South Parade Pier
Premises Licence Application
Acoustic Report

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Environmental Health Service

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Contents

1. Summary

1.1. In response to an application for a premises licence for South Parade Pier, The Environmental Health Service have made representations due to concerns regarding potential public nuisance primarily associated with the performance of amplified music to 02:00hrs 7 days a week within the venue.

1.2. The applicant has subsequently submitted a report compiled by an acoustic consultant outlining the sound insulation of the structure and concluding that performances of amplified entertainment within the venue will have no adverse impact upon local residents.

1.3. We have reviewed the report and have concluded that the consultant has underestimated the impact of the predicted noise levels due to the following.

- Internal octave band music noise levels which we do not consider to be representative of typical entertainment venues.
- Background noise measurements taken on a Saturday rather than being representative of the most sensitive day within the proposed operating schedule.
- Calculation methods inappropriate for plane noise sources such as building facades.
- Failing to add appropriate corrections for façades at the receiver and propagation over hard ground, both of which increase predicted noise levels.
- Use of overestimated sound reduction indices for building elements.
- Proposed use of acoustic curtains as mitigation measures which will not provide the quoted improvement to the sound insulation of the windows due to the principle of the mass law i.e. the mass of the curtains being insignificant compared to that of the glazing.

1.4. The consultant's predictions were repeated using the corrected sound reduction indices and including allowances for façade / hard ground propagation but using their proposed music noise spectrum, which revealed that the recommended criteria to ensure no significant impact upon residents would not be met.

1.5. A further assessment has been conducted by the service using our own data and using procedures and methods within British Standard BS 12354-4 Estimation of acoustic performance of buildings from the performance of elements (transmission of indoor sound to the outside) and ISO-9613-2 1996 Attenuation of sound during propagation outdoors.

1.6. These predictions demonstrate that the music noise levels from the operation of the venue will not comply with the required criteria, particularly in the 63Hz and 125 Hz octave bands, indicating a potential significant problem with bass breakout from the venue.

1.7. Noise maps have been produced in Appendix 4 which demonstrates the likely extent of the predicted impacts. Whilst disturbance from the broad band noise would be mainly confined to the front facade of The Royal Beach Hotel and the new McCarthy and Stone retirement accommodation, the low frequency bass component of the music is likely to adversely affect the front facades of all properties along South Parade from Alexandra Court Retirement Home to St Helens Court.

1.8. The music noise level has been plotted against the measured background level between 12:00hrs and 02:00hrs which demonstrates that the impact from the venue in terms of bass breakout is likely to be noticeable from around 21:00hrs.

1.9. Therefore it would appear that the provision of regulated entertainment should be restricted to 23:00hrs as allowed by The Live Music Act or music noise levels reduced commensurate with the sound insulation of the structure, which

will require internal levels to be tightly controlled to a maximum of 89dB in the 63Hz and 125Hz octave bands.

2. Review of Consultants Report

2.1. This section is a review of the report titled "Noise Breakout Testing Report for South Parade Pier Ltd" compiled by Airtight & Noisecheck Limited, dated 25-26th April 2017.

2.2. In order to assess the likely impact it is necessary to establish the existing background noise level and then compare this with the predicted noise levels from the operation of the venue.

2.3. Paragraph 4.2 of the report states that the existing background noise level was measured for a 24 hour period over a weekend "as this is the time when the venue will be in operation and most busy". However the licence application is for entertainment until 02:00hrs seven days a week therefore we would contend that the background noise level used in the assessment should be representative of the quietest period within the proposed operating schedule.

2.4. Consequently we have conducted a background noise assessment over a 24 hour period on Wednesday 31/5/2017 (see Appendix 2), the results of which are shown in Table1 below and compared with those obtained by the consultant.

Table 1: Comparison of Background Noise Measurements

	$LA_{90\ (15min)}$	$L_{90\ (15min)}$ 63Hz	$L_{90(15\ min)}$ 125Hz
PCC	33 dB	43 dB	36 dB
Consultant	39 dB	37 dB	34 dB

2.5. The results indicate that the broad band level is likely to be 5dB lower than that quoted in the report however the octave band levels were higher. The octave band results obtained by the consultant appear unusual as the 63Hz octave band levels are generally higher than the broad band A weighted level.

2.6. Section 5.1 of the report highlights the fact that there is currently no recognised criteria for the assessment of music noise from pubs and clubs, however guidance within the Institute of Acoustics Good Practice Guide on The Control of Noise from Pubs and Clubs recommends that for premises where entertainment takes place on a regular basis, music and associated sources should not be audible inside noise sensitive properties at any time.

2.7. The guidance further advises that noise may be considered inaudible when it is at a low enough level such that it is not recognisable as emanating from the source in question and does not alter the perception of the ambient noise environment.

2.8. The Consultant also quotes a line from the DEFRA report on noise from pubs and clubs stating that "in many cases subjects who were able to hear the entertainment noise, nonetheless considered it to be acceptable", however I would also contend that from 20 years of experience I have found many people are also bothered by and complain about noise which is just audible, particularly late at night.

2.9. My personal views on the DEFRA report are that the assessment method involved questioning subjects in a laboratory rather than their own homes where I am sure the response would have been different, especially after being subjected to the noise on a weekly basis late at night.

2.10. The Service currently tends to favour criteria which were recommended within a draft measurement procedure proposed for the IOA Good Practice Guide. Although this was never formally included within the Guide, in the absence of any other definitive assessment methods, we are of the opinion it should achieve the definition of inaudibility contained within the Guidance.

