

# An Energy Efficient Air Change Rooftop Package System Selected for Bondi's New Marine Discovery Centre

David Goodwin

**One of Sydney's newest attractions has been set up to educate and preserve a pristine underwater environment that few get to see – the world beneath the waves of Bondi Beach, in Sydney's Eastern Suburbs.**

Like the world famous beach, the Bondi Pavilion, which houses the Marine Discovery Centre, is an icon itself and home to the original Bondi Lifeguards. Its foundation stone was laid in 1928 and it was classified by the National Trust in 1977. Today it is a centre of community life and culture, and has a thriving commercial centre with cafés, restaurants, an art gallery, theatre, music studios and entertainment spaces.



*Iconic Bondi beach as locals and visitors from around the world see it on the surface*

The Marine Discovery Centre is a non-profit charity that educates visitors about coastal underwater ecology and the need to preserve it for future generations. It is housed by the local Waverley Council and funded by a variety of government grants, particularly the Australian Government's Department of Infrastructure.



*The historic Bondi Pavilion is home to the Marine Discovery Centre*

Marine Biologist and diving instructor, Will Jones, had a vision to create an inspiring and entertaining experience, introducing visitors to a beautiful underwater ecosystem. "You can only take maybe a few hundred people diving in a year. They are a certain type of person that is more aware of the underwater environment and

conservation than most land lubbers. The whole idea is to take the non-diver through the surf, the shallows, the rock-pools, the boulder fields and down into the deep water of a dive site off North Bondi," Will said.

The Marine Discovery Centre offers a combination of real and virtual underwater experiences in a 30-minute virtual dive around Bondi Bay – without having to even get wet. Admission to the new Underwater Bondi Experience is \$10 for adults and \$5 for children, so it is quite an affordable addition to a great day out at Bondi Beach.



*Founder and Executive Director, Will Jones, welcomes visitors to a unique underwater experience beneath the waves of Bondi beach to a beautiful but fragile eco system*

The entrance to the Centre is adorned with the rare and endangered Weedy Seadragon, an exotic fish similar to a seahorse, a colony of which lives just off North Bondi. Visitors are first taken into the Transporter Room and when the automatic door shuts behind them, a simulated dive begins on a large curved scene. First they are transported high into the air and look down on Bondi from above. "This is achieved with hundreds of still photographs edited together," Will said.

Suddenly the scene descends into the sea and when the bubbles clear you travel to a particular dive site. This is the home of a variety of brightly coloured fish

including a large Blue Groper that darts across the screen. The rocks are covered in distinctively pink coloured algae with black spiny sea urchins in crevices. A couple of snorkellers come into view.

The second door slides open and visitors follow the on-screen snorkellers who swim left into the Underwater Bondi Room. This is a re-creation of an actual underwater dive site with huge screen projections and large simulated rocks. Full length mirrors make the scene much larger and the underwater vista seems to go on forever into the distance in both directions (in fact the room is only around 30 m<sup>2</sup>). The effect is similar to being there with fish, divers and vibrant sea life all around you.

"There is around 4.5 tonne of water in the main tank which has holes prepared for our two Moray Eels to live in. We created the boulders from photos of a real dive site at North Bondi. A company called Universal Rocks made the rock walls from cement, and as divers we helped because they had never built underwater rocks before. We sculpted the sea urchin holes, which are made by generations of sea urchins boring into the rocks.

"The sea urchin spines are real. We got them from the fish markets and took each individual spine out, washed them and put all the spines back into a body moulded from clay. We also collected sand from the same dive site and mixed it with resin to create the floor of the room. The same sand is also used in the aquarium, but in there it is loose and is full of bacteria, which act as a bio-filter removing the fishes' waste and ammonia from the water," Will said.

High definition images from the actual dive site are projected onto the walls and ceiling. "There have been a few too many specialist cutting edge technologies I have had to learn in this area. The software comes from Austria and the guy who is helping me is in



*The underwater magic of the simulated dive site inside the Bondi Room*

Singapore. There is underwater sound of the divers breathing and we have two water effect lights to give the room movement," Will said.

