

MARSHALL DAY

Acoustics 

84 Symonds Street
PO Box 5811 Wellesley Street
Auckland 1141 New Zealand
T: +64 9 379 7822 F: +64 9 309 3540
www.marshallday.com

15 January 2016

Ministry of Education
c/- Frequency Projects
PO Box 13059
Tauranga 3141

Attention: Dylan Workman

Dear Dylan

ROTOTUNA STAGE 1 ACOUSTIC TESTING RESULTS

Introduction

The Ministry of Education (MoE) has engaged Marshall Day Acoustics to undertake commissioning acoustic measurements in Stage 1 of the new Rototuna Junior High School located in Hamilton North.

The commissioning measurements included reverberation time, airborne sound isolation and impact sound isolation. This letter presents the results from the commissioning measurements. It is noted that no measurements of mechanical services noise or external noise ingress were undertaken.

The Rototuna Junior High School is an Innovative Learning Environment (ILE) school. It is our understanding that the design goals for the school were the MoE *'Designing Quality Learning Spaces: Acoustics'* (DQLS) and the Australian/New Zealand Standard AS/NZ 2107:2000 *"Acoustics - Recommended design sound levels and reverberation times for building interiors"*. These guidelines were developed prior to the introduction of ILE environments. In some cases the guidelines are not appropriate and strict accordance with the guidelines would be counter to the teaching goals for the spaces. The Ministry of Education is currently updating the requirements to fit with the ILE requirements but these have not yet been released. The UK government Building Bulletin 93 has recently been updated to include more detailed acoustic criteria for open plan spaces. Detailed assessment in accordance with these criteria is not appropriate in this case but the document does provide some useful guidance on risk factors associated with open plan learning spaces which has been included for reference.

Results and Discussion

The measurements were conducted on 11 January 2016 between 5pm and 8pm. Stage 1 was furnished during the testing.

Provided below is a summary of the measurement results. Attached to this letter in Appendix A and B is table presenting the measurement results from each location and drawings showing the measurement positions.

Reverberation time

Reverberation time measurements were undertaken in three Innovative learning spaces (ILS) and ranged between 0.6 and 0.8 seconds. The DQLS recommends a reverberation time of 0.4 seconds in 'open plan teaching areas'.

The reverberation time is a function of the volume of the room, the area of absorptive finishes and the location of the absorption. For small enclosed rooms the DQLS guidelines are appropriate and should be achieved. However, in our experience it is very difficult to achieve strict compliance with the DQLS requirements with large open spaces. Controlling the reverberant build-up is critical to success of ILEs. But a specific reverberation time target will vary depending on the size of the room. Achieving adequate performance typically requires a high performance ceiling tile as well as extensive wall treatment.

The measurements indicate that for the large open plan areas the reverberation is controlled by the high performance ceiling absorption and the reverberation time is higher than desirable due to sound reflecting between wall surfaces. This is illustrated by the very 'flat' shape of the Iris 3D impulse response plots attached in Appendix C. The rooms could certainly benefit from additional absorptive treatment on the walls and or via free-standing partitions.

Airborne Sound Insulation

The airborne sound insulation measurements were undertaken for three walls and one floor. The measured performance ranged between STC 23 and 46. The DQLS recommends wall and floor performance between STC 50 and 60 depending on the type of spaces.

In ILEs a lower standard of performance is appropriate for breakout rooms and other similar areas where connectivity is important and large sliding doors are the preferred arrangement. In these areas a performance of approximately STC 25 – 30 is considered suitable. However between independent rooms the DQLS standards are still appropriate. A high levels of sound insulation is particularly important for technical areas with noisy equipment.

Impaction Sound Insulation

The impact sound isolation measurement was undertaken on the vinyl flooring outside the first floor labs. The measured impact sound insulation performance was IIC 39. The DQLS recommends a performance of IIC 55. This requirement is equally applicable to ILE classrooms.

