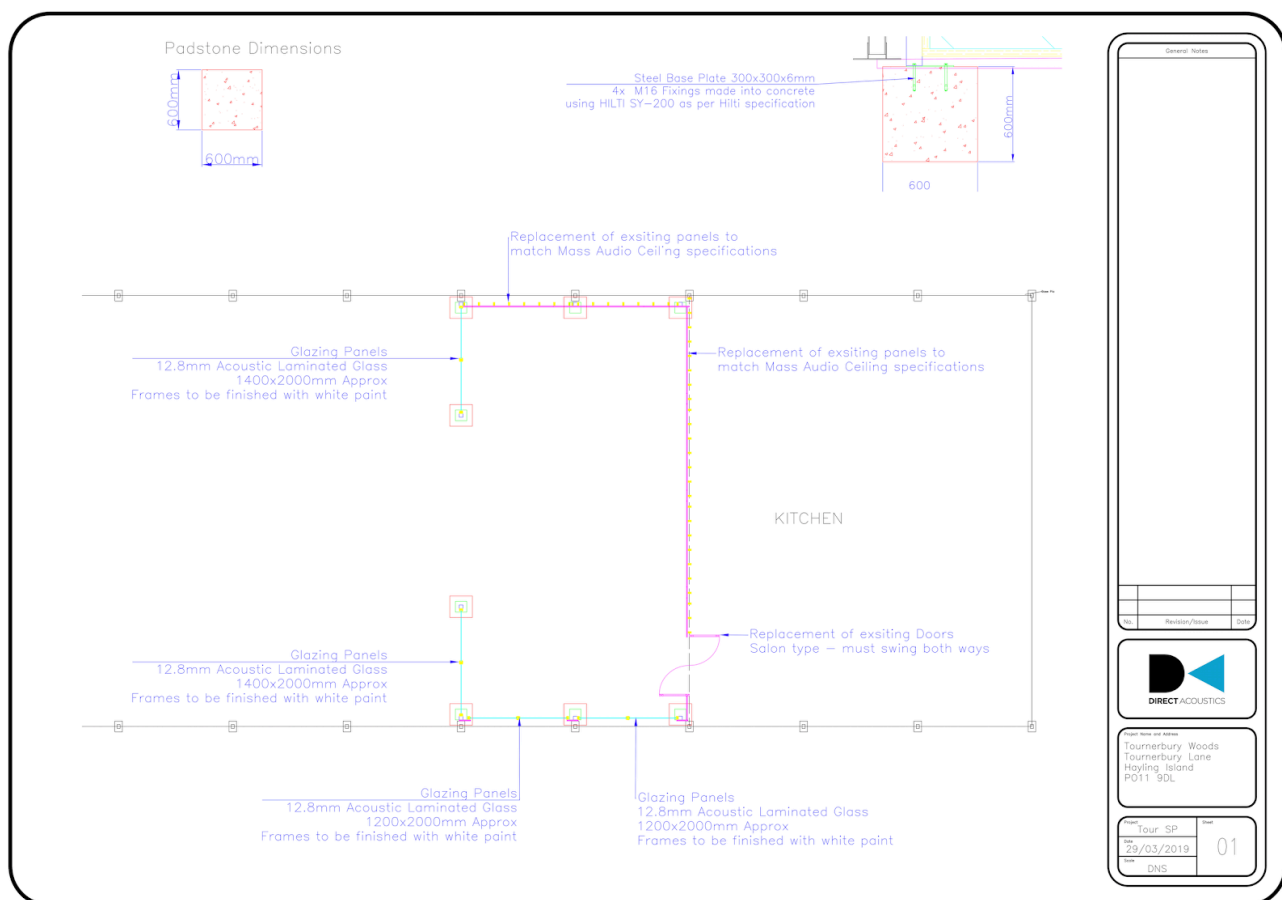


Figure 2

One gable wall was constructed between the catering area and main marquee, with Rw30 doors installed to allow for ingress and egress of staff.

The other gable wall was erected 6m away from the existing with an open frontage to encourage guests into the dancefloor area as detailed in figure 3.