2.11. The criteria are as follows:

- The L_{Aeq} of the entertainment noise should not exceed the representative background noise level L_{A90} (without entertainment noise) 2 metres from the façade of any noise sensitive premises.
- The L_{10} of the entertainment noise should not exceed the representative background noise level L_{90} (without entertainment noise) in the 63Hz and 125Hz octave bands 2 metres from the façade of any noise sensitive premises.

2.12. The octave band background noise levels within Table 7 of the report are based on measurements of L_{eq} not L_{90} , the L_{90} levels will be lower than L_{eq} as it relates to the lowest 10% of measured values and consequently describes the lower noise levels in the locality so these measurements are of little value for the purposes of this assessment.

2.13. The following unnumbered table in section 7 of the Report contains the values used in the assessment for typical music noise levels measured within a similar venue. However research carried out by Environmental Health to obtain a typical frequency spectrum for entertainment venues involved a measurement exercise within seven venues within the city which revealed the following.

Table 2: Typical Internal Music Noise Levels

	LAeq	L_{10} 63Hz	L_{10} 125Hz	L_{max} 63Hz	L_{10} 125Hz
Average	101dB	110dB	108dB	119 dB	116 dB
Range	96 - 102 dB	106 - 112dB	101 - 114dB	116-123dB	108-120dB

2.14. Consequently when compared with the consultants data it is our view that the source noise levels used in the predictions are not representative of the music noise levels generally associated with such venues.

2.15. This research also established a typical frequency spectrum for music noise levels relative to the proposed broad band level i.e. for a given level of L_{Aeq} we can establish likely values of L_{eq} within each octave band and for a proposed music noise level of 95dB(A) we would anticipate the following spectrum.

Table 3:Typical Internal Music Noise Spectrum Relative to 95dB(A)

	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Leq dB	102	98	94	92	89	86	82	80
L10 dB	104	102						

2.16. Section 8 of The Report contains various calculation methods to establish noise levels at the nearest noise sensitive dwelling 75 metres from the venue and including propagation over hard ground.

2.17. The method in paragraphs 8.1 to 8.2 of The Report is based upon the use of broad band L_{Aeq} levels, therefore the values used for the sound reduction indices associated with each building element should be based upon the R_{w+Ctr} as this describes the performance of each building element relative to a standard frequency spectrum considered appropriate for "disco music" contained within British Standard BS ISO 717-1 Rating of sound insulation in buildings and of building elements.

2.18. However the consultant has used the values of R_w in the calculations which overestimate the performance of the windows against music noise sources by 4dB. The figure used for the sound reduction index in the calculation should be 31dB and not 35dB.

2.19. The Table in paragraph 8.1 also states that the anticipated sound reduction of the ceiling / Roof of the venue is greater than 55dB(A) so can be ignored from the calculation but there is no explanation as to how this figure has been derived.

2.20. We have used insulation prediction software based upon the mass of the building elements and construction technique which indicates this structure is more likely to have a sound reduction index of R_{w+Ctr} 46dB. See Appendix 1 for detail.

2.21. As the background noise levels are façade measurements the predicted noise levels at the receiver should also include a correction of +3dB to allow for a reflective façade.

2.22. When all the above corrections are included within the calculation the resultant noise level at the façade should be LAeq 35dB as opposed to 27dB.

2.23. This indicates that even using the consultant's original source noise levels the predicted music noise levels at the façade of the nearest dwelling will be greater than the measured background level.

2.24. The calculation method used in paragraphs 8.3 to 8.4.5 is based upon the use of octave band levels of L_{eq} . However this technique does not consider the surface area of the façade therefore it is only appropriate for point noise sources and will underestimate noise levels from plane sources such as building facades.

2.25. We have checked the sound insulation performance of the proposed 10mm laminated glass within British Standard BS 8233, Pilkington Glass Technical Documents and also by using sound insulation prediction software, all of which indicates that the octave band performance is less than that quoted in the report, particularly in the lower frequencies. See Table 4 below.

Table 4: Sound Reduction Index of 10mm Glazing

	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
PCC Data	20	24	26	33	33	35	44	46
Consultant's	26	26	27	34	35	36	44	44

2.26. The attenuation due to distance has been calculated using a formula for soft ground propagation therefore the equation should include a correction factor of +3dB for hard ground.

2.27. Similarly as the background noise levels are façade measurements the predicted noise levels at the receiver should include a further correction of +3dB to allow for a reflective façade.

2.28. When all the above corrections are introduced into the calculations the resultant noise levels at the facade of the receiver are shown in Tables 5 and 6 below and compared with those obtained by the Consultant.

Table 5: Leq Façade Noise Levels at Receiver (Method 2)

	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
PCC Calcs dB	43	36	32	25	25	23	10	1
Consultant's Calcs dB	31.5	28.5	25.5	18.5	17.5	16.5	4.5	-2.5

Table 6: Lmax Facade Noise Levels at Receiver (Method 2)

	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
PCC calcs dB	53	49	37	25	28	26	11	9
Consultant's calcs dB	41	41	30	18	20	19	5	5

2.29. As previously stated the calculation method employed to obtain the above results in Tables 5 and 6 is inappropriate for the purposes of this assessment as it is only applicable to point noise sources.

2.30. The procedure in paragraph 8.4.5 of the Report contains another assessment procedure based upon our preferred criteria of comparing octave band values of L_{10} with the background value of L_{90}.

2.31. For some reason rather than using a measured value of $L_{10,}$ attempts have been made to derive a relationship between the measured values of L_{max} and L_{10} to establish the value of L_{10} to use in the assessment.

2.32. However the calculation method employed is only suitable for point noise sources and likely to underestimate the predicted levels from plane noise sources and also makes no allowance for hard ground and building facades at the receiver.

