



The 4,000 sq m Melbourne Recital Centre and MTC Theatre is something of an architectural and engineering feat.

High-performance space

The latest addition to Melbourne's arts precinct is drawing international accolades for its world-class acoustics. That a modern building can be placed in such an echelon while surrounded by the noise of the city – and at the same time maintaining the comfort of its audience – is testament to the unique collaboration and passion of those involved, writes **Sean McGowan**.

The \$128 million Melbourne Recital Centre and Melbourne Theatre Company (MTC) Theatre complex is located on the corner of Sturt Street and Southbank Boulevard in the heart of Melbourne's arts precinct.

It is one of the final pieces of a vision that has existed since the Victorian Arts Centre was completed in the early 1980s. However, unlike that nearby complex, both these new venues have been built entirely to purpose.

The MTC Theatre finally provides a home to the company for which it's named, through the 500-seat Sumner Theatre and smaller Lawler Studio. The Melbourne Recital Centre is said

by some to have placed Melbourne on the international map of intimate musical performance.

The latter features the stunning Elisabeth Murdoch Hall, a 1,000-seat venue acoustically inspired by the great pre-World War I European recital halls such as London's Wigmore Hall and Vienna's Musikverein.

The smaller Salon, a 150-seat flexible space, has been designed for even more intimate musical performances such as chamber music ensembles, soloists and classical quartets and quintets.

The project was delivered by Major Projects Victoria on behalf of Arts Victoria and the University of Melbourne

for the Victorian government, which awarded Bovis Lend Lease the role of managing contractor.

The design team comprising architects Ashton Raggatt McDougall (ARM); Arup acoustic and theatre consultants; Umow Lai sustainability and building services engineers; Bonacci structural engineers and other consultants collaborated with the client bodies and managing contractor to deliver the project three months ahead of schedule in December 2008.

The manner in which the 4,000 sq m performance space has been arranged on such a small piece of real estate is in itself something of an architectural and engineering feat. Yet the fact such

a world-class recital hall can reside surrounded by the tracks of Melbourne's iconic, noisy tram network makes it all the more impressive.

Such an achievement is due very much to the building's architectural form and construction techniques.

Behind the modern façade of honeycomb-shaped glass panels that reveal the building's interior from the street, Elisabeth Murdoch Hall sits within a cast-concrete box mounted on 38 spring assembles (comprising a total of 496 individual steel springs).

With the performance space "floating" within this "box-within-a-box" arrangement, the springs' natural frequency isolates the building from the vibrations and noise created by passing trams.

“They can play really delicate pieces of music, and as an audience member you can hear every detail. You can hear the breaths the musicians take, or the fingering on the instruments.”

But such were the strict criteria for the hall that this treatment was but a sample of the sophisticated acoustic design.

According to Sylvia Jones, senior consultant for Arup's Acoustic and Theatre Consulting Practice, controlling the noise created from such a variety of sources – including traffic, patrons and building services – was paramount in achieving the client's strict acoustic criteria.

This included NR (Noise Rating) criteria for all mechanical services equipment, and the very stringent PNC15 (Preferred Noise Criterion) in the performance spaces.

“The reason for the low noise criteria is that it gives the musicians maximum dynamic range,” Jones says. “They do not have to compete with the background noise level. It means they can play really delicate pieces of music, and as an audience member you can hear every detail. You can hear the breaths the musicians take, or the fingering on the instruments.”



Controlling noise from external sources as well as patrons and buildings services was paramount to achieving the client's strict acoustic criteria.

“One of my favourite quotes is from Melbourne Chamber Orchestra director William Hennessey, who said that the most magical aspect is the silence, because it lets musicians make sounds that they can only dream about.”

CREATING SILENCE

Entering the Melbourne Recital Centre, patrons could be excused for thinking they've walked into a giant violin case, such is the resemblance of the red velvet-

coloured walls and smooth lines that decorate the foyer.

Walking the wide staircase to level one, the honeycomb-shaped glass façade provides a clear view of the streetscape below. These panels are fully openable – controlled by the centre's BMS to allow the building to breathe via passive ventilation when conditions allow.

A thermal chimney has been created to allow hot air to exhaust high above the staircase.



The Elisabeth Murdoch Hall sits within a cast-concrete box mounted on 38 spring assemblies, which isolates the building from the noise and vibrations of passing trams. Image: John Gollings.

Entry to the stalls seating of the completely wood-panelled Elisabeth Murdoch Hall is via level one.

Its resemblance to the wood grain of a Stradivarius violin is no coincidence. That the hall operates as a giant instrument for musicians has clearly not been lost on the building's designers.

The striking Australian hoop-pine panels give the shoebox-shaped hall a sense

of warmth and intimacy, the beauty of their seemingly random, swirling patterns betraying their role as acoustic engineering tools.

Chosen for its density and pliability, each hoop-pine panel has been precisely machined according to accurate acoustic computer modelling, and installed one by one to create deliberate variations of depth.

The depth and placement of each panel relates precisely to the acoustic scattering and diffusion of sound frequencies within the hall, with higher frequencies scattered by the 12-50mm deep swirl patterns on panels' surfaces.