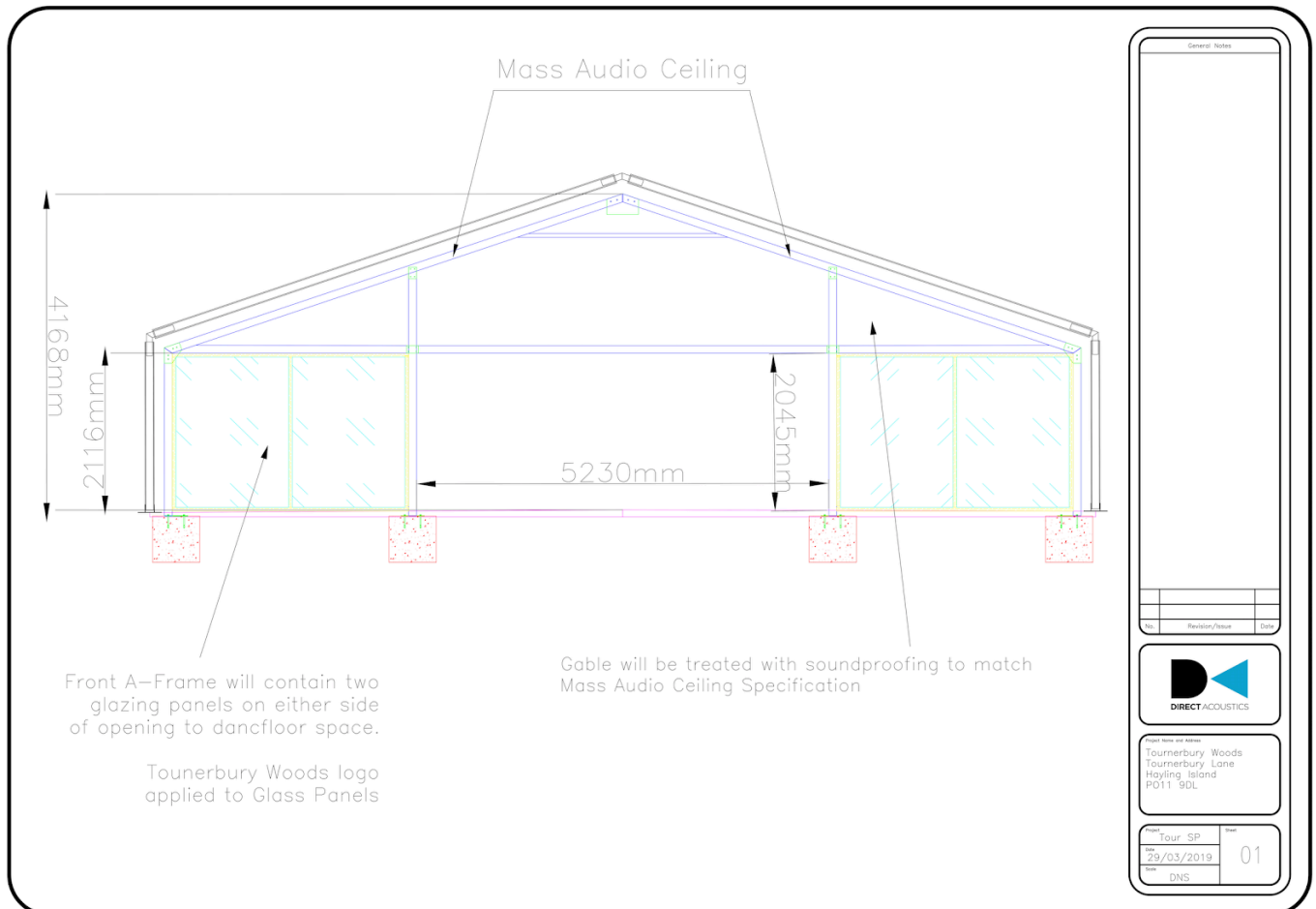


Figure 3

Mass Audio Ceiling/Wall constructions, that are detailed in figures 2 and 3, differ depending on location and access beyond the existing marquee.

Attenuation Composites:

Rear Gable Wall (small aperture)

- 1x 15mm Soundcheck;
- 1 x 3mm acoustic vinyl;
- 1x 15mm Soundcheck;
- 100mm stud - cavity infill - Rw3 60kg/m³ Rockwool;
- 1x 15mm Soundcheck;
- 1 x 3mm acoustic vinyl;
- 1x 15mm Soundcheck;
- 25mm profiled foam.

