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DIGITAL EDITION

Refitting the Joan Sutherland Theatre

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REFRESHING AN ICON

Rob Halliday reports from Australia as the Joan Sutherland Theatre, housed within Sydney Opera House, enjoys a refresh over 40 years in the making

If it happened now, it would undoubtedly end up being a movie. Probably, inevitably, starring Tom Hanks as the unknown, tall, bright-eyed, charismatic Danish architect Jørn Utzon, who sent a competition entry for an opera house far around the world, his design rejected for not meeting the criteria but then plucked from the reject pile by one of the judges. Who had a vision of sails floating above the sea of Sydney Harbour, but no idea how to build his vision, or if it could be built at all. Who was made to start construction before he and the remarkable engineers at Arup actually figured that out, with the aid of slide rules and one of the earliest uses of computers in building design. Who, as the building work over-ran and a new, less supportive government came in, found his fees withheld. Who ultimately walked away from the project - resigned or pushed in a game of bluff and double bluff - leaving the country never to return. Never seeing the finished building that is now an icon of its city, indeed, of its country.

All good movies need a third act, and there would be one here. Sydney would ultimately seek Utzon's involvement once again, recording his original vision as they worked to adapt the building to meet the needs of a new century. Working with his son Jan, he would make perhaps the biggest change to the building's exterior since it opened, cutting new entranceways into the side of the podium that supports those famous shells. However, the architect never returned, passing away in 2008.

> Movies tend to simplify, of course, and the full story of the Sydney Opera House is by no means a simple one. Though Utzon receives, and deserves,

credit for creating this unique building on this remarkable site - a structure that is magical from whatever angle it is viewed from, even, as he anticipated, from far above as the skyscrapers in central Sydney rise ever higher (you see a whole new view of the shells from there, not the gack of air conditioners and ventilation and access routes that top most buildings) - the final design of the building, and particularly its interiors, was not his alone. After Utzon left, a team of architects led by a young Australian called Peter Hall, were drafted in to complete the work. Their contribution has been overlooked for decades, classified as 'just finishing off' when it was far, far more than that, particularly inside the building and its auditoria; interestingly there does recently seem to have arisen a greater interest in, understanding of and respect for Hall's contribution.

As the build moved laboriously on through the late 1960s, the work of all involved was complicated by change. Curiously for a building with the name it has, the highest priority was originally given to symphony concerts, then opera, then ballet and dance.

Of the two shells, the larger one was initially intended to house a versatile hall capable of hosting all of these performance types. Very late in the day, the changed priorities of a changed government and a review of the project by the new architects triggered a revised arrangement. Hall, it seems, had concluded that achieving the kind of versatile hall specified in the original brief was impossible, so when the building opened in 1973, the main hall was used for concerts only and the smaller one for opera and dance.

All who use the Opera Theatre - in 2012 renamed the Joan Sutherland Theatre for Australia's most famous soprano have been living with the consequences of that decision ever since.









SQUARE PEG, ROUND HOLE

Utzon's original 1957 sketch for the Sydney Opera House (SOH) was a series of low, free-form curves; the competition judge who rescued Utzon's entry and championed it was Eero Saarinen, who's design for the similarly modernist TWA airport terminal building in New York had already been commissioned. Utzon and the Arup team ultimately rationalised the shape into segments of a sphere, with a constant curvature that made it possible to pre-cast segments of the building in concrete and then assemble them on-site. This supporting structure of the shells - which are effectively roof and side walls all in one - is still clearly visible as the building's 'ribs' when you are inside the foyers.

But most traditional proscenium arch theatre buildings share a familiar basic shape - that's why if you know what you're looking for, you can almost always spot a theatre as you walk through a new city. There's a tall rectangle, the stage with the fly tower above it. This will usually sit in the centre of a lower rectangle, containing side stages and sometimes a rear stage, particularly for opera houses that have to change regularly between shows. In front of that, another rectangle: the auditorium, with the public foyer spaces surrounding it.

The challenge at the SOH was literally one of a square peg and a round hole: fitting those familiar rectangles into a complex 3D shape, its overall width dramatically constrained by the surrounding water of Sydney Harbour. With the building's sides curving inwards, space diminishes rapidly as you move upwards where the two sides of each shell meet, and continues to change as you move front-to-back because of the intersections of the three principle shells. Even just visualising what's going on is quite a mental exercise.

