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Acoustical Design of a new Conservatorium for the University of Melbourne

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ABSTRACT

February 2019 saw the first use of a new building for the Melbourne Conservatorium of Music named The Ian Potter Southbank Centre. This venue is designed to promote the well-being for all occupants by incorporating open study areas to compliment the dedicated teaching and practice areas. It encourages a collegiate approach to practical music training through the acoustic interaction of the practice and communal spaces.

The building includes a flexible 380m^2 orchestral/choral rehearsal studio, 400 seat concert/lecture venue, 190m^2 flat floor studio, 12 Tutorial/ensemble rehearsal rooms, 7 Large teaching studios, 18 Medium teaching studios, 13 Small teaching studios, 4 Electronic music studios, 2 Early music studios, 5 Percussion studios, 5 Composition staff studios, Staff/administration and Communal study areas.

This paper discusses the acoustic challenges involved in packaging this for a 1200m^2 site. Reference was made to the Norwegian Standard NS 8178:2014 *Acoustic criteria for rooms and spaces for music rehearsal and performance* during the design. This document proved its worth not only in the detailed information it contains, but also to demonstrate to the client and value management consultants the best practice in the design of venues for musical training.

Keywords: Conservatorium, NS 8178:2014

1. BUILDING LAYOUT

Coming from a land known for open spaces, this project presented challenges, particularly with the packaging of the larger studios and performance venues. The site was a small parking lot located in the developing Arts Precinct in Melbourne adjacent to the Melbourne Recital Centre. Other nearby venues include, the State Theatre Company, studios for the Australian Broadcasting Corporation, and Arts Centre Victoria which houses three major theatres and Hamer Hall, Melbourne's principal large concert venue. Sturt Street on the main façade is a busy thoroughfare with trams, cars and heavy vehicles rumbling past.

The briefed spaces were tightly packaged into an eight-storey building which required special planning approval in a height restricted area.

The three largest spaces are all double height rooms. They are vertically stacked but located low in the building to be accessible for public events as required. Smaller rooms and studios are located above and around them.

The project brief called for the following:

- The building is intended principally for non-amplified music and voice. Amplified music genres are taught in a nearby facility
- The three largest studios are to be usable for commercial quality recordings
- The teaching spaces should be flexible and suited to a wide range of functions, from tutorials and spoken presentations, individual instrumental and vocal tuition, group masterclasses, ensemble rehearsals including chamber music groups, and orchestral sectional rehearsals
- The teaching rooms would not be permanently designated to any staff or instrumental groups. Changes in the room uses are anticipated within the life of the building
- The building should avoid the acoustic ambiance of a monastery
- Practice and teaching spaces should not appear subjectively dead
- The sound in the corridors should reflect the function of the building but sound transmission between adjacent teaching spaces should not be distracting

A section through the building is shown in Figure 1.

Figure 1 – Section view of the Conservatorium building provided by the architect

2. ACOUSTIC DESIGN

2.1 Large studios

The three principal studios are constructed as box in box rooms with concrete slabs mounted on steel springs. This system is effective in reducing noise intrusion from trams and sound transmission between the studios. Building service systems achieve NR20.

The large studios on levels 1 and 5 are flat floor spaces designed for flexibility in layout and use. They are intended for ensemble rehearsal from orchestras with choir to chamber groups, larger tutorials, movement and vocal classes, and for recordings. The larger level 1 studio is fitted with a bank of 200 retractable seats. Ceiling panels with double curvature are used to provide multiple reflections covering the entire floor areas. Wall diffusion reduces the strength of individual lateral reflections while still providing strong envelopment. Fixed absorption is provided in the upper wall panels. Operable double thickness roller banners are installed to provide variation of reverberation time for different uses

The large studios all benefit from natural light and have additional internal windows to promote connections with the other users of the building. The level 1 studio includes a 6m diameter oculus to the landscaped park, a large internal viewing portal to the entrance foyer, small viewing windows to the main façade, and a viewing gallery, Glazed panels can be covered with operable shutters as required.