The middle frequencies are scattered by the seemingly random pixel-like panels, which are stepped in and out by as much as 250mm, while lower frequencies are scattered by the wave-like modulations of entire wall surfaces.

"When sound hits the surface you want it to scatter. It helps with what we call envelopment of sound, so it makes you feel like the sound is coming from all around, not just from a particular direction," explains Jones.

Along with the acoustic shaping of the wood panels, the geometry of the hall plays an important role in achieving the acoustic criterion. At just 20m wide, the narrowness of the shoe-box – shaped

hall results in early lateral reflections of sound, while the height of the space generates volume and reverberation.

This design contrasts with that of concert halls that are typically broader in order to accommodate larger audiences and to host a different repertoire.

"The reverberation time here is a lot shorter than a concert hall. It's about 1.8 seconds. A concert hall would be about 2.2, 2.4 seconds," illustrates Jones by clapping her hands.

"The reason comes back to the type of music. This was purpose-built for small chamber music, where you want to hear the detail. Symphonic music lends itself to a more reverberant sound, where the music is allowed to blend and bloom."

STATE OF THE ART

Accommodating an audience of 1,000, along with providing state-of-the-art facilities for performers, has resulted in an array of modern building services being incorporated into the building, almost all of which generate noise – from the high-frequency buzz of electrical lighting and theatrical audio-visual control equipment to the constant drone of HVAC fans and chillers.



The Salon was designed for intimate performances such as chamber music.



A displacement system was deemed most appropriate for the space.

Responsible for the building's mechanical services design, Umow Lai was confronted with the enormous challenge of delivering effective, efficient cooling to the hall and adjacent Salon, while effectively attenuating the noise created throughout the whole HVAC system.

The occupied space of the Elisabeth Murdoch Hall is really up to temperature or down to temperature in approximately 15 minutes, so an energy saving is there in that this occupied space can actually be treated instantly.

It's for this reason that at a very early stage a displacement system was deemed the most appropriate for the space.

The alternative, a top-down system featuring high-level introduction of conditioned air, simply wasn't going to meet the acoustic criterion, given the velocities required due to the ceiling height.

Assisting in the adoption of a displacement system, the acoustic protection afforded to the hall meant it was also protected thermally from significant heat gain. The result is an incredibly efficient system.

"In traditional theatres, if you have a performance at 7pm on a hot summer day you would probably turn the air conditioning on after lunch to get the space down to temperature," explains Gareth Day, senior associate and project leader with Umow Lai.

"The occupied space of the Elisabeth Murdoch Hall is really up to temperature or down to temperature in approximately 15 minutes, so an energy saving is there in that this occupied space can actually be treated instantly."

This solution sees conditioned air delivered at floor level, via top-hat terminal units integrated into the seating pedestals of each seat in the hall.

This provides the benefit of only conditioning the occupied space, before the air is extracted at ceiling level via the lighting bridges. By operating at low velocity, the system is inherently quiet.

SPACE AT A PREMIUM

Because it's on such a small footprint, space for mechanical services within the building was at a premium.

The ceiling void and wall and floor cavities were used as plenums to deliver air from the upstairs plant room to the displacement system at floor level.

Even the wings of the stage are put to work, forming a return-air plenum.

"I'd say it was the lack of space that was the single biggest challenge of this project, just getting everything into the footprint," says Jones. "It meant we had to come up with some innovative solutions to use all the space we could."

Incredibly, one section of the ductwork delivering air to the space weighs 9.2 tonnes, having been encased in cement sheet construction to meet the acoustic criterion. It is supported by the concrete slab below.

Some runs are up to 20m in length to help keep air velocities down.

Drawings of the ductwork plan required serious contemplation by mechanical services contractor A.G. Coombs to get right.

A MODEL APPROACH

The task of building a modern performance space that compares favourably with the acoustic qualities of the world's great recital halls was made easier with the assistance of acoustic modelling.

Not only did this help with the continual fine-tuning of design, it also gave the client and key stakeholders the ability to compare the sound of the Elisabeth Murdoch Hall with that of top-shelf venues such as the Musikverein in Vienna, well before the physical space had even started to materialise.

SoundLab, a purpose-built auralisation studio developed by Arup, uses computer acoustic modelling based on the 3D architectural model to calculate how the sound would behave in the room.

Reproduced (or auralised) in this specially calibrated room, the acoustic reflections that would be experienced within the actual space are virtually replicated.

"Auralisations of chamber music in the Elisabeth Murdoch Hall allowed the client and design

team to scrutinise the space before it was even built, using the most appropriate and relevant design analysis tool: their ears," says Jones.

"We were also able to demonstrate the effect of trams passing outside the building, and the difference between structurally isolating the building – and not. It meant the client could come in and actually partake in the decision, knowing what the cost was, and then hear the effect [of that decision] in relation to the performance."

“It’s not just your standard ductwork here,” says Day. “We had to consider the requirement for the much larger duct dimensions and its enclosure within required acoustic insulation mediums – insulation, air/space and compressed cement sheet – to absolutely isolate air noise to the space and break-in noise to the ducting. This entire construct was required to attenuate the noise getting in and out of the ductwork.”