"The first fish inhabitants have been collected by Sydney Aquarium, our aquarium partners on the project. The 100 fish were kept in quarantine and delivered in groups. The tanks, filtration and chillers were built by OzSea and are working very well, so the fish are happy.

The rock pool aquarium had manmade objects like pieces of glass, fishing line and part of a mobile phone. "I collected these when I collected the animals from the same rock pools at North Bondi. It's a highly urbanised environment and we have started to trash it. If we are left to our own devices we will continue to do so," Will said.

After this fascinating experience you enter a theatrette, where you sit and relax to watch a 20-minute big screen movie of an underwater tour around Bondi Bay. This film allows you to experience what a fish or diver sees down to depths of around 23m, telling the story of this unique ecosystem and the need to preserve it.

As one leaves the theatrette there is a stark reminder of the human impacts threatening this new underwater world you have just discovered. Walking into the simulated stormwater drain there are bottles and plastic bags caught in its large grate, reminding the visitor of their responsibility to conserve the underwater wonders of our coastal environment. At the end of the Experience visitors receive Missions to help the environment; simple actions that everyone can do to keep our oceans beautiful.

### Choosing the Right HVAC System

"The Marine Discovery Centre is an environmental charity organisation, so we wanted to create an exciting and interesting centre that would appeal to the public, and that wasn't going to cost the earth" Will said.

"I started to look around for an air conditioning system in 2006, and like everybody else I looked in the Yellow Pages. I selected three of the bigger companies, all of which recommended a conventional large capacity ducted split system of around 35 kW. As we are a public facility I learned we needed to provide 10 L/sec, per person of fresh air, which meant that we would have to turn over the air volume in the centre every 13 minutes. We were going to be air conditioning Bondi Beach at that rate! To ensure the Marine Discovery Centre did the right thing by using sustainable systems that don't produce too many greenhouse gases I decided to learn more, and so attended the Sydney ARBS exhibition in Darling Harbour."

Will spoke to several contractors recommended by exhibitors at the show but liked the energy efficient solutions and attention to detail of Orion Mechanical Services, a specialist design and construct HVAC contractor based in Alexandria, south of Sydney.

Justin Phillips runs Orion Mechanical Services specialising in providing high quality air conditioning and ventilation solutions for many commercial and residential building projects across Sydney. Justin has had a lot of experience with a variety of large and small air conditioning systems.

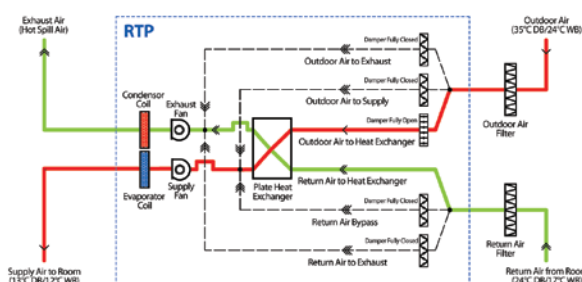
"When I first met Will, to discuss his energy efficiency requirements, I needed to listen closely, understand his objectives, and think outside the square to achieve what was needed. How to position the unit in the roof and make it work properly was a major challenge. Will asked me to explore all options, even quoting on a standard large capacity split ducted system but I preferred the simplicity and energy efficiency of a single packaged system," Justin said.

Will told Justin he had heard of Air Change's rooftop package units from his contacts at the Department of Environment and Climate Change. Justin had already worked on two Air Change PoolPac installations that had worked very well.

Justin contacted the NSW/ACT State Manager at Air Change, Shane Carmichael, and asked him to come to the site and have a close examination of the site at the Bondi Pavilion where the Marine Discovery Centre is located.