Figure 2 provides an internal view of the Large Studio on Level 1 named the Kenneth Myer Auditorium.

Figure 2 – Interior of the Kenneth Myer Auditorium from the viewing gallery

Figure 3 shows the large studio on level 3, named the Hanson Dyer Hall. This the main performance venue. It has fixed raked seats for an audience of 400, a fixed stage and a choral balcony for 35. It is not designed for use by large ensembles. This is an intimate space that responds well to musical nuances. Operable banners are installed on the upper side and rear walls with fixed absorption provided by the perforated panels between them.

Ceiling panels of single curvature distribute sound along the hall, and diffusion on the front walls of the room distribute early lateral energy to promote envelopment. Along the rear side walls weaker diffusion is provided by curved wall panels that provide a visual link to the ceiling form.

Figure 3 – Interior view of the level 3 Hanson Dyer Hall

2.2 Teaching spaces

The layout of the teaching rooms above level 3 was arranged with two long access corridors and a cross corridor linking the teaching and practice rooms. A plan of Level 5 is shown as Figure 4.

Figure 4 – Corridor layout with open plan study area on level 5

The building is designed to promote well-being for all occupants by incorporating open study areas leading from the corridors. This encourages a collegiate approach to practical music training through the interaction of all users of the building.

Lightweight internal construction was used for partitions to the teaching rooms. Triple layers of plasterboard on double studs were used between all instruction and rehearsal spaces. Single doors and partitions of double layers of plasterboard on a single stud were used between the teaching rooms and the corridors. The detailed design of the doors was a major contribution to the successful outcome. The doors required a rating of D_w40 while achieving a robust low maintenance design. They can be operated by a single person holding a cello.

Vertical sound insulation between teaching rooms is achieved using 290mm thick concrete slabs and floating timber floors on resilient pads.

This sound insulation design provides privacy between teaching rooms but can support a functional and lively ambiance in shared areas.

3. ROOM ACOUSTICS – TEACHING ROOMS

The reverberation time criteria for the tutorial and teaching rooms were selected based on the subjective impression and the need to control noise exposure for the users.

The room acoustic treatments in the teaching rooms are consistent with the principles described in NS 8178:2014 *Acoustic criteria for rooms and spaces for music rehearsal and performance* (1).

General design features principles included:

- Provision of non-rectangular floor plan in most spaces to reduce coincidence of room modes
- Selection of room heights 3.5m, 3.8m and 4.5m to suit intended room occupancy and usage. This ultimately determined the distribution of rooms and floor to floor heights of the building
- Perforated plasterboard ceilings on an airgap provide broadband absorption
- Timber floors at the client's request
- Modular wall treatments of absorptive and diffusive panels installed at head height on two adjacent walls. Panels are not fixed but moveable to allow ease of fine tuning the spaces within the life of the building

The interior of two of the teaching spaces is shown in Figure 5.