2.33. Paragraph 8.5 of the report contains an appropriate calculation method for use with plane sound sources however there appears to be no allowance for hard ground and facade corrections so the results need to be increased by a further 6dB which will result in the following facade noise levels.

Table 7: Leq Façade Noise Levels at Receiver (Method 3)

	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	-/-A
Leq dB	47	40	36	29	29	27	34
Background L90 dB	43	36	-	-	-	-	33

2.34. Comparison of these results with the measured background noise levels indicates that the predicted levels are just above the broad band criteria.

2.35. Although no appropriate calculations have been carried out to establish compliance with the octave band L_{10} requirements the above results indicate that the predicted values of Leq in the 63Hz and 125Hz bands are above the corresponding background noise levels so it can be concluded that the criteria will not be met as the values of L_{10} will always be greater than Leq.

2.36. The Report makes reference to alternative noise criteria from the World Health Organisation Guidelines for Community Noise and Noise Rating Curves, however these are only really applicable to anonymous and steady noise sources such as those associated with transportation or building services. There are many references within the WHO guidelines regarding the requirement for stricter criteria for noise with significant low frequency content, therefore we do not consider these criteria to be appropriate for the assessment of music noise owing to the low frequency bass noise associated with entertainment venues and the emotional response associated with their impact.

2.37. In terms of further mitigation the Report claims that the addition of acoustic curtains will further increase the sound attenuation offered by the windows. The sound insulation of a panel is dependent upon the mass law principle, which requires the mass of a structure to double in order to obtain an increase in sound reduction of around 5dB.

2.38. The mass per unit area of the acoustic curtains is 0.8kg/m^2 whilst the mass of 10mm laminated glass is 2700kg/m^2, consequently the addition of a curtain to a window will make no difference to the attenuation of direct sound particularly in the low frequencies associated with bass music.

2.39. The Report also mentions the need to control the frequency content and music levels within the venue but contains no detail how this will be achieved apart from recommending the applicant drafts and implements a noise management plan which has not been submitted.

3. Predicted Music Noise Levels

3.1. To establish the potential impact from the operation of the proposed venue The Environmental Health Service has undertaken an assessment based upon source noise levels derived from research conducted at seven local entertainment venues and using appropriate prediction methods to establish a source sound power level of the building facades as per the requirements of BS12354-4.

3.2. The attenuation over the propagation path has been modelled using the procedures within ISO 9613-2 and noise maps produced using Cadna noise prediction software to identify the extent of the area within the locality where the criteria is expected to be exceeded. See Appendix 4.

3.3. The predicted noise levels have been compared with the background noise level measured as $L_{90\ (15\ mins)}$ 1 metre from the façade of Rostrevor Mansions, 2 St Helens Parade, between 12:00hrs and 02:00hrs.

3.4. The following criteria were used for the purpose of this assessment:

- The L_{Aeq} of the entertainment noise should not exceed the representative background noise level L_{A90} (without entertainment noise) 2 metres from the façade of any noise sensitive premises.
- The L_{10} of the entertainment noise should not exceed the representative background noise level L_{90} (without entertainment noise) in the 63Hz and 125Hz octave bands 2 metres from the façade of any noise sensitive premises.

Internal Music Noise Levels

3.5. The source noise levels used in the assessment have been based upon the proposed level of 95dB(A) with the octave band spectrum derived using the C_{dm} adaptation term.

Table 8: Internal Music Noise Levels

	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Leq dB	102	98	94	92	89	86	82	80
L10 dB	104	102	-	-	-	-	-	-

Source Sound Power Levels

3.6. Sound power levels were derived for the roof and the glazed façade of the pier based upon the internal noise level and surface area of each façade together with a diffusivity term of -6dB. See Appendix 3 for input data.

Table 9: Sound Power Level of Glazed Facade

	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Leq dB	95	87	81	72	69	64	51	47
L10 dB	97	91	-	-	-	-	-	-

Table 10: Sound Power Level of Roof

	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Leq dB	90	76	70	72	61	49	36	31
L10 dB	92	80	-	-	-	-	-	-

Predicted Music Noise Levels at Receiver

3.7. The predicted music noise levels at the façade of the receiver were calculated based upon the following assumptions

- Source - Receiver distance 75m
- Source and Receiver height 1.5m
- No barriers
- 100% hard ground
- No directivity correction
- Ambient air pressure 101.8 Pascalls
- Humidity 77%
- Air Temp 287^0 Kelvin

Table11: Predicted LAeq Contribution from Glazed Facade

Horizontal Propagation Path								
Hz	63	125	250	500	1k	2k	4k	8k
Lw dB	94.75	86.75	80.75	71.75	68.75	63.75	50.75	46.75
Dc	0	0	0	0	0	0	0	0
Adiv	48.50	48.50	48.50	48.50	48.50	48.50	48.50	48.50
Aatm	0.01	0.03	0.08	0.17	0.30	0.64	1.92	6.85
Agr	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00
Abar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lp dB	49.24	41.22	35.17	26.08	22.95	17.61	3.33	-5.60
Lp façade	52.24	43.22	38.17	29.08	25.95	20.61	6.33	0.00
Lp dB(A)	**34.62**							

Table: 12: Predicted LAeq Contribution from Roof

Horizontal Propagation Path								
Hz	63	125	250	500	1k	2k	4k	8k
Lw dB	89.5	75.5	69.5	71.5	60.5	48.5	35.5	30.5
Dc	0	0	0	0	0	0	0	0
Adiv	48.50	48.50	48.50	48.50	48.50	48.50	48.50	48.50
Aatm	0.01	0.03	0.08	0.17	0.30	0.64	1.92	6.85
Agr	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00
Abar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lp dB	44.03	30.01	23.95	25.86	14.74	2.40	-11.89	-21.82
Lp facade	42.03	33.01	26.95	28.86	17.74	5.4	0	0
Lp dB(A)	**28.29**							