Space Planning

An issue that is not addressed in DQLS is the acoustic separation between class groups. The large open nature of the classroom block means acoustic separation between groups will be very difficult. This means that activities by one group will necessarily affect adjacent groups. Addressing this issue requires additional design and planning that is outside our brief at this stage. However table 7.2 from BB93 has been included below which outlines some of the key risks. If there are several areas of high-moderate risk then addition modifications to the building layout may be required.

Figure 7.2: Activity management risk chart

Management plan	Risk category		
	High	Moderate	Low
1. Number of teaching groups sharing space	4+ groups	2-3 groups	1 group
2. Point of control	4+ independently operating teachers/facilitators	2-3 facilitators, with some planning and interaction	1 single team planning cooperatively
3. Area per student	<3 m ²	3-4 m ²	>4 m ²
4. Time spent in area	Usual or permanent place of learning	Frequent, but not 100% of lessons	Occasional/breakout activities
5. Curriculum grouping	Different age/stage/subjects	Mixed, but closely linked groupings	Similar age/stage/subjects
6. Activity types	Frequent critical listening (instruction or discussion in large groups)	Critical listening is less frequent: Mainly individual/small group work/1 on 1 instruction	Critical listening occurs as plenary session only. Individual/small group work/1 on 1 instruction is co-ordinated. OR Resource/social area
7. Organisation of activities	Simultaneous use, independently planned	Simultaneous use, but activities planned co-operatively	Sequential use
8. Communication distance	>4 m	3-4 m	<3 m
9. Extraneous circulation	Access to other areas of the building required through open plan unit during teaching time	Restricted or minimised during teaching time	None within open plan unit
10. Vulnerable listeners	Need to use open plan space frequently	Very occasional use	Mix of enclosed and open to provide extra support/alternative accommodation

Conclusion

The reverberation time, airborne sound isolation and impact sound isolation have been measured representative number of areas and the measured values assessed against design criteria in the DQLS and AS / NZS 2107:2000. Areas requiring additional treatment have been highlighted.

We trust this information is satisfactory. If you have any further questions please do not hesitate to contact us. If the MoE requires additional discussion or recommendations to improve the acoustics we would be happy to assist.

Yours faithfully

MARSHALL DAY ACOUSTICS LTD

Shaun King

Acoustic Consultant

APPENDIX A MEASUREMENT RESULTS

Location	Measured Reverberation Time (s)	Recommended Reverberation Time (s)	Comments
		MoE DQLS	AS / NZS 2107:2000
T/L 5	0.7	0.4	0.5 to 0.6 Additional wall treatment recommended
T/L 9	0.6	0.4	0.5 to 0.6 Additional wall treatment recommended
T/L 11	0.8	0.4	0.5 to 0.6 Additional wall treatment recommended
Specialty C Soft Tech	0.6	0.5 to 0.7	0.6 to 0.8
T/L 9 Breakout	0.6	0.5	0.5 to 0.6
		Measured STC (dB)	Recommended STC (dB)
		MoE DQLS	AS / NZS 2107:2000
Hardtech to T/L 6	38	60	n/a Improvement in sound insulation required
Hardtech to Specialty A Printing (vertical)	46	55	n/a Improvement in sound insulation required
T/L 9 to Breakout	23	50	n/a Improvement in sound insulation recommended
T/L 9 to Teachers	35	n/a	n/a Improvement in sound insulation recommended
		Measured IIC (dB)	Recommended IIC (dB)
		MoE DQLS	AS / NZS 2107:2000
Lab D to T/L 5	39	55	n/a Improvement in impact insulation required

APPENDIX B MEASUREMENT LOCATIONS

ZONE PLAN

```

graph LR
    Z1[1] --- Z2[2]
    Z1 --- Z3[3]
    Z2 --- Z3
    Z3 --- Z4[4]
    Z3 --- Z6[6]
    Z4 --- Z5[5]
  
```



ARCHITECTS
INTERIOR DESIGNERS
LANDSCAPE ARCHITECTS

James
 2 Manhattan Plaza
 Audible 1022
 1000 Broadway
 10th Floor
 1-646 385 5625