Using a sound reduction computer modelling software, called INSUL, the overall attenuation of the installed composite to the rear gable wall provides an R_w of 48dB. Frequency specific reductions can be seen in figure 4.

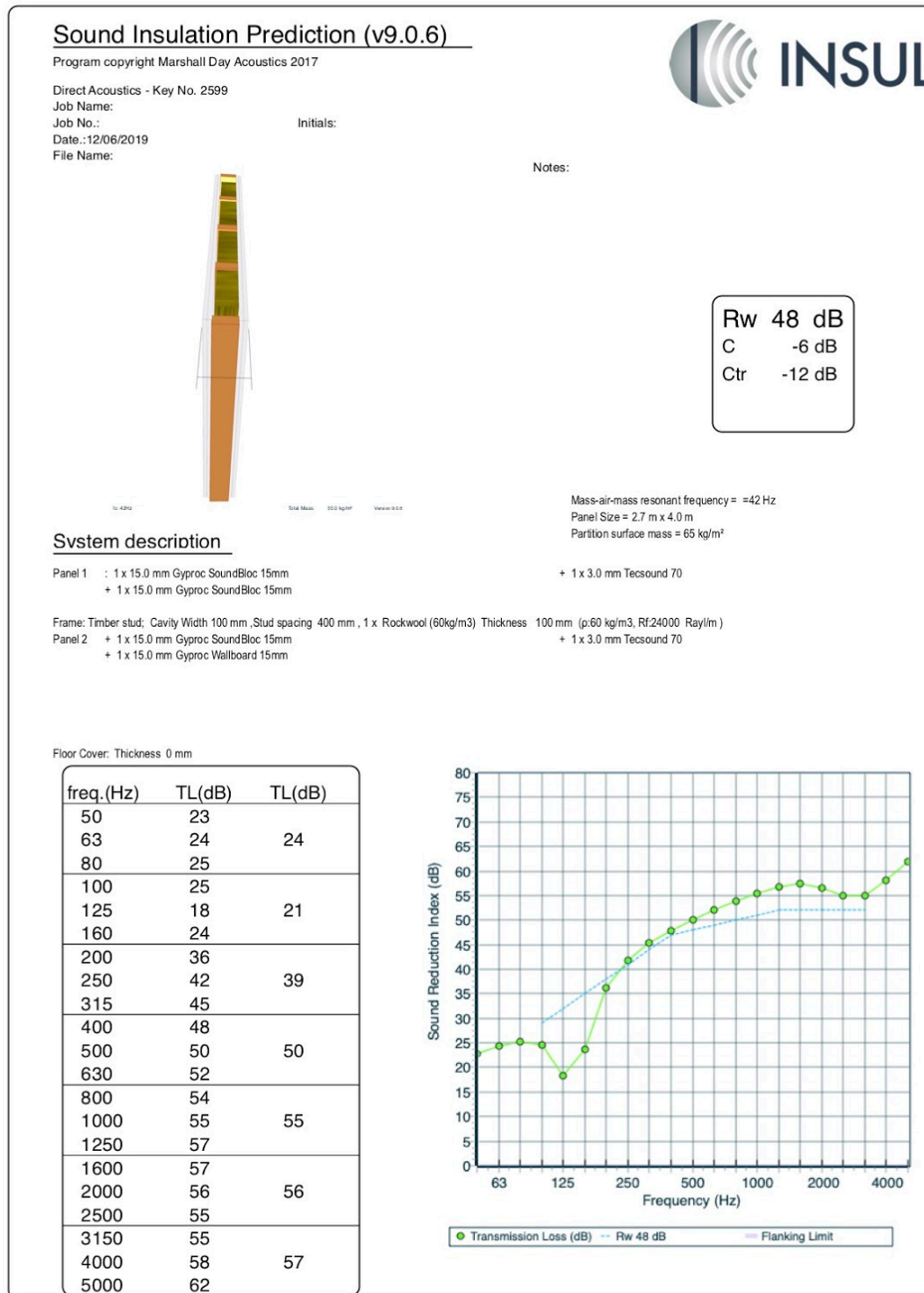


Figure 4

Southern Wall and Gable Triangle

- 1x 12mm plywood;
- 1 x 3mm acoustic vinyl;
- 100mm stud - cavity infill - $Rw3$ 60kg/m³ Rockwool;
- 1x 15mm Soundcheck;
- 1 x 3mm acoustic vinyl;
- 1x 15mm Soundcheck;
- 25mm profiled foam.