3.8. Based on the above predictions the combined music noise level at the façade will be LAeq 36dB.

Table 13: Predicted L10 Contribution from Glazed Façade

Horizontal Propagation path								
Hz	63	125	250	500	1k	2k	4k	8k
Lw dB	97.00	91.00	0.00	0.00	0.00	0.00	0.00	0.00
Dc	0	0	0	0	0	0	0	0
Adiv	48.50	48.50	48.50	48.50	48.50	48.50	48.50	48.50
Aatm	0.01	0.03	0.08	0.17	0.30	0.64	1.92	6.85
Agr	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00
Abar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lp dB	51.49	45.47	-45.58	-45.67	-45.80	-46.14	-47.42	-52.35
Lp facade	**54.5**	**48.5**						

Table14: Predicted L10 Contribution from Roof

Horizontal Propagation Path								
Hz	63	125	250	500	1k	2k	4k	8k
Lw dB	92.0	80.0	0.0	0.0	0.0	0.0	0.0	0.0
Dc	0	0	0	0	0	0	0	0
Adiv	48.50	48.50	48.50	48.50	48.50	48.50	48.50	48.50
Aatm	0.01	0.03	0.08	0.17	0.30	0.64	1.92	6.85
Agr	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00	-3.00
Abar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lp dB	46.49	34.47	-45.58	-45.67	-45.80	-46.14	-47.42	-52.35
Lp facade	**49.5**	**37.5**						

3.9. Based on the above predictions the combined music noise level at the façade will be $L_{10\ (63Hz)}$ 56dB and $L_{10\ (125Hz)}$ 49dB

4. Impact Assessment

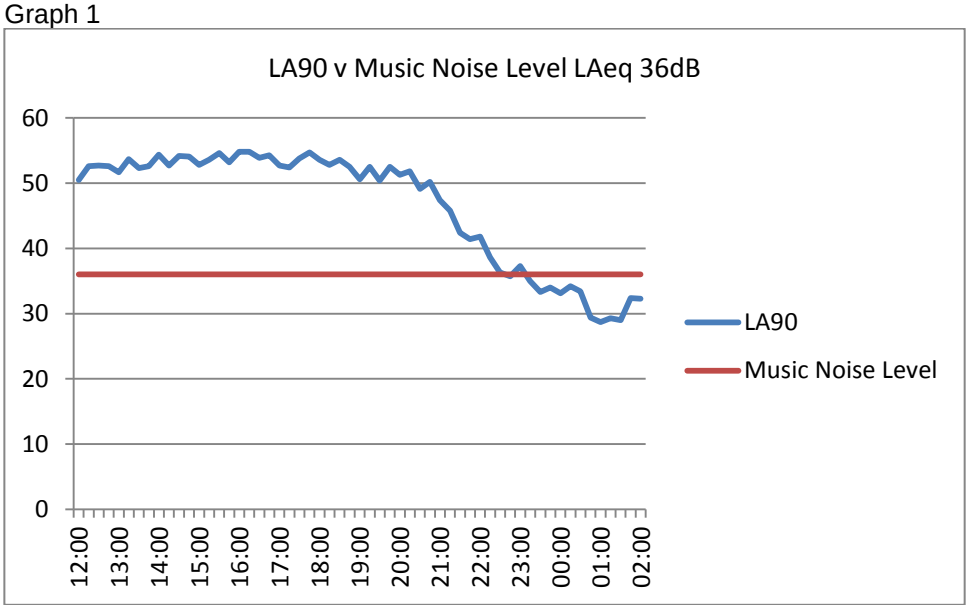
4.1. Comparison of the predicted noise levels with the measured background levels indicates that the music noise levels will not comply with the recommended criteria particularly at low frequencies. The assessment indicates a potential significant problem with bass breakout from the venue.

Table 15: Comparison of Predicted Music Noise Levels with Background

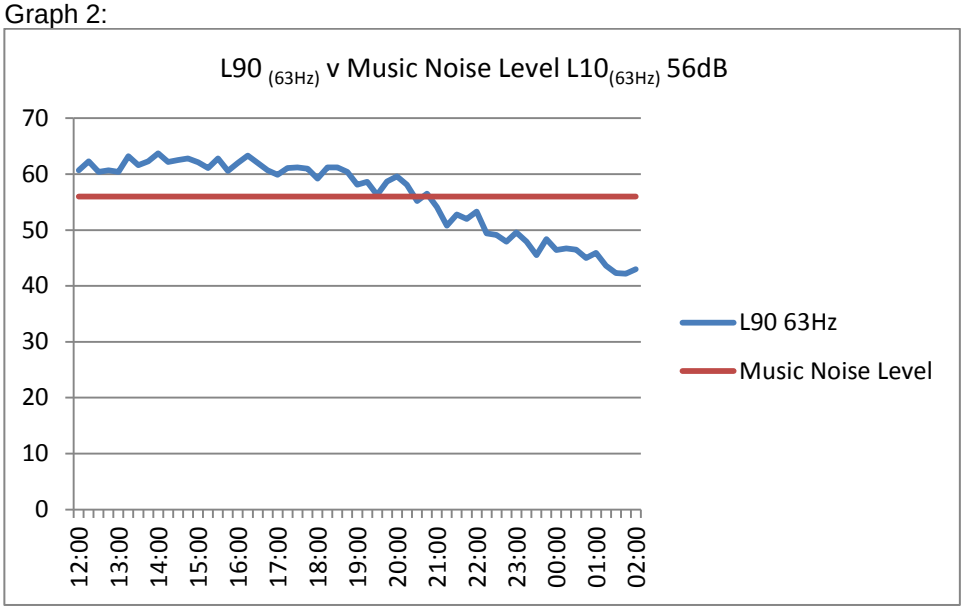
	63Hz	125Hz	A weighted
L10 dB	56	49	-
Leq dB	-	-	36
L90 dB	43	36	33
Difference dB	+13	+13	+3

4.2. Plotting the music noise level against the measured background over time indicates that the impact from the venue in terms of bass breakout is likely to be noticeable from around 21:00hrs and the broad band level from around 23:00hrs. See Graphs 1-3.