78 Second Ave
 Toronto 3110
 100th Street
 "Taraingia Mall Centre"
 1-646 729 7223

Level 1, Glaxi Thornton House,
 212 Lumber Quay,
 100 Hudson St
 PO Box 11642
 New York 10036
 1-646 452 2811

47 Recreation Road
 100th Street
 100th Street
 1-646 341 1853

www.james.com

Consultant Team

**Opus International
Structural & Civil**

**Opus International
Services & Fire**

Project: Rototuna Junior High School
 ROTOTUNA, HAMILTON NORTH
 214354

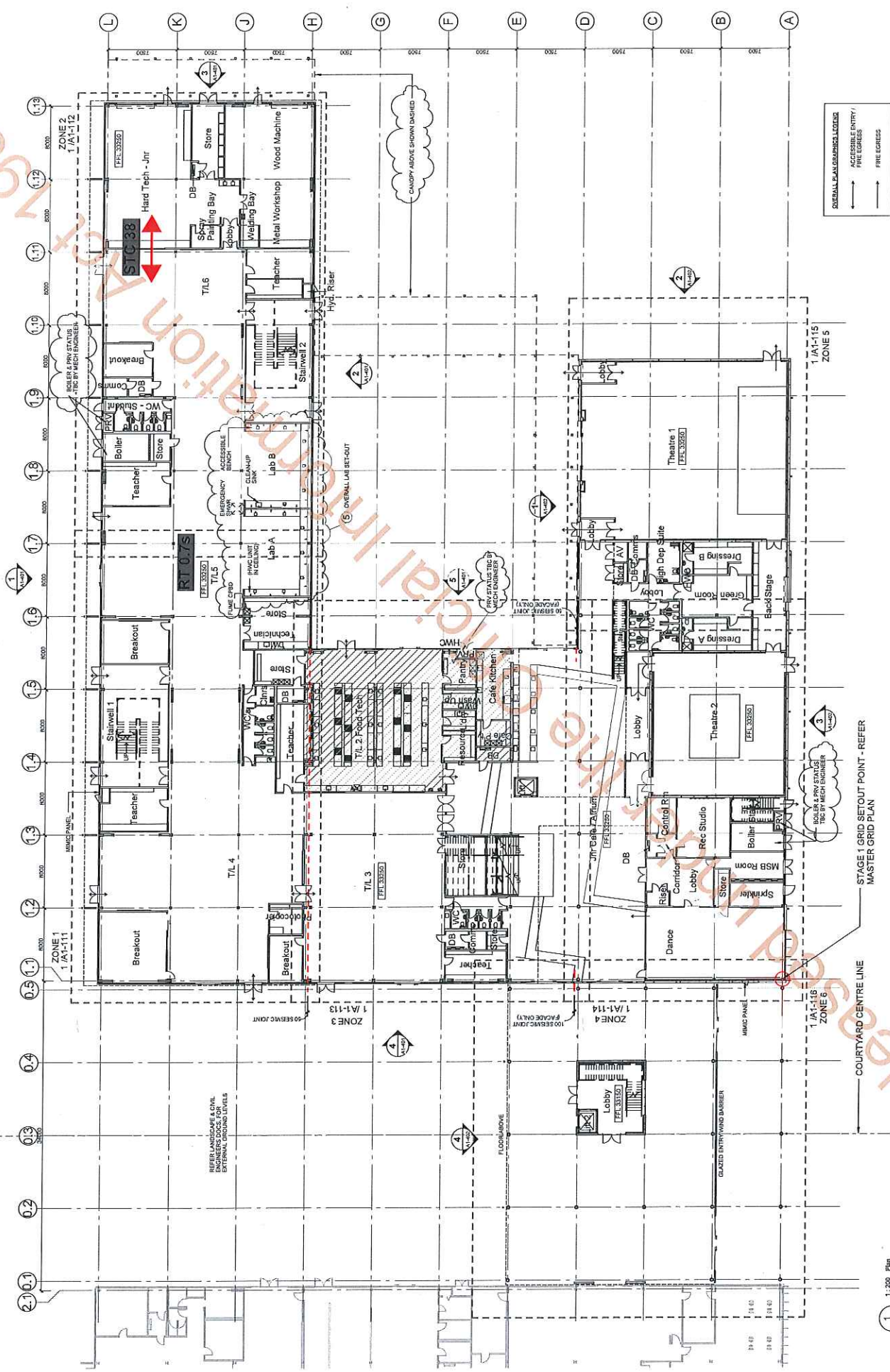