INSUL Spec Sheet

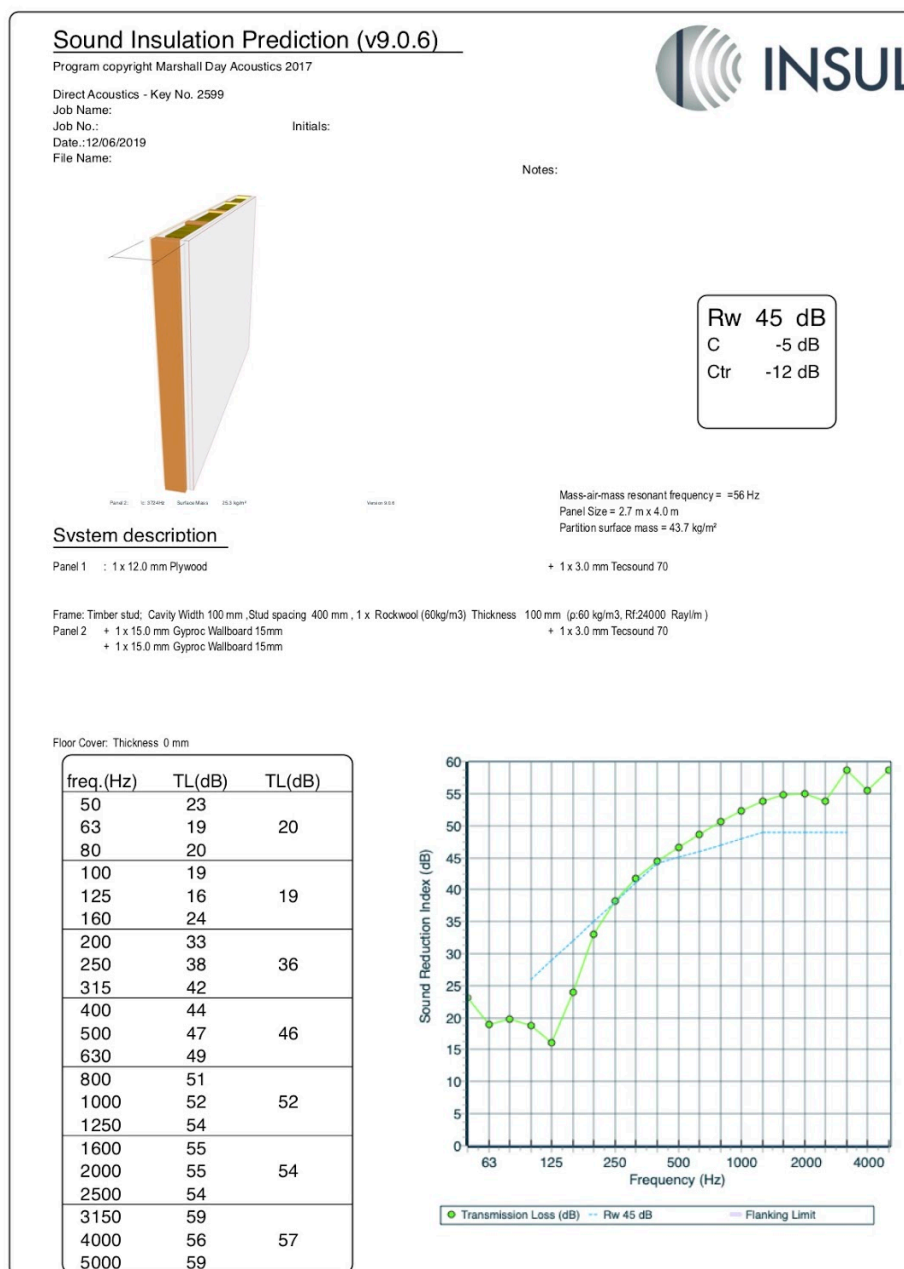


Figure 5

Roof

- 1x 3mm 650g/m² PVC;
- 200mm cavity (no connections);
- 1 x 12mm plywood;
- 1x 15mm Soundcheck;
- 1 x 3mm acoustic vinyl;
- 1x 15mm Soundcheck;
- 25mm profiled foam.