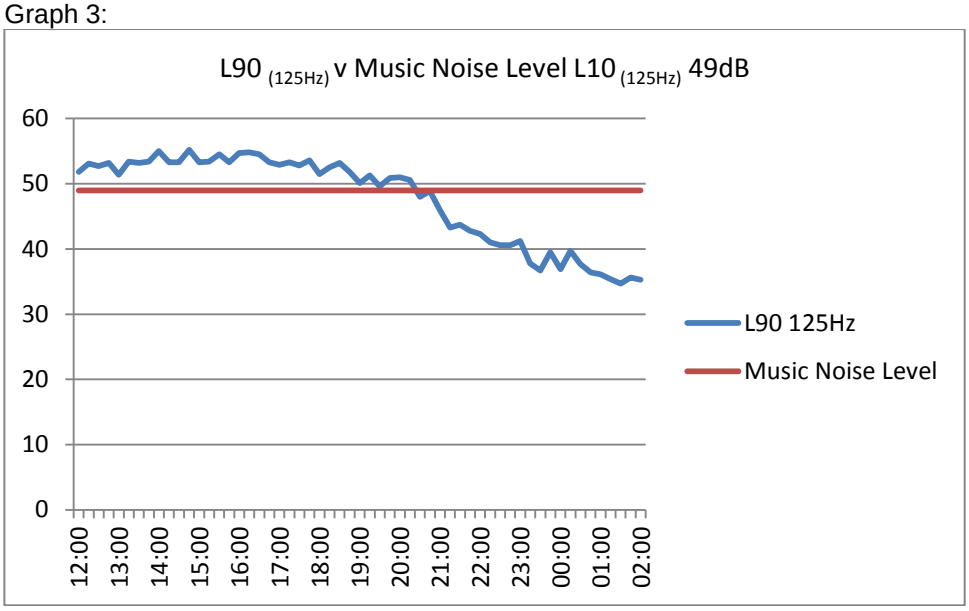
Graph 1



Graph 2:



Graph 3:



5. Conclusions

5.1. The acoustic report submitted in support of the application contains significant errors in the choice of methodology and execution and the content does not alter our opinion in respect to the likely impact upon residents not only from music but also from the noise and disturbance created by patrons leaving the premises (which has not been addressed by the report).

5.2. No information has been received as to how maximum levels of noise within the premises will be controlled and therefore our original comments in respect to managerial and automatic controls of music volumes remains unchallenged.

5.3. The assessment has been repeated using data obtained by the Environmental Health Service which indicates that the music noise levels will not comply with the recommended criteria, highlighting a potential significant problem with bass breakout from the venue and validates our concerns in respect to the ability of the venue to attenuate noise to a degree that will prevent public nuisance from occurring.

5.4. The noise maps in Appendix 4 demonstrate the likely extent of the predicted impacts upon the locality. Whilst disturbance from the broad band noise would be mainly confined to the front façade of The Royal Beach Hotel and the new McCarthy and Stone retirement accommodation, the low frequency bass component of the music is highly likely to affect all properties along South Parade from Alexandra Court Retirement home to St Helens Court.

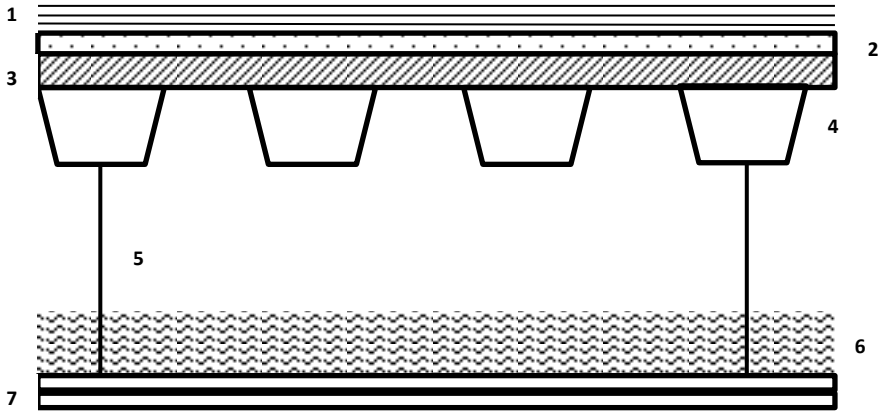
5.5. Plotting the predicted music noise level against the measured background over time demonstrates that the impact from the venue in terms of bass breakout is likely to be noticeable from around 21:00hrs and the broad band level from around 23:00hrs, with the impact increasing steadily as the evening progresses. The impact between midnight and 02:00hrs being highly significant.

5.6. Our experience of investigating complaints from residents disturbed by noise differs to those of the consultant. These experiences provide expert testimony in respect to the likelihood of public nuisance caused when levels of music reach those as predicted by the service.

5.7. This service continues to maintain its position that the provision of regulated entertainment should be restricted to 23:00hrs as allowed by The Live Music Act or music noise levels reduced commensurate with the sound insulation of the structure, which will require levels to be tightly controlled to a maximum of 89dB in the 63Hz and 125Hz octave bands.