Overall Floor Plan -
Ground Floor

SCALE @ A1= 1 : 200

SLIST/ITEM NAME	REVISION & DATE	APPROVED	APPROVER
FHCT ISSUED	Q A - 14/11/2014		
RESOURCE CONSULT	Q -		
BUILDING CONSULT	Q O - 17/03/2015		
SCHEDULING	Q -		
TENDER	Q -		

ARCHITECTURAL
Sheet Drawing Number Revision
A1-101 5

DO NOT SCALE ON THIS DRAWING
CONTRACTOR MUST VERIFY ALL DIMENSIONS ON
SITE BEFORE COMMENCING ANY WORK
COMPONENT & JETTING



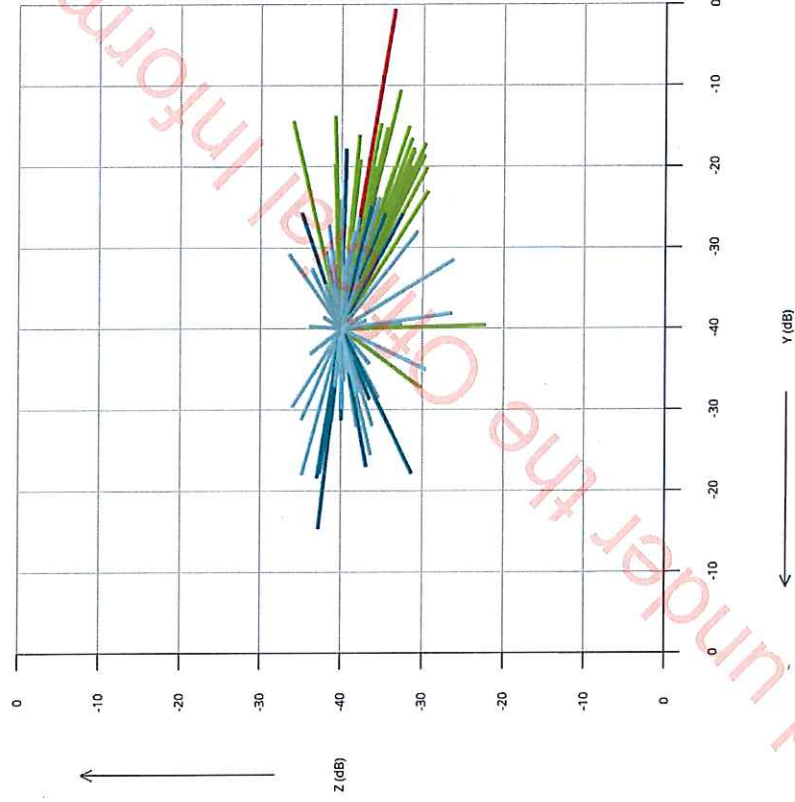
1 1 : 200 Plan
FLOOR PLAN - GROUND FLOOR