As built, the Joan Sutherland Theatre is effectively a separate structure sitting within the smaller of the building's principle sets of shells, pushing out to the limits of those shells. The auditorium tricks you into thinking you're sitting beneath the exposed shell itself, though you aren't - rather, what you see is a high, undulating, black-painted ceiling. Behind the proscenium, it's a rectangular box pushed out to the limits of the biggest shell - but still, it's a stage without wings, without upstage storage, without even a full height flying space. The theatre is the Sydney home for two of Australia's leading performance companies - Opera Australia and the Australian Ballet. Both have spent more than four decades pushing the building to its limit . . .

The original design did understand that both of these art forms needed to be able to change scenery between shows, which meant the need for storage. The solution was to go in the only direction available: down. At the rear, large stage elevators much of the width of the stage - were installed. These could carry scenery down to a substage level of the building. With no other alternative, theatre practitioners just learnt to deal with it.

They also dealt with the relatively limited facilities overhead. In the original brief for the building, Waagner-Biro had been commissioned to create a range of stage machinery for the big, adaptable hall. Ever-efficient, they built and delivered it before the functions of the halls were changed. There's always been a rumour that some of this now-redundant machinery - which would not fit into the smaller shell - ended up at the bottom of Sydney Harbour. That would make a great scene in the movie,

From top: Mid-refurbishment, looking out to the auditorium with seats removed and new followspot box under construction; Engineering work on stage, in the orchestra pit and in the auditorium; New Waager-Biro flying system with revised grid above; Looking across the stage from the re-worked fly floors

Facing page: Scenery under construction in the refurbished theatre



but it more likely spent years in storage before finally being scrapped. The freed-up space was used for the building's drama theatre and studio. Waagner did end up with some machinery in the final opera theatre - those lifts were theirs, as was a revolve permanently built into the stage and a mixture of powered hoists and counterweight flying overhead in that low grid, itself constructed from reworked sections of the grid intended for the larger shell.

Everyone knew it wasn't ideal, but the problem with busy buildings is finding the time - as well as, of course, the money - to improve them. Particularly backstage work that isn't really visible to the public: they wonder where the money went.

AN UPGRADE 40+ YEARS IN THE MAKING

Last year, the SOH found both the time and the money. Realising that a raft of equipment was nearing the end of its operational life, the theatre announced a self-funded AU\$45m upgrade scheme, with the New South Wales government contributing a further AU\$25m for accessibility and acoustic upgrades. For the first time in the building's history, one of its principle venues was closed for a substantial amount of time: seven months, from May 2017 through to a don't-dare-missit re-opening deadline of a gala performance on New Year's Eve, timed around letting the audience enjoy Sydney's famous annual fireworks from perhaps the best vantage point in the city.

Since the theatre is an independent structure sitting within the shells, there has long been talk of removing the whole thing and starting again, perhaps with something closer to Utzon's original intent. Utzon himself, in the Utzon Design Principles he created when invited to be involved with his building again in 1998, didn't think this was a viable solution (in the same document, he is also charmingly gracious about the work of Hall and his team in completing the building). Ultimately, the project became a refresh rather than a rebuild: the theatre's architecture is largely unchanged, but just about every technical element has been ripped out and renewed in a way that tries to eek out as much additional usable space as possible within a site with unchangeable confines (the shells, the ocean . .).

"Part of the goal of this project was to gain centimetres wherever we could," notes Philby Lewis, the SOH's technical manager. "That does sound a bit crazy, but space is so tight - the grid is so low, the wings are so limited but you can't go up or out because of the shells, so it's a case of little increment after little increment. Do enough of those and they all add up to a useful gain."

Lewis and Ian Cashen, the SOH director of building, brought a raft of experience to the project - Cashen from his civil engineering background; Lewis from having run his own production company and then his involvement with the epic *House of Dancing Water* in Macau. Both knew that this closure was a once-in-a-generation opportunity. They started with a list of jobs that *had* to be done, particularly replacing those rearstage elevators. But then, working with a team from UK-based theatre consultants Theatreplan, led by Dave Ludlam, they started to fold in other jobs that *should* be done and would be impossibly tricky to do with the theatre running.

Starting at the rear of the stage, the stage elevators have been replaced with new versions also supplied by Waagner-Biro, a result of competitive tender rather than just a sense of history. Driven by a wire rope system, with the equalisers lying beneath that give a flat floor downstairs when the lifts are up using a Serapid lifting chain system, the two new elevators are designed to meet Australian safety requirements that have tightened dramatically since 1973. Each elevator has lasers to detect whether people are entering the underside of the lifts, and side safety barriers that normally have to be raised up into position for things to move. However, with space so tight on stage, the lifts are sometimes used in performance rather than just for scene changes, so they have a performance mode that disables the lights, warning sounds and some of those interlocks.