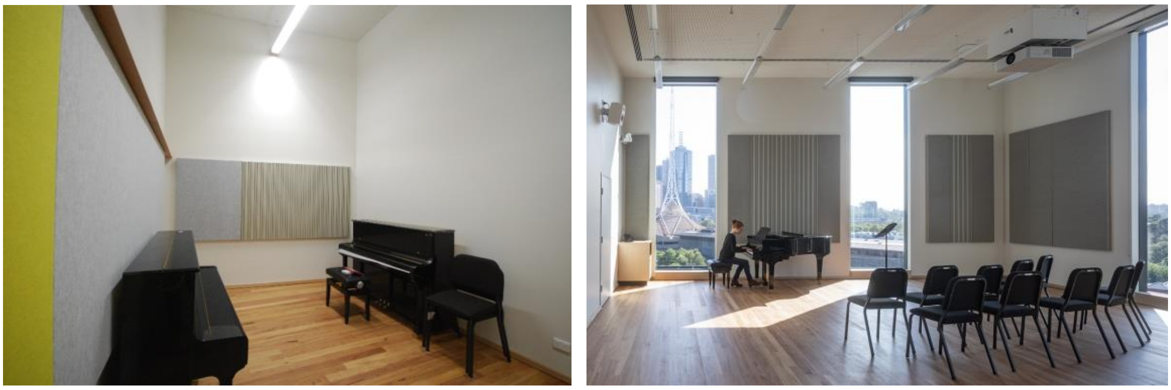

Figure 5 – Interior of a small studio and tutorial room showing modular wall treatments

4. ROOM ACOUSTIC DISCUSSION

Norwegian Standard NS 8178:2014 provides guidance on the selection of room acoustic criteria and recommends design features for music rooms. This has been based on the control of internal sound levels experienced in the rooms during normal use. With increased awareness of musician's well-being this is a most worthy pursuit.

Rindel (2) describes the calculation of sound strength (G in dB) as defined in ISO 3382-1. Using listed sound power data for many instruments NS 8178:2014 presents a method for calculation of sound pressure level L_p based on previous work by Meyer (3,4,5).

Measured reverberation times in rooms at the Melbourne Conservatorium and calculated values for G are shown in Table 1.

Table 1 – Calculated sound strength G

Room	Plan area (m^2)	Comment	Volume (m^3)	RT measured (seconds)	G calc
Small studio	17	Height 3.5m	60	0.4	23
Medium studio	24	Height 3.8m	91	0.4	22
Large studio	30	Height 3.8m	114	0.4-0.5	20
	30	Height 4.5m	135	0.5	20
Tutorial room	84	Height 3.8m	319	0.5	18
	92	Height 4.5m	414	0.5	17
Level 1 Studio	380	No banners	3240	1.25	10.5
	380	With banners	3240	1.15	9.3
Level 5 Studio	190	No banners	1310	1.2	14
	190	With banners	1310	0.9	12
Level 3 performance room	426	No banners	3500	1.6	10.5
	426	With banners	3500	1.3	9.3

Figure A.1 from NS 8178:2014 shows recommended ranges of sound strength G based on reverberation time and room volume. Figure 6 reproduces this information with the results from the Melbourne Conservatorium superimposed.