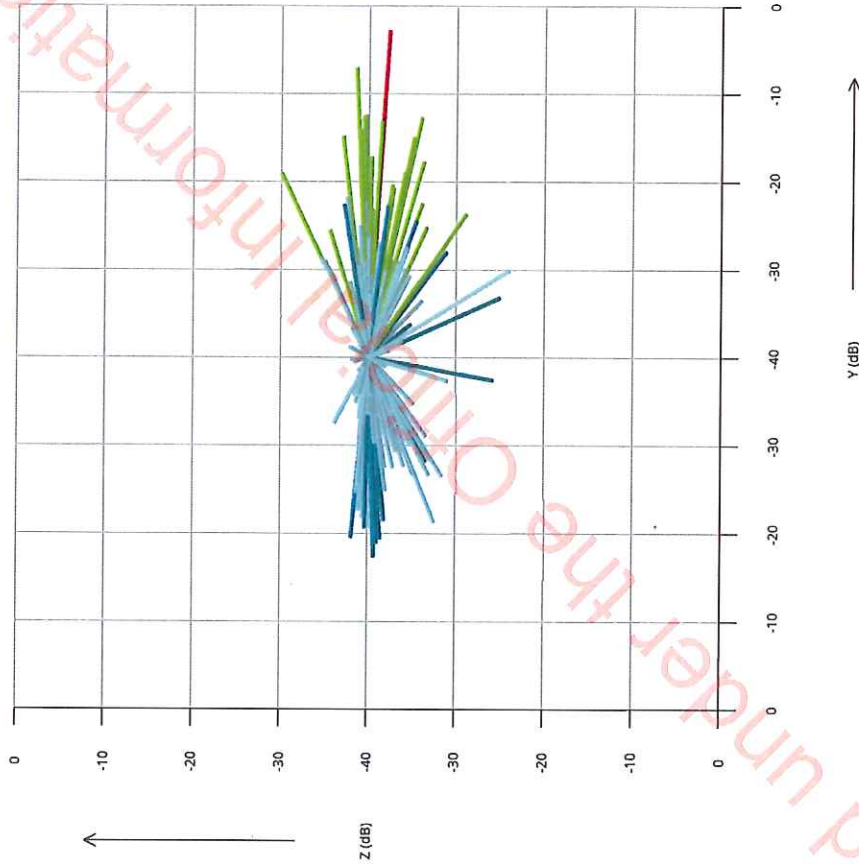
FOR CONSTRUCTION /
CO-ORDINATION

0154 16:31 a.m. C:\ms0214254 Release_NN 02014 Bioscience



APPENDIX C IRIS PLOTS





MARSHALL DAY

Acoustics

84 Symonds Street
PO Box 5811 Wellesley Street
Auckland 1141 New Zealand
T: +64 9 379 7822 F: +64 9 309 3540
www.marshallday.com

16 January 2017

Ministry of Education
c/- Frequency Projects
PO Box 13059
Tauranga 3141

Attention: Dylan Workman

Dear Dylan

ROTOTUNA JUNIOR HIGH SCHOOL - POST REMEDIAL WORKS ACOUSTIC TESTING

Introduction

The Ministry of Education (MoE) has engaged Marshall Day Acoustics to undertake acoustic measurements within the new Rototuna Junior High School following remedial works.

Works have been undertaken to reduce the reverberation time in the flexible learning spaces and Theatre 1. Reverberation time measurements have been subsequently conducted to quantify the improvement. This letter outlines post remedial measurements undertaken on 12 January 2017. A discussion has also been provided comparing the results to the MoE DQLS Version 2.0.

Project Standards

The Junior School was designed and completed prior to version 2.0 (September 2016) of the MoE Designing Quality Learning Spaces (DQLS) being published. Prior to this document being published no guidance existed for Innovative Learning Environments (ILE) spaces. We understand that the design of the school was based on Version 1.0 of the MoE DQLS and Australian/New Zealand Standard AS/NZ 2107:2000 "Acoustics - Recommended design sound levels and reverberation times for building interiors". We understand that the MoE also set a design target reverberation time of 0.4 to 0.55 seconds for occupied flexible learning spaces.

A summary of the acoustic criteria relating to the project is provided below in Table 1.

Table 1: Project Criteria

Space	Occupied Reverberation Time (s)		
	MoE Design Target	MoE DQLS (v.1)	AS / NZS 2107:2000
Flexible Learning Spaces	0.55	0.4	0.5 to 0.6
Theatre 1	n/a	1.0 to 1.4	0.9 to 1.1

Results and Discussion

Reverberation time measurements were undertaken in T/L 3, T/L 5, T/L 9, T/L 11 and Theatre 1. These spaces were chosen as reverberation time measurements had been undertaken before the remedial works were undertaken. It is understood that remedial works have also been undertaken in other spaces, but measurements were not performed in these spaces.