Below the stage, the elevators tie into a larger project that dates back to 2015: a new access route to get trucks from the street to the scenery dock without them having to drive through the public spaces around the building. The drop point used to be at the central passage that runs between and beneath the two main venues, accessed beneath the grand staircase at the



front of the building - this public realm that also provides access to the box office and to the stage door.

The new route takes trucks down a new access ramp well away from the building to a new storage space a floor below that original technical alley. A large new goods lift connects these two areas. It's still a slightly convoluted route, but it is well implemented and even two years after opening, immaculately clean. The public probably have no idea it's there - except because it allowed all vehicles to be removed from the public areas, they no longer need to be mindful of traffic while gazing up at the famous shells.

In the theatre, the original manual and 1960s-era power flying system has been fully stripped out, and replaced with a new motorised flying system also by Waagner-Biro. This consists of more than 85 multiline hoists ranging from 600kg to 1500kg capacity, 12 500kg fixed point hoists, 12 250kg mobile point hoists, and 12 1000kg integrated chain hoists. The permanent hoists are now arranged in a new machine room above the grid to control noise and improve access; a new grid floor has been installed to allow greater flexibility for positioning the temporary hoists as needed. The bars themselves are the rectangular battens that Australia seems to favour, here chosen for offering the greatest strength for the smallest height - again, part of gaining a precious few extra centimetres of flying height. The control system for the flying is Waagner-Biro's CAT V4, with elegant, portable, touchscreen-based control surfaces that can be wheeled around the fly floor to wherever the best view is available, or even carried around on stage - equipped with neck-straps, they become a bit like an usher's ice-cream tray.



Downstage, a new more efficient portal bridge structure made room for a new downstage crossover bridge at mid-gallery level. "This, coupled with a new prompt side staircase in a space previously occupied by counterweights, has greatly improved circulation around the stage galleries," notes Theatreplan's Dave Ludlam.

Beneath the stage, some of Waagner-Biro's original work remains - the stage revolve is still there, though last used in 1985. "The revolve has not been used for decades," Lewis notes, "but while it would have been nice to get some storage space back by removing it, it's the primary structure of the stage." Forward of that is the orchestra pit; this has been one of the more notorious areas of the theatre, the opening to the audience adjudged too narrow and the pit itself problematic for the musicians playing in it. Revisions to the pit were made in 1978 and in 1994. There have been plans over the years to enlarge it further, but doing so would involve cutting through one of the main structural tie beams that holds the shells up - to get this cut wrong and have Australia's cultural icon implode would be unfortunate . . .

"We have worked out how to do this safely," Cashen notes, "but it would be



a three-year, multi-million dollar project and, ultimately, it was decided not to pursue it." Instead, the team have increased the aperture of the orchestra pit by raising its ceiling profile, and have installed a comprehensive series of adjustable acoustic treatments within the

- The new rear-stage elevators at sub-stage level
- Facing page: Looking on to the stage from the rear stage galleries













- The theatre returns to life with the opening gala performance of Opera Australia's *The Merry Widow*
- From top: The re-worked orchestra pit; The new stage lifts arrive; Advance bar containing MAC Encores, controlled from a portable Waagner-Biro v4 control console

pit itself. "Often the measure of success of a change like this in a project is silence, no feedback at all from the users. In this case, the feedback from the musicians has been really positive," says Lewis. "They've been really excited about how good it is, so I guess we've done a good job here!"

All around the place, cable has been removed and renewed. "We pulled all of the string out and started again," Lewis explains, with Cashen noting his amazement on seeing huge teams of electricians descend on the theatre as it closed to replace all of these services; the new installation retains both the colour-coding by service and neat installation of the original.

As part of this, lighting received a big system upgrade. Originally, the theatre was equipped with Siemens magneticamplifier dimmers and a Siemens console. Control was later updated to an early Galaxy (so early it arrived badged 'DDM3', an alternative name Strand had for the product), and Bytecraft eventually created thyristor dimmers that fitted into the physical space occupied by the original mag-amp units. Control moved to ETC Eos some years ago, but now the dimming has been replaced with the versatile ADB Eurodim Twin Tech system, more than 1000-ways capable of operating either as dimmers or as switched power for LEDs or moving lights. The dimmers are split between upper and lower dimmer rooms, allowing easy access for problem-solving and maintenance while also shortening cable runs and simplifying climate control issues. Pathport network distribution converts network lighting data back to DMX, while an ETC Paradigm system now controls houselights and worklights, including GDS BluesSystem LED fixtures.

The rig has also had some upgrades, particularly to deal with FOH areas that are difficult to access: two side slots and an advance bar that is pretty much impossible to access to focus

manually. The slots are fitted with ETC Lustr2s set to a fixed season focus. The advance bar, an updated version of a position first installed by Robert Ornbo for the opening season back in 1973, is now home to Martin's new MAC Encore LED moving lights, with which the Opera House team seem more than happy.