5.8. As mentioned in 1.2 above this service has no information in respect as to how such measures will be introduced, managed and maintained or that these levels will be viable in respect to the wishes of the applicant to provide both recorded and live music in a venue of this description.

Appendix 1: Roof Construction.



1. Three layers of Felt (6mm total depth).
2. 1 Layer 18mm Plywood.
3. 1 Layer 25mm Wood cement board.
4. 0.7mm steel profiled deck.
5. MF Gridliner suspended from roof.
6. Mineral wool.
7. 2 Layers 15mm Fireline Plasterboard.

Table 16: Properties of Materials

	Density kg/m^3	Young's modulus
Felt	100	0.1
Plywood	600	8.7
Wood Cement Board	460	2
Steel Profile Deck	7800	207
Fireline plasterboard	780	2

Mass of Roof construction = 28.8 kg/m^2
Depth of Roof = 50mm Density of Roof = 576 kg/m^3 Ceiling Void = 0.3 -1m

Table 17: Composite Roof and Ceiling Acoustic Performance
Insul software calculation

Hz	63	125	250	500	1k	2k	4k	8k	Rw	Rw+Ctr
SRI dB	34	44	46	42	50	59	68	71	49	46

Appendix 2: Measured Data

Background Noise Measurements

Instruments:
Norsonic 140 sound analyser Serial No. 3966
Norsonic 1225 Microphone Serial No. 118625
Norsonic 1209 Preamplifier Serial No. 13404
Norsonic 1251 Calibrator Serial No. 32606
Norsonic 1217 outdoor microphone enclosure

Location:
1.5 metres from façade of Rostrevor Mansions, St Helens Parade, 2 m above ground level.

Met Conditions:
Nil Precipitation
Wind speed 0 - 3m/s
Temp 9 - 20°C
Humidity 58 - 94%
Pressure 102.2Pa

Table 18:Measured Background Levels

Time	$LAeq_{(15min)}$	$LA90_{(15min)}$	$L90_{63Hz\ (15min)}$	$L90_{125Hz\ (15min)}$
23:00	55.6	37.3	49.6	41.2
23:15	56.5	35	47.9	37.8
23:30	61.7	33.3	45.5	36.7
23:45	53.1	34	48.4	39.5
00:00	53.8	33.1	46.4	36.9
00:15	52.8	34.2	46.7	39.7
00:30	50.3	33.4	46.5	37.7
00:45	46.3	29.4	45	36.4
01:00	48.5	28.7	45.9	36.1
01:15	42	29.3	43.6	35.4
01:30	47.7	29	42.3	34.7
01:45	45.2	32.4	42.2	35.6

Appendix 3

Façade Sound Power Level Data Input

Portsmouth CITY COUNCIL

BS12354-4:2000

Estimation of transmission of indoor sound to the outside

Title: South Parade Pier

Facade Description		
1	Window	
2	Roof	
3		
4		

Propagation distance	75	metres
Max segment dimension	26.52	metres

Divide each facade into segments which do not exceed above maximum dimension

Segment dimensions			
facade		width m	Height m
1	Window	25	3
2	Roof	27	21
3	0		
4	0		

General Principles of model (BS 12354-4: 2000 section 4)

Each facade is divided into segments composed of individual building elements and a substitute point noise source calculated for the segment

$$L_W = L_{pin} + C_d - R' + 10\log\frac{S}{S_0}$$

R' = Apparent SRI for the segment

S = area of segment

$$R' = -10\log\left[\sum_{i=1}^{m}\frac{S_i}{S}10^{-Ri/10} + \sum_{i=m+1}^{m+n}\frac{A_0}{S}10^{-Dne,i/10}\right]$$

Si =Area of element

S = Area of segment

Dne,i = Element normalized level difference for a small element i

Project: South Parade Pier Licence Version: 2.0

Title: **South Parade Pier Leq**

BS12354-4:2000 section 4.3 Segment substitute point source sound power levels

Input internal noise level, diffusivity term, building element SRI and directivity appropriate for each segment

Large openings in the façade (>1m2) should be allocated a separate segment.

Facade 1 **Window**		**Segment 1**							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Internal noise level Lp	dB	102	98	94	92	89	86	82	80
Diffusivity term Cd (BS 12354-4 Annex B)	dB	-6	-6	-6	-6	-6	-6	-6	-6
				Sound reduction index R dB					
Building element	Area (S) m2	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Window 10mm laminated glass	75	20	24	26	33	33	35	44	46
Segment area (So)	75								
Total R' ΣS/So(10^ -R/10)		0.01	0.0039811	0.0025119	0.0005012	0.0005012	0.0003162	3.981E-05	2.512E-05
Small openings in facade <1m2		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
	Dne dB								
	Dne dB								
	Dne dB								
Total Dne' Σ10/So(10^ -Dne/10)		4E-101	4E-101	4E-101	4E-101	4E-101	4E-101	4E-101	4E-101
R'+Dne'		0.01	0.0039811	0.0025119	0.0005012	0.0005012	0.0003162	3.981E-05	2.512E-05
Segment sound reduction index dB		20	24	26	33	33	35	44	46
10log segment area		18.750613	18.750613	18.750613	18.750613	18.750613	18.750613	18.750613	18.750613
Directivity Dc (BS 1235-4 Annex D) dB									
Segment sound power level Lw dB		94.75	86.75	80.75	71.75	68.75	63.75	50.75	46.75

Title: **South Parade Pier Leq**

BS12354-4:2000 section 4.3 Segment substitute point source sound power levels

Input internal noise level, diffusivity term, building element SRI and directivity appropriate for each segment

Large openings in the façade (>1m2) should be allocated a separate segment.