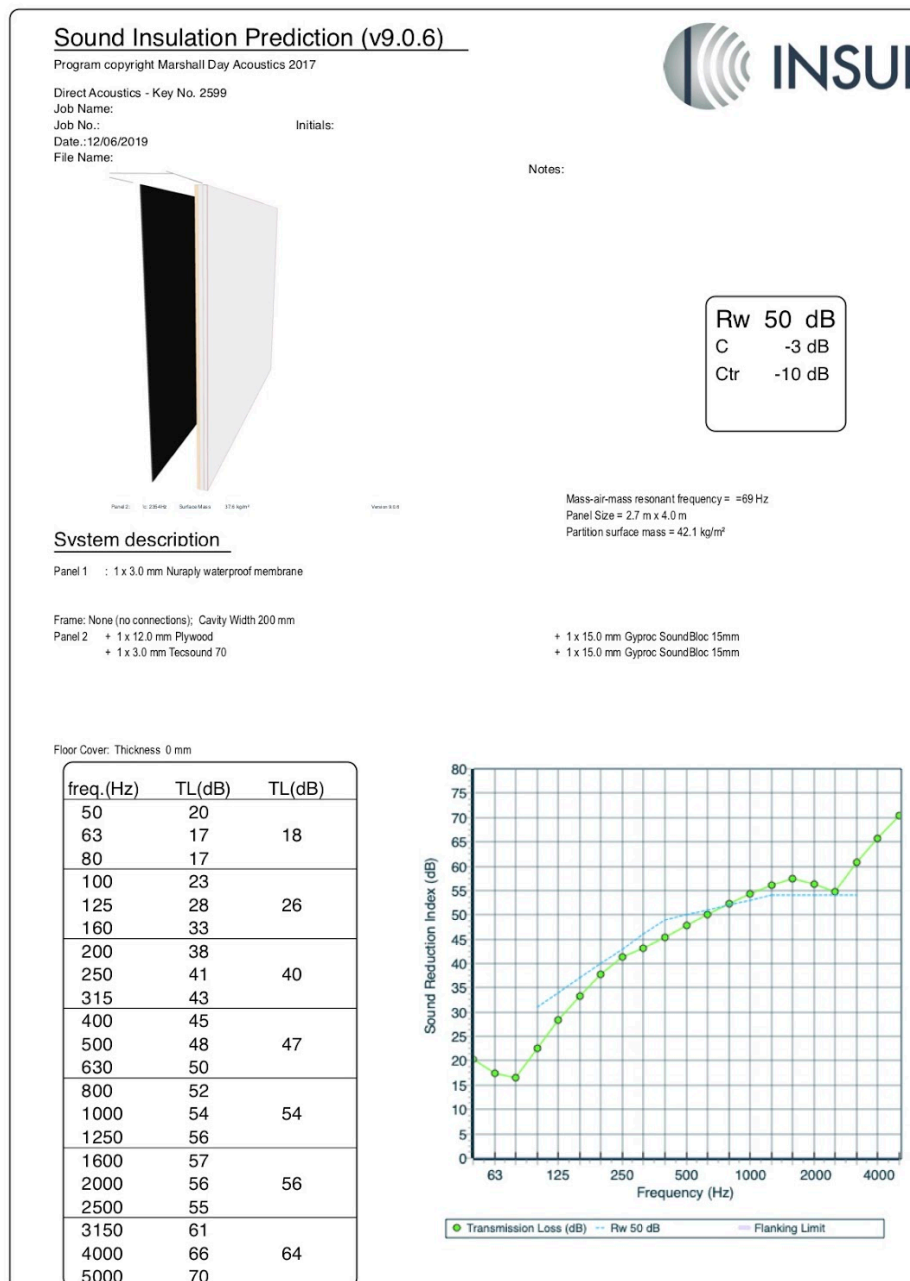


Figure 6

Acoustic Glass

As denoted in figure 2 and 3 there are 4x acoustic glass panes to allow light in the demountable structure, however to ensure that no acoustic weak leak is formed, a 12.8mm acoustic glass variant has been installed offering a 37dB reduction.