Table 2 overleaf presents the measured unoccupied and predicted unoccupied reverberation times for post and pre remedial works.

Table 2: Unoccupied and Occupied Reverberation Times Post and Pre Remedial Works

Space	Post Remedial Works		Pre Remedial Works	
	Unoccupied RT (s)	Occupied RT (s)	Unoccupied RT (s)	Occupied RT (s)
T/L 3	0.62	0.56	0.64	0.57
T/L 5	0.67	0.63	0.68	0.64
T/L 9	0.57	0.54	0.64	0.62
T/L 11	0.59	0.56	0.76	0.72
Theatre 1	2.3	1.4	2.7	1.6

The results show that T/L 9 and T/L 11 have had significant reductions in reverberation time. T/L 3 and T/L 5 have very small reductions in the reverberation times. T/L 3, T/L 9 and T/L 11 are predicted to comply with (or only slightly exceed) the MOE target of 0.55 seconds when occupied. The 0.01 second exceedance in T/L 3 and T/L 11 is considered insignificant. It is predicted that T/L 5 will exceed the MOE target by approximately 0.1 seconds when fully occupied.

Theatre 1 has a flutter echo which increases the reverberation time and adversely effects the acoustics of the space. The flutter echo is generated between the glass doors at the rear and the wooden wall at the front. We understand that the school intends to install blackout curtains along the glass doors at the rear of the theatre. Blackout curtains are likely to eliminate the flutter echo and significantly improve the acoustics in the space. It is recommended that the installation be undertaken as soon as possible.

Without the flutter echo it is predicted that the reverberation time in Theatre 1 would be 1.4 seconds unoccupied and 1.0 seconds when fully occupied. With the effects of the flutter echo excluded, it is predicted that the reverberation time in Theatre 1 complies with the DQLS version 1 (1.4 s) and the AS/NZS 2107:2000 curve 2 (1.1 s) criteria when fully occupied. We note that at partial occupancies the AS/NZS 2107:2000 criterion is likely to be exceeded. We consider that additional absorption in Theatre 1 would be beneficial.

MOE DQLS Version 2.0

For completeness the results above have been compared to the criteria in the new MoE DQLS version 2.0. The DQLS recommends a reverberation time range of 0.5 to 0.8 seconds for flexible learning spaces and 0.6 to 0.8 seconds for halls/multipurpose spaces. The DQLS also provides a figure (figure 1-2) which is intended to be used as a guide to suitable reverberation times for larger spaces.

The T/L 3, T/L 5, T/L 9 and T/L 11 predicted occupied reverberation times all fall within the acceptable range. The predicted occupied reverberation time in Theatre 1 exceeds the recommended range.

The predicted occupied reverberation times for T/L 3, T/L 5, T/L 9, T/L 11 and Theatre 1 have been plotted on Figure 1-2 and is attached to this letter. T/L 3, T/L 5, T/L 9 and T/L 11 all fall within the middle of the acceptable range. Theatre 1 sits on the upper bound of the acceptable range when fully occupied. During partial occupancies of the theatre it is likely that the reverberation time will exceed the upper bound of the acceptable range.

Conclusion

The reverberation times have been measured post remedial works in T/L 3, T/L 5, T/L 9, T/L 11 and Theatre 1. Significant reductions in the reverberation times has been achieved in T/L 9, T/L 11 and Theatre 1. T/L 3 and T/L 5 have achieved very small reductions in the reverberation times. We consider that T/L 3, T/L 9, T/L 11 and Theatre 1 have generally achieved compliance with the Project Standards when fully occupied. T/L 5 does not meet the project standards but is within the acceptable range recommended within the MoE DQLS version 2.0

Theatre 1 would benefit from additional absorption to achieve good acoustics during partial occupancies. It is strongly recommended that the rear doors be treated with a curtain or similar to control the flutter echo.

We trust this information is satisfactory. If you have any further questions, please do not hesitate to contact us.

Yours faithfully

MARSHALL DAY ACOUSTICS LTD

Shaun King

Acoustic Consultant