Facade 2 **Roof**	**Segment 1**								
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Internal noise level Lp	dB	102	98	94	92	89	86	82	80
Diffusivity term Cd (BS 12354-4 Annex B)	dB	-6	-6	-6	-6	-6	-6	-6	-6
				Sound reduction index R dB					
Building element	Area (S) m2	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Roof	567	34	44	46	42	50	59	68	71
Segment area (So)	567								
Total R' ΣS/So(10^ -R/10)		0.0003981	3.981E-05	2.512E-05	6.31E-05	0.00001	1.259E-06	1.585E-07	7.943E-08
Small openings in facade <1m2		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
	Dne dB								
	Dne dB								
	Dne dB								
Total Dne' Σ10/So(10^ -Dne/10)		5.29E-102	5.29E-102	5.29E-102	5.29E-102	5.29E-102	5.29E-102	5.29E-102	5.29E-102
R'+Dne'		0.0003981	3.981E-05	2.512E-05	6.31E-05	0.00001	1.259E-06	1.585E-07	7.943E-08
Segment sound reduction index dB		34	44	46	42	50	59	68	71
10log segment area		27.535831	27.535831	27.535831	27.535831	27.535831	27.535831	27.535831	27.535831
Directivity Dc (BS 1235-4 Annex D) dB		0	0	0	0	0	0	0	0
Segment sound power level Lw dB		89.54	75.54	69.54	71.54	60.54	48.54	35.54	30.54
Segment sound power level Lw dB		89.54	75.54	69.54	71.54	60.54	48.54	35.54	30.54

Project: South Parade Pier Licence Version: 2.0

Title: **South Parade Pier L10**

BS12354-4:2000 section 4.3 Segment substitute point source sound power levels

Input internal noise level, diffusivity term, building element SRI and directivity appropriate for each segment

Large openings in the façade (>1m2) should be allocated a separate segment.

Facade 1 **Window**		**Segment 1**							
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Internal noise level Lp	dB	104	102						
Diffusivity term Cd (BS 12354-4 Annex B)	dB	-6	-6	-6	-6	-6	-6	-6	-6
				Sound reduction index R dB					
Building element	Area (S) m2	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Window 10mm laminated glass	75	20	24	26	33	33	35	44	46
Segment area (So)	75								
Total R' ΣS/So(10^ -R/10)		0.01	0.0039811	0.0025119	0.0005012	0.0005012	0.0003162	3.981E-05	2.512E-05
Small openings in facade <1m2		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
	Dne dB								
	Dne dB								
	Dne dB								
Total Dne' Σ10/So(10^ -Dne/10)		4E-101	4E-101	4E-101	4E-101	4E-101	4E-101	4E-101	4E-101
R'+Dne'		0.01	0.0039811	0.0025119	0.0005012	0.0005012	0.0003162	3.981E-05	2.512E-05
Segment sound reduction index dB		20	24	26	33	33	35	44	46
10log segment area		18.750613	18.750613	18.750613	18.750613	18.750613	18.750613	18.750613	18.750613
Directivity Dc (BS 1235-4 Annex D) dB									
Segment sound power level Lw dB		96.75	90.75	-13.25	-20.25	-20.25	-22.25	-31.25	-33.25

Title: **South Parade Pier L10**

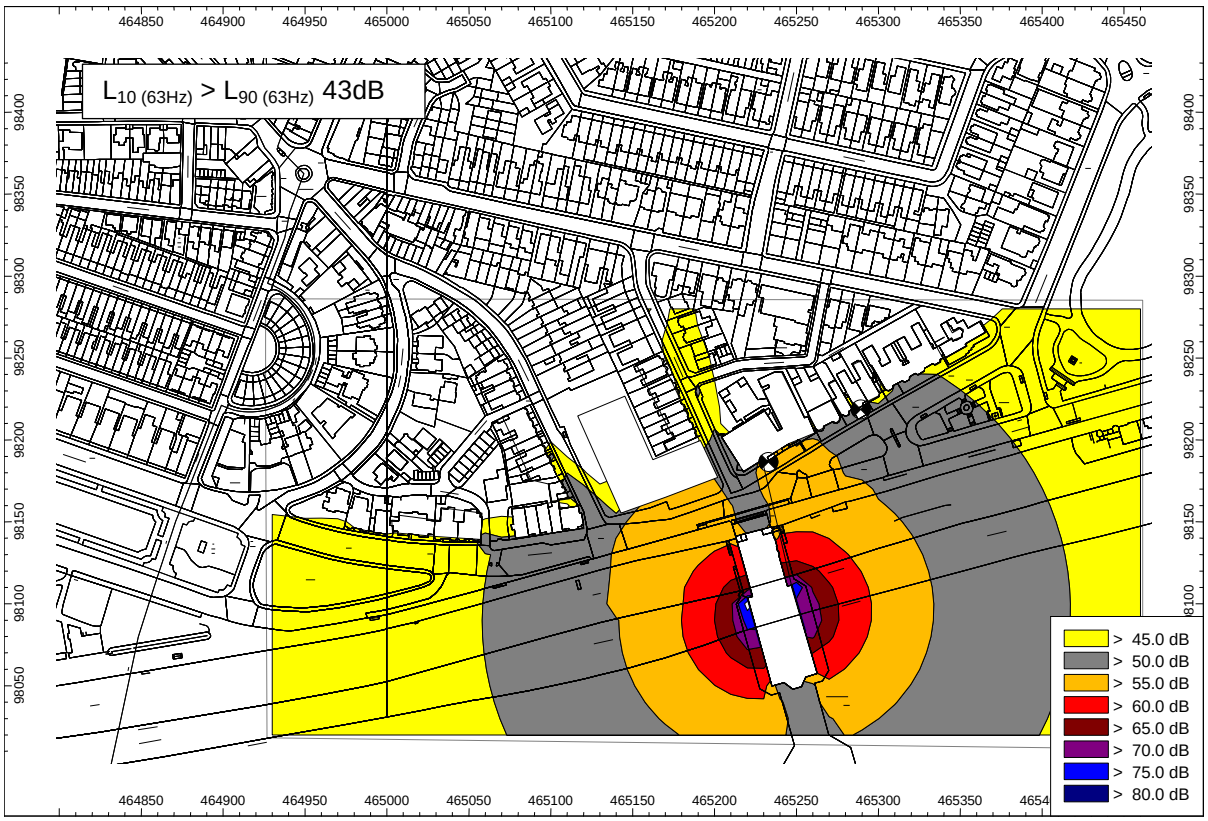
BS12354-4:2000 section 4.3 Segment substitute point source sound power levels