- 6.8mm toughened glass;
- 1mm acoustic resin;
- 6.8mm toughened glass;

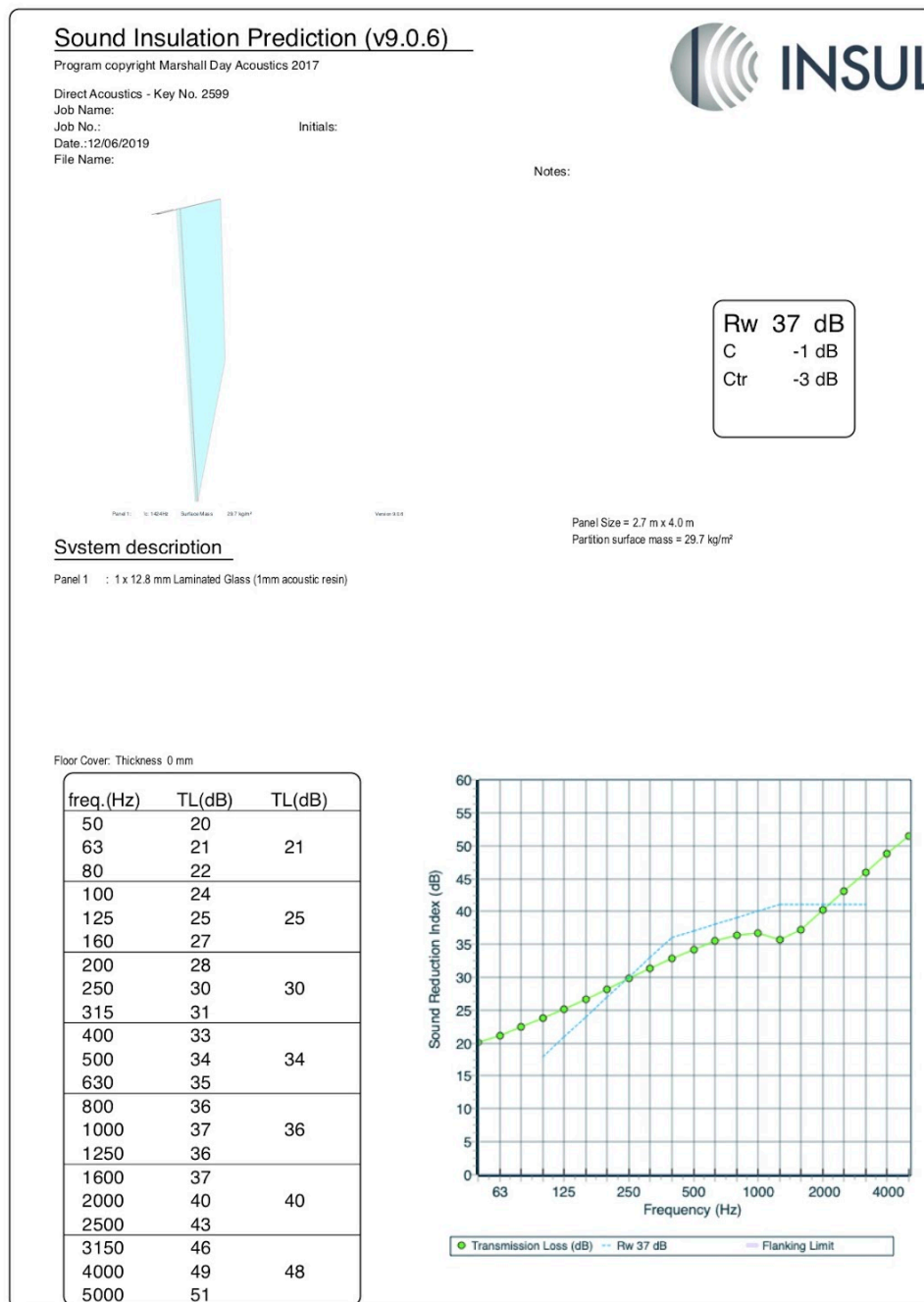


Figure 7

Absorption Coefficient

The attenuation design, whilst very effective, provides a relatively hard and reflective finished surface, which is not suitable for the reverberation time of a space.

To further improve upon its performance, 25mm melamine foam was applied to the internal of the space. Melamine is extremely effective, being 100% absorbent at high frequencies (1kHz-4kHz) and 50% absorbent between 125Hz-500Hz. Overall it can achieve an absorption coefficient of 0.8 (80%), ensuring that the specific troublesome frequencies do not resonate and cause further issues.