The ceiling void proved an ideal space to locate one of the building’s air plenums, but such large volumes of air also required oversized acoustic attenuators to meet the low-velocity requirements. One is almost large enough to walk through.

One of the return air fan’s motors weighs 268kg, and required considerable thought, not just to where it would be positioned but how it could be removed in the event that it needed to be replaced.

In all, 67 individual silencers were specified and installed to attenuate the



The glass panels on the external façade can open for natural ventilation.

HVAC equipment in the Melbourne Recital Centre building alone.

According to Day, almost everything was taken into account. Even the electrical system had to be evaluated for its noise outputs, much of which was hidden under the auditorium floor in order to rid the space of noise.

“Every single piece of duct . . . we went through with Arup and technically sorted it out so it met the criterion,” Day says. “Then they went ahead and built it.”

Day says his team was constantly challenged by the acoustic criteria, with much of the mechanical equipment specified not immediately meeting requirements.

“For example, in the control room we had specified a particular air register, but whenever they were plugged into the acoustic modelling program they just wouldn’t work,” Day says. “And no matter what we sourced from around the world, we couldn’t find a model that would remove the regenerative noise coming off the registers.”



A sense of collaboration and perfection extended to every aspect of the project.

PROJECT AT A GLANCE

The professionals

Acoustic engineer: **Arup**

Architect: **Ashton Raggatt McDougall**

Builder: **Bovis Lend Lease**

Building services engineer: **Umow Lai**

Structural engineer: **Bonacci Group**

Mechanical contractor: **A.G. Coombs**

The equipment

Central plant serving both the MRC and MTC

Boilers: **2 x HHW boilers Automatic Heating**

Chillers: **2 x McQuay air-cooled screw chillers, model ALS SE344-2XN**

Pumps: **KSB-AJAX Pumps**

Dedicated HVAC items for MRC

Air-handling units: **G.J. Walker**

Attenuators: **National Acoustic Products (NAP Silentflo)**

BMS: **Alerton Australia**

Exhaust fans: **Fantech**

Fan coil units: **G.J. Walker**

Grilles and diffusers: **Holyoake**

Return-air fans: **Fantech**

Top-hat terminal units: **Quinette Gallay**

VAVs: **Holyoake**

Day says in this case like many others, the solution lay in stripping everything back and asking themselves what they were trying to achieve.

“It took us a long time to come to terms with the criterion and realise that Arup needed to meet this criterion everywhere to guarantee the performance. That’s when everyone came together and started saying, ‘Well, how can we do that?’”

“Why did we need a register? It’s a finishing detail. Humans like finishing details but the answer was to put a very-wide-grid wire mesh there and get rid of the register,” Day says. “Now you didn’t have to pay too much for that solution, but a lot of the solutions through this place meant you just had to go outside the norm.”

Similarly, only one chiller that met Arup’s acoustic criterion was found to be available in Australia.

“It became an iterative process,” Jones says. “The problem is, whenever you’re designing acoustic attenuation for building services, the attenuation has an impact on the functional performance of the equipment. We had to work really closely together during the design phase to account for these inter-connected acoustic and mechanical impacts. And then we had to work really closely with the builder during the construction phase as well.”

Jones insists the acoustic design was not about including as much treatment as possible to meet the onerous noise criteria. Rather, it was about understanding the system as a whole, including using acoustic treatment where it would provide maximum benefit, and ultimately achieving a finely controlled and balanced noise environment.

“It took us a long time to come to terms with the criterion and realise that Arup needed to meet this criterion everywhere to guarantee the performance,” Day says. “That’s when everyone came together and started saying, ‘Well, how can we do that?’”

This sense of collaboration and perfection extended to every practitioner on the project, from plasterers to insulators. Jones recalls instances where plaster work was completed, only to be re-done because those completing the job weren’t entirely satisfied with the finish.

As managing contractor, Bovis Lend Lease had the unenviable task of sequencing the trades.



The project is said to have set new benchmarks in design response.

“It was with military precision what they were doing – every day,” says Day. “There were about 400 people working on this building and they programmed everything perfectly. A lot of people did something special here, and made it work – made this place what we wanted it to be.”

GLOBAL RECOGNITION

The Melbourne Recital Centre and MTC Theatre Project achieved practical completion in September 2008, with commercial acceptance achieved three months later.

According to those involved, it has set new benchmarks in design response and construction quality, and has been the subject of many papers presented around the world.

The recital hall, named in honour of Dame Elisabeth Murdoch, officially opened on February 8 2009 to coincide with her 100th birthday.

It quickly went on to earn numerous awards. Yet the greatest accolade that could be bestowed on the building and its designers is one granted by elite musicians, both from Australia and around the world. It is not a trophy, bauble or statuette, but rather their esteem for a space they say might just rank among the world’s great halls. ■

AWARDS

- 2009 Property Council of Australia National Award for Public Buildings
- 2009 Victorian Architecture Medal
- 2009 Australian Institute of Architects Victorian Architecture Awards Public Architecture and Urban Design Awards
- 2009 Victorian Engineering Excellence Awards Award for Excellence