Input internal noise level, diffusivity term, building element SRI and directivity appropriate for each segment

Large openings in the façade (>1m2) should be allocated a separate segment.

Facade 2 **Roof**	**Segment 1**								
		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Internal noise level Lp	dB	104	102						
Diffusivity term Cd (BS 12354-4 Annex B)	dB	-6	-6	-6	-6	-6	-6	-6	-6
				Sound reduction index R dB					
Building element	Area (S) m2	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
Roof	567	34	44	46	42	50	59	68	71
Segment area (So)	567								
Total R' ΣS/So(10^ -R/10)		0.0003981	3.981E-05	2.512E-05	6.31E-05	0.00001	1.259E-06	1.585E-07	7.943E-08
Small openings in facade <1m2		63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz
	Dne dB								
	Dne dB								
	Dne dB								
Total Dne' Σ10/So(10^ -Dne/10)		5.29E-102	5.29E-102	5.29E-102	5.29E-102	5.29E-102	5.29E-102	5.29E-102	5.29E-102
R'+Dne'		0.0003981	3.981E-05	2.512E-05	6.31E-05	0.00001	1.259E-06	1.585E-07	7.943E-08
Segment sound reduction index dB		34	44	46	42	50	59	68	71
10log segment area		27.535831	27.535831	27.535831	27.535831	27.535831	27.535831	27.535831	27.535831
Directivity Dc (BS 1235-4 Annex D) dB		0	0	0	0	0	0	0	0
Segment sound power level Lw dB		91.54	79.54	-24.46	-20.46	-28.46	-37.46	-46.46	-49.46

Appendix 4: Noise Maps




Leq > L90 33dB(A)
465050
465100
465150
465200
465250
465300
465350
465400
465450
98300
98250
98200
98150
98100
98050
> 35.0 dB
> 40.0 dB
> 45.0 dB
> 50.0 dB
> 55.0 dB
> 60.0 dB
> 65.0 dB
> 70.0 dB

Appendix 5: Glossary of Technical Terms

"A" Weighting	Filter used in the measurement of noise to simulate the frequency response of the human hearing range.
dB, dB(A)	Decibels. A logarithmic scale used to describe the magnitude of sound. Sound is generally measured by fluctuations in pressure (Pa, Pascalls), human hearing ranges from 20 μPa to 20,000 Pa. The decibel scale compresses these figures to a more manageable range of 0 – 140dB. The human ear responds to continuous sound sources in broadly the following way: • A 1 dB increase is the smallest audible change in level under laboratory conditions; it would only be noticeable if two sounds were presented in quick succession. • A 3dB increase is the smallest noticeable audible change which could be detected over a period of time. • A 10dB increase represents a doubling of loudness. The suffix (A) simply identifies that the sound has been measured using an "A" weighting filter.
Frequency	Frequency is measured in Hertz (Hz) which is the oscillation of a sound wave per second. Higher frequency sounds have higher pitches; lower frequency sounds have lower pitches. Sound sources usually produce sound waves which are made up of a spectrum of many frequencies. Analysis of the frequency spectrum of a sound is usually carried out by grouping frequencies into octave or 1/3 octave bands.
L01, LA01	The L01 is a statistical index defined as the level of noise exceeded for 1% of the measurement period and relates to the highest 1% of the measured values. Often used as an alternative to Lmax to describe the highest noise levels in the locality. The inclusion of "A" in the term identifies that the sound has been measured using an A weighting filter.
L10, LA10	The LA10 is a statistical index defined as the level of noise exceeded for 10% of the measurement period and relates to the highest 10% of measured values. Therefore it describes the higher noise levels in the locality. The inclusion of "A" in the term identifies that the sound has been measured using an "A" weighting filter.
L50, LA50	The LA 50 is a statistical index defined as the level of noise exceeded for 50% of the measurement period and is the mathematical average of the measured values. The inclusion of "A" in the term identifies that the sound has been measured using an "A" weighting filter.
L90, LA90	The LA90 is a statistical index defined as the level of noise exceeded for 90% of the measurement period and relates to the lowest 10% of measured values. Therefore it describes the lower noise levels in the locality. The inclusion of "A" in the term identifies that the sound has been measured using an "A" weighting filter.

Leq, LAeq	The equivalent continuous noise level. Noise levels vary with time. The Leq is the level of a steady sound that has the same amount of energy as the fluctuating noise being measured. Although not strictly accurate a simple definition would be a time weighted average. The inclusion of “A” in the term denotes the measurement has been obtained using an A weighting filter.
Lw, LwA	Sound power level. The total amount of sound inherent in a particular sound source independent of the acoustic environment it is in. The inclusion of “A” in the term denotes the value has been obtained using an A weighted spectrum. Mainly used in the prediction of sound pressure levels.