While the auditorium has largely been left alone as part of the upgrades, changes to lighting also played a part here. A new followspot room has been created, below the old one. "The old followspot room was a really awkward, uncomfortable place to work followspots from, creating ergonomic and manual handling issues for the operators. But there was no space up there to improve that, so we've created a completely new follow spot room," notes Lewis. The new spot room, which Dave Ludlam describes as "an inspired piece of lateral thinking from Theatreplan's Clive Odom," sits below and behind the original space; it houses four underslung Robert Juliat Cyrano 2.5k HMI followspots, allowing them to see further upstage than the previous position.

Elsewhere in the auditorium, the houselights - particularly those that decorate the side step-down boxes - have

been upgraded to LED using a system supplied by Jadecross.

The front few rows of the auditorium have also had important changes made to them, though these are again hard to spot: there are new wheelchair positions, complete with their own surtitle screens since those mounted on the sides of the proscenium are out of view from these locations, and access from the foyers through to these positions is now level access to a lowered floor (one tiny detail Lewis and Cashen both noticed as we walked around was that an old blackout curtain outside the auditorium door no longer reached the new floor height). The fire resistance of the front rows of seating has also been upgraded as part of getting rid of the front fire curtain - another instance of a few more centimetres being turned back into useable space.

Sound also concentrated on updating its infrastructure, with all-new cabling and patchbays throughout the building. This was then used to connect the existing Midas Pro X mixing console to over 220 discreet d&b loudspeakers, all individually powered by d&b amplifiers, with a Lawo Nova73 serving as the system router. To work around some of "Ultimately, the project became a refresh rather than a rebuild: the theatre is largely unchanged, but just about every technical element has been ripped out and renewed in a way that tries to eek out as much additional usable space as possible"



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"The theatre is largely unchanged, but just about every technical element has been ripped out and renewed in a way that tries to eek out as much additional usable space as possible"



♠ VENUE

the acoustic issues within the theatre, a Vivace electro-acoustic enhancement system is used across opera and ballet productions, with a d&b DS100 3D spatial mixer used for sound effects and contemporary music.

CHANGES ABOUND

As with all upgrades of this type where a theatre is closed for several months, there came the question of what to do with the crew during the closure. Lewis was clear that they did not want to lay off staff who had served them well for many years, only to have to re-hire them a few months later. "Instead, we wanted to support them during this time and tried to provide many opportunities, including being involved in aspects of the project itself, on- and off-site development opportunities, volunteering opportunities for organisations they were passionate about, internal and external secondments to the safety team and learning and development team to assist in preparing us for our return to the theatre. There were even some external secondments, with two staff going over to the Royal Danish Theatre for five weeks.'

Though the theatre has now re-opened, the project is not quite finished. The foyers that wrap around the auditorium rise and fall in level via steps, meaning these spaces don't satisfy current Australian access regulations. As a result, a new flat passageway is being carved through part of the foyer, leading to a new lift. Installing this means peeling back to and then cutting through parts of the original concrete structure.



Cashen notes that this is always something of a voyage of discovery, and it's fascinating to see the long-hidden substructures exposed, complete with marks left by the original construction crew - some of whom stuck around. "Until recently, one of the staging team working here had been a rigger during the building phase and then just stayed on," says Lewis.

Of course, cutting through reinforced concrete is also messy work: "It gets everywhere; the crew would come and clean the bars, then the next day they'd be covered in dust again, though I think we are now catching up." The final parts of the project will also see some more ladies toilets added, and a new reception space to replace the temporary tent structure that's sat on the back of the building for more years now than anyone would have wanted.

Though towards the end things were a bit rushed - as they surely always are on these projects - the theatre did re-open on 31 December, with a performance of Opera Australia's *The Merry Widow*.

Did the public notice the changes? Hard to know. Did the crew and creative teams working in the theatre? Certainly. It's a better space to work in than it was, albeit still imperfect - and the constraints of the site mean it will probably always be.

The thing is, ultimately that doesn't matter. The importance of the building transcends that - without these constraints you wouldn't have the beautiful, unique Sydney Opera House. "It is a remarkable building," Lewis notes, "uplifting just to walk into at the start of every day. Our job is to preserve that, while adapting the building to respond to the changing needs of productions and the public over time." An epilogue to the movie, perhaps (or perhaps to the opera on the subject, *The Eighth Wonder*, which does exist).

Or the start of a series of epilogues: they're done, for now, in the Joan Sutherland. But next up: a similar set of upgrades for the Concert Hall next door . . .