"Because the Marine Discovery Centre might have up to 50 people inside the building at one time, the centre needed a substantial amount of outside air. Together with Will's requirement for energy efficiency, this made heat recovery the ideal solution," he said Justin selected an ACS16RCRTP Rooftop Package unit supplying 100% outside air at a nominal 750 L/sec throughout the centre. The unit combines a patented air-air heat exchanger system with a DX heat pump system.

### 100% Outdoor Air



"The element that makes the unit unique is the built in Enthalpy Heat Exchanger, which reclaims energy from the exhausting spill air and transfers this energy to the incoming outside air. This will pre-cool outside air in summer, and pre-heat in winter." Shane said.

"The unit has a cooling capacity of 16 kW from the compressor side as well as a further 15.2 kW from the heat recovery system under Sydney conditions.

"If you add those two totals together the grand total capacity is equivalent to a

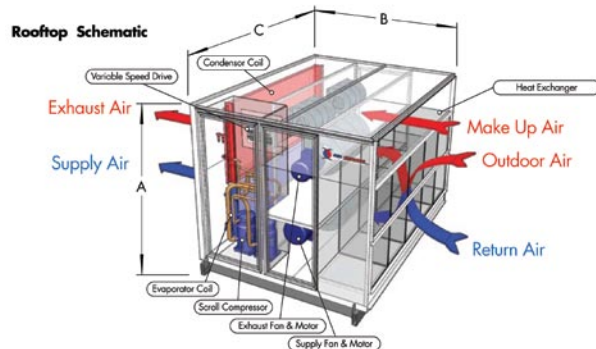
conventional 31.2 kW air conditioning unit.

"To achieve energy savings for the centre was very important, so being able to give Will a 16 kW rather than 32 kW system saved a lot of greenhouse gases. The refrigerant in the unit is 407C, a direct replacement for R22," Shane said.

"This model is equipped with a Copeland Scroll compressor, the coils are epoxy treated and the fans on this unit are both corrosion resistant with a powder coating treatment. The inside of the unit is treated with an Inter-tough 203, an anti corrosive vinyl paint used on the hulls of ship to protect from saltwater.

"The cabinet is a colorbond 50 mm double skin sandwich panel which in itself has great resistive properties for pool and salt water applications. We go one step further and treat the internal parts and fittings. This includes the stainless steel shafts on the fans."

According to Justin, it is a building code



requirement to provide minimum outside air flow rates to all public buildings.

"Here, we're very comfortably exceeding the minimal outside air requirements of AS1668.2 with 750 L/sec of filtered fresh outside air being supplied into the building at all times. Additionally, we can easily adjust this flow rate if we need to by simply changing the speed of the outside air fan," he said.

Once all the information and quotations for the air conditioning systems was completed Will added it to the Climate Change Fund, Public Facilities grant he was submitting to the NSW Government's Department of Environment and Climate Change.

"Because we are asking the public to act environmentally I needed to ensure that the systems we installed were the most energy efficient available. It was a very detailed grant and took ages to write, but it had already taken months and months for me to find a suitable energy efficient air conditioning system that was market-ready and that we could afford," Will said.

"I quoted tables and the energy efficiency figures supplied by Shane and some of the other equipment suppliers on the project. One of the main points about the selected air conditioning system was the Air Change unit saves approximately 50% of the cost of running a normal air conditioner system and more to the point for us, it produces only half the greenhouse gas emissions.

CONTINUES ON PAGE 16

FEATURE ON HEAT EXCHANGERS

**CONTINUED FROM PAGE 15**

"Other elements applied for included magnetic drive pumps for the aquariums, which are much more energy efficient than standard shaft drive swimming pool pumps. We have also put in electronic ballasts in the fluorescent lighting used in the aquariums to reduce the input of heat and are going to install bulk insulation in the ceiling to complete the project. We were successful and received a \$25,460 grant, which was recently announced by the Deputy Premier, Carmel Tebbutt."

**The Installation**

"The old timber post and beam and cantilevered roof construction meant Justin and his team needed to do a lot of preliminary planning and logistics to work out how to get the ACS 16 Air Change unit inside the roof space.