Heavyweight Acoustic Marquee Linings

In addition to the acoustic enclosure constructed at Tournerbury Woods Estate, Direct Acoustics have installed a 6.9kg/m² acoustic lining into two marquee bays adjoining the enclosure. This is to assist with attenuating and deflecting residual sound emitting from the 5m x 2m aperture whilst also reducing patron noise.

On the 2nd November 2018, the specified acoustic lining underwent a UKAS accredited lab test to determine its frequency specific sound reduction index. The lab report can be seen on the following page.

SRL

**Test Report No: C/24219/T01****Page 13 of 27****Date: 13/11/2018**

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Data Sheet 5

Test Number: 6
Client: Direct Acoustics
Test Date: 02/11/2018
Sample Height: 2.2 m
Sample Width: 2 m
Sample Weight: 6.9 kg/m²

Test Room:
Air Temperature: 11.8 °C
Air Humidity: 61 %
Volume: 115 m³

Receiving

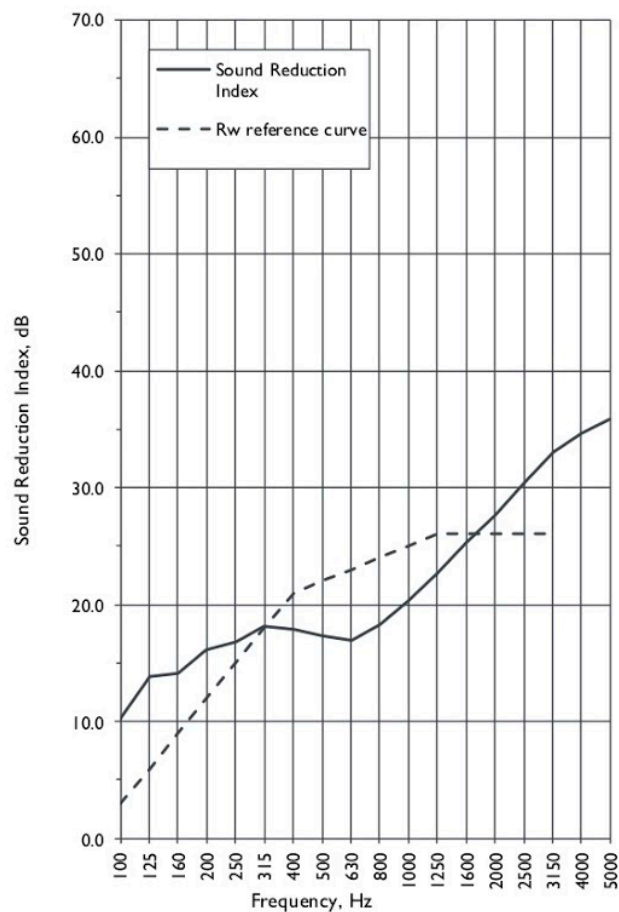
12.6 °C

57 %

300 m³**Air Pressure:** 1015 mbar

Product
Identification:

Freq, f Hz	Sound Reduction Index, dB	
	1/3 Oct	Octave
50+	14.3	11.3
63+	13.5	
80+	8.6	
100	10.2	12.4
125	13.9	
160	14.1	
200	16.1	16.9
250	16.8	
315	18.1	
400	17.9	17.3
500	17.3	
630	16.9	
800	18.3	20.1
1000	20.3	
1250	22.7	
1600	25.3	27.3
2000	27.7	
2500	30.4	
3150	33.1	34.4
4000	34.6	
5000	35.9	
6300+	36.8	37.2
8000+	36.9	
10000+	38.0	
Average 100-3150	19.9	Version v3.1



Rating according to BS EN ISO 717-1:2013

R_w(C;C_{tr})= 22 (-1 ; -3) dB

* shows measurement corrected for background

> shows measurement limited by background

+ shows Frequency beyond standard and not UKAS accredited

Figure 8

An identical lab test was carried out on the 650g/m² PVC currently used to cover Tournurbury Woods Estate's marquee. A 1st octave sound reduction index can be seen for standard marquee PVC below.