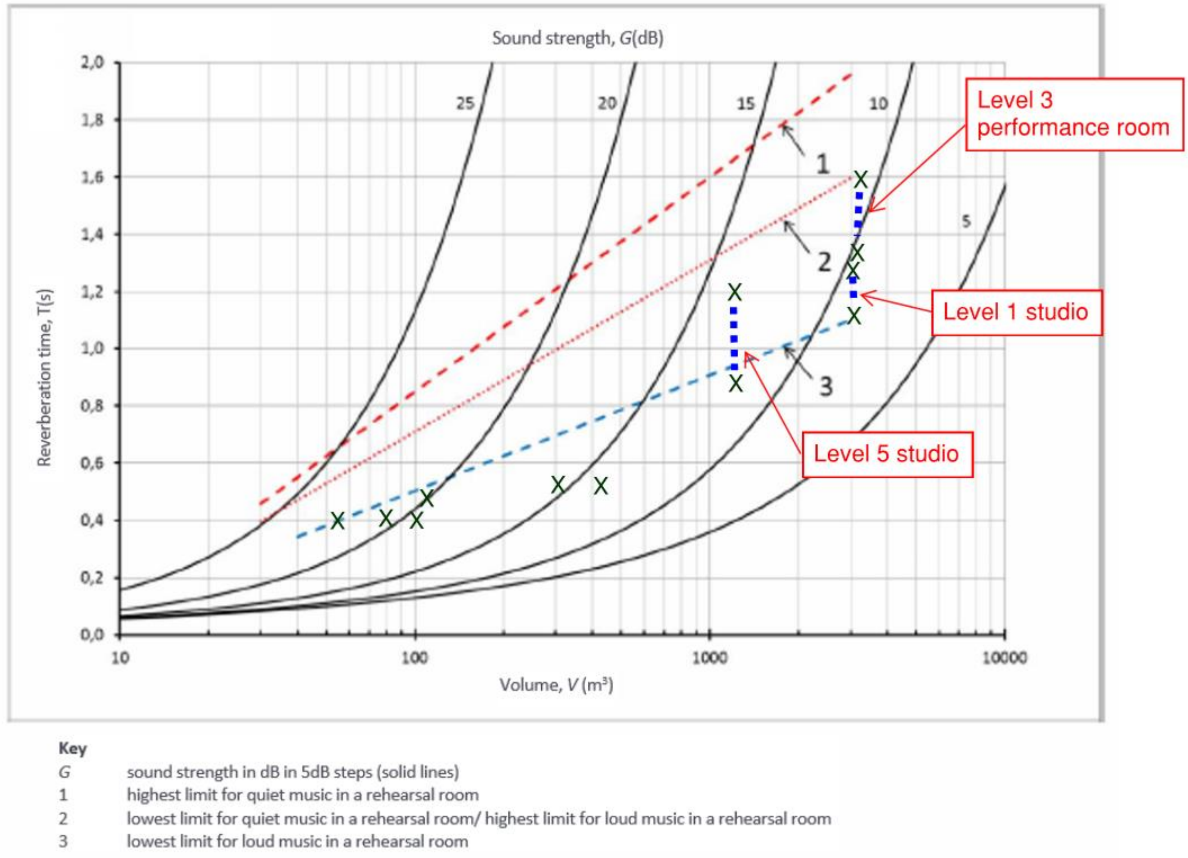

Figure 6 – Reverberation time and room volume values plotted with ranges recommended in NS 8178:2014

We note that the values of G for the teaching and tutorial studios are close to the lowest recommended limit for loud music in a rehearsal room. This results in the rooms being at the lowest end of the recommended range for noise exposure for the occupants.

The values for the three largest studios lie in the range recommended for loud music in a rehearsal room. Figure 6 confirms the subjective impression that the level 3 performance room is the most sensitive of the large spaces, fulfilling its design objective for performances of recitals and fine chamber music.

5. OTHER MEASURED PARAMETERS

Predictions of acoustic parameters for Hanson Dyer Hall, the level 3 performance room were made during the design phase using Odeon. At commissioning, room acoustic measurements were made in general accordance with ISO 3382-1 using the Iris© system developed by Marshall Day Acoustics. A summary of the averaged results from a single stage source and 14 receiver positions is presented in Table 2. Values quoted below are for the mid frequency average (500Hz and 1kHz octave bands).

Table 2 – Predicted and measured parameters for the level 3 performance room.

	Parameter	Odeon prediction	Measured result
No banners	EDT	1.4s	1.5s
	T30	1.45s	1.6s
	LF80	0.25	0.21
	C80	+1.2dB	+0.93dB
	C50	-1.6dB	-1.65dB
	STI	0.53	0.53

	Parameter	Odeon prediction	Measured result
With banners	EDT	1.1s	1.3s
	T30	1.1s	1.3s
	LF80	0.26	0.21
	C80	+2.6dB	+1.7dB
	C50	-0.2dB	-0.82dB
	STI	0.57	0.55

6. FINAL REMARKS

Every project involves the challenge of allocating the available budget within different aspects of the design. This can contribute to positive creative tension in the project team and lead to efficient packaging in the design.

NS 8178:2014 does more than provide authoritative guidelines for the acoustic quality of the outcome.

During the inevitable "value management" discussions on this project the Standard was invaluable in demonstrating to the client the importance of room volume for the teaching spaces. The building height and cost of this project were under intense scrutiny. This Standard assisted us in persuading our client and the design team of the significance of our design principles.

For this we are grateful to the authors of the Standard and the authorities that enabled its existence.

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