"I did all the design, engineering and equipment selections on the project. I was backed up two teams of sub-contractors. It is a credit to these guys that I can give them a set of drawings and they can finish the work without too much supervision," Justin said.



*Lifting the Air Change Package Unit into the roof of the Bondi Pavilion*

"The challenge for us was we had to manufacture everything before we opened up the roof, so we had the Air Change Unit delivered to site beforehand so we could accurately measure up everything we needed including all the ductwork, safety tray and insulated boxes. Every machine has its slight nuances you may not pick up from a technical drawing or brochure. So it was important that we got all the PAC duct, electrical and drain connection dimensions 100% correct.

"I bought two large square section 100 x 100 mm galvanised steel beams and lifted them into the roof. From these the Air Change unit hangs from four 12 mm stainless rods. I bought some appropriately sized compression spring hangers and the two roof cowls from Fantech.



*The Air Change ACS 16 being lifted into position by Rob & Chris showing the exhaust air trouser piece either side of the roof timber post*

"We needed to get a crane on site, open the roof, put all the duct work and fittings

into the roof space, get the crane to lift the unit into the roof space last and then put back all the tiles - all in one day. I am blessed with my installation team, led by Chris Gooley, because positioning the large inlet trouser pieces around the vertical roof beam was very tricky, but they did it and completed all of the positioning in that time frame.

"The roof cowls were fitted on another day. They look like they have always been there and nothing protrudes above the ridgeline of the roof. There is very little evidence of us cutting the roof open apart from some batons that are up there.



*The Inlet and outlet cowls are all you see of the rooftop unit*

"I was not driven by money on this project but rather the challenge, opportunity and knowledge I gained"

**The Air Conditioning Controller**

The Leasam controller was supplied by OEM Electronics. It has a seven-day programmable control supporting sensor electronics, according to Justin.

"If I'm installing any simple DX single or two-stage reverse cycle air conditioning system that requires a generic controller, I wouldn't go past Leasam. It's a reliable, high quality programmable controller that tells you the room temperature and if the compressor is running," Justin said.

"We have connected two sensors to it. One is in the return air on the Air Change unit and the other is on the wall control. We have made provision for an additional sensor inside the theatre but it's not wired into the controller. That is the room where there is potentially a large heat load and the spare thermostat gives us the flexibility to make simple control changes down the track if required."

**Ducting, Insulation and Filtration Making the System Super Quiet**

"All of our duct work is made of 316 stainless steel. These are internally lined with traditional foil faced 25 or 50 mm insulation making the unit incredibly quiet. On other parts of the duct work we use 6mm black foam stick-on internal lagging and 12 mm black foam with foil face stick on external lagging," Justin said.



*The stainless steel, fully lined metal and flexible duct work*

"The unit has stainless steel filter frames for both the outside air and the return air. Some return air grills are hinged egg crate type with additional filters. There is one in the reception area, for instance, which has a white 600 x 600 mm hinged egg crate grill with filter and in the main theatre there is a 900 x 400 mm black hinged grill with filter. In addition we have spread around additional return outlets in every room using round plastic diffusers.

"Every supply air grill has a damper with quadrant balancing device. We have as many return air grills as we have supply grills and are using round white plastic diffusers which are very quiet.

"You can only just hear the fans running through the duct work and that is all. When I stand next to the unit I have to take the panel off the side to hear if the compressor is running, it's so quiet.

"We also installed return air grills in the top of the three AV equipment cupboards to reclaim some of the heat energy in winter. This is also really important because this equipment is really expensive and needs to be kept cool." Justin said.

**Conclusion**



*Contractor on the project Justin Phillips with the Air Change ACS16RCRCTP Rooftop Package Unit*

"We are very pleased we have been able to build a facility that inspires and educates visitors to look after our precious marine environment, whilst at the same time meeting the various building codes and not producing too much in the way of greenhouse gas emissions in the process. I'm keen to open the Centre in early January 2009 and look forward to keeping our visitors in air-conditioned comfort while they are here," Will said.

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