Sound Reduction Index Comparison (1st Octave Hz)								
Product	Rw	50-80Hz	100-160Hz	200-315Hz	400-630Hz	800-1.25KHz	1.6-2.5KHz	3.15-5KHz
Existing 650g/m ² PVC	11	4.6	3.8	4.5	7.0	10.4	14.9	20.1

Figure 9

As detailed in figure 10, replacing the existing PVC with a 6.9kg/m² acoustic variant demonstrates a clear improvement, with double the broad spectrum of energy being reduced (Rw 11dB). More importantly, similar reductions can be found at low frequencies (50Hz-160Hz) which often give rise to complaint due to the larger oscillation pattern found.

Sound Reduction Index Comparison (1st Octave Hz)								
Product	Rw	50-80Hz	100-160Hz	200-315Hz	400-630Hz	800-1.25KHz	1.6-2.5KHz	3.15-5KHz
Existing 650g/m ² PVC	11	4.6	3.8	4.5	7.0	10.4	14.9	20.1
Acoustic Lining	22	11.3	12.4	16.9	17.3	20.1	27.3	34.4
Improvement	+11	+6.7	+8.6	+12.4	+10.3	+9.7	+12.4	+14.3

Figure 10

Mitigation - Monitoring Equipment

The works carried out have proved extremely effective, however Direct Acoustics advise Tournurbury Woods Estate purchase a sound pressure level meter with a minimum type two frequency specific microphone.

Direct Acoustics propose to undertake additional testing to establish a suitable internal music noise level that meets pertinent objective criteria at noise sensitive receptor positions. Subjective observation will also be carried ensuring disturbance does not occur.

Once this level has been established, Tournurbury Woods Estate can use the sound pressure level meter to monitor visiting acts throughout each event to confirm that they are not exceeding the permitted volume level.

Conclusions

Taking into account the comments made with regards to the proposed planning application (APP/18/00943), Direct Acoustics understand that historic complaints have been established when external equipment has been brought into the marquee by visiting acts.

To combat this, Tournerbury Woods Estate have installed numerous mitigation systems, such as:

- Soundproof Enclosure - Dancefloor Area;
- Highly Directional Speaker System - Zone Array;
- Acoustic Glass Panels;
- Heavyweight Acoustic Marquee Linings.

Images of the installed products can be seen in the appendix.

To further assist in regulating the internal volume level, Direct Acoustics suggest that a sound pressure level meter with type one or two frequency specific microphone is used. All staff should be given suitable training on the use of sound pressure level metres and the methodology when obtaining accurate noise levels.

If there are any further questions on the systems used at Tournerbury Woods Estate, please do not hesitate to get in touch.

Regards,

Direct Acoustics

Appendix

Installation Photographs







Glossary of Acoustic Terms

Decibel (dB): a unit of level derived from the logarithm of the ratio between the value of a quantity and a reference value. It is used to describe the level of many different quantities. For sound pressure level the reference quantity is 20 Pa, the threshold of normal hearing is in the region of 0 dB, and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.

dB(A): decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound. The background noise level in a living room may be about 30 dB(A); normal conversation about 60 dB(A) at 1 metre; heavy road traffic about 80 dB(A) at 10 metres; the level near a pneumatic drill about 100 dB(A).

Hertz (Hz): unit of frequency, equal to one cycle per second. Frequency is related to the pitch of a sound.

$L_{A10,T}$: the A weighted level of noise exceeded for 10% of the specified measurement period (T). It gives an indication of the upper limit of fluctuating noise such as that from road traffic.

$L_{A10,18h}$: is the arithmetic average of the 18 hourly $L_{A10,1h}$ values from 06.00 to 24.00.

$L_{A90,T}$: the A weighted noise level exceeded for 90% of the specified measurement period (T). In BS 4142: 1990 it is used to define background noise level.

$L_{Aeq,T}$: the equivalent continuous sound level -the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period (T).

$L_{Aeq,T}$: is used to describe many types of noise and can be measured directly with an integrating sound level meter. It is written as L_{eq} in connection with aircraft noise.

L_{Amax} : the highest A weighted noise level recorded during a noise event. The time weighting used (F or S) should be stated.

Additionally, the term SPL refers to the quantity Sound Pressure Level as discussed under Decibel (dB) above. This can be either a broad-band quantity including all octave-band figures or can refer to individual octave-bands for instance.

Additional terms within this proposal:

MNL: Music noise level

NSR: Noise sensitive receptor

SAP: Structural acoustic panel