

# The Age of AQUARIUMS



**GREG ADAMS** talks to Mike Murphy about his latest creation in a coral lagoon in the Indian Ocean, and finds out about the challenges of engineering giant acrylic bubbles for keeping people and water apart.

**SPECIALISING IN AQUARIUMS**, Mike Murphy MIPENZ has worked from a modest office in his Manurewa home for clients around the world – Kelly Tarlton's in Auckland, Manly UnderwaterWorld in Sydney, others in China, Hawaii, Spain and Vanuatu. He has designed underwater windows for the filming of the Xena-Hercules TV series, a new sea lion pool at Auckland Zoo, and also came up with bubble wall-tanks for the SkyCity Casino in Auckland.

Currently, he's working on one of the largest ever shark tanks, at 3,500 cubic metres, for a US\$40 million aquarium in Palma, Spain, and has been approached about a semi-submerged hotel. However, his latest effort could perhaps be his most mouth-watering – an underwater dining room in the Maldives.

## Underwater restaurant

"Instead of fish it's people in the tank, looking out at the fish and the coral," he explains. "The initial idea was for flat-panel windows. It didn't look that exciting to me, so I suggested an arch structure." And not just any old arch, either – it equals the world's largest, in a Murphy-designed aquarium in Kuala Lumpur, which is twice the width of the arch at Kelly Tarlton's. The result is a

five-by-ten-metre "bubble" enclosing the underwater dining area for an exclusive restaurant in a Hilton hotel resort on Rangali Island, about half an hour's flight from the capital Malé. Diners walk along a narrow wooden jetty to a grass hut in the middle of the lagoon. Here they enjoy pre-dinner drinks before descending a spiral staircase to the seating area, the top half of which is transparent, allowing diners spectacular close-up views of coral and sea-life.

The financial backers of the project, who came across Mr Murphy on the Internet, loved his ideas. But the question was how exactly to build it. The original plan involved a concrete structure with acrylic windows – but it proved "a bit hard to do" in concrete, given the issues of cracking, water-proofing and quality control. "So we ditched that and went for a painted steel sub-structure with an acrylic arch."

The project got the go-ahead in February last year. Mr Murphy spent the next couple of months crunching the numbers and working out the details – and checking out the location. "It was hell," he says with a smile. "I had to go there a few times and swim around to find the best spot to put it." Sunburn and coral cuts aside, one of the biggest challenges was partially submerging

the whole structure, which had to be weighed down with an efficient mass. "If you only use light-weight material, you need more volume," he explains, "but, of course, the more the volume the more water it displaces so you need more weight. Bloody Archimedes! I ended up filling the base and the ends with concrete – about 50 cubic metres in total. This was just enough that the crane could lift it and it would still float, three-quarters submerged."

### Fabrication

Another brain-teaser was the paintwork. The submerged steel structure needed a really durable paint system – "You don't want to be lifting it out of the water to repaint in a couple of years." Zinc anodes, which will corrode before the steel, were also attached to the structure. They can be easily checked and replaced when necessary, prolonging the life of the steel.

The project was initially designed to be constructed on the beach of the lagoon, although both Mr Murphy and the client had their concerns. It soon became obvious that this was not the way to do it – quality control on an open beach with limited facilities was just too difficult. "Even if we'd pulled it off, the structure weighs about 180 tonnes. We'd have struggled to get it into the water. It just wasn't going to work."

The three-month fabrication process eventually took place in Singapore, but only after an ocean-going barge large enough to cope (and equipped with a 300-tonne crane) had been found. The three acrylic arch segments, each 100mm thick, and 5m wide by 3.5m long, were fitted into a steel frame, which was braced with steel trusses and beams. The concrete was poured, the paint applied, the arches silicone-sealed, and the whole lot strapped on the deck of the barge. "I had visions of losing everything overboard in a storm," says Mr Murphy, but the three-week journey proved uneventful.

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### Sinking

Perhaps the most challenging aspect of the project was determining the many load-cases the restaurant unit would be subject to, and designing for them. The constant dynamic forces acting on it had to be calculated not just for its final position, but also during construction and during the sinking process. "We had to make sure the positioning was correct (piling tolerances, etc) but we also

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The tsunami wave, however, could have been a problem; Mr Murphy feared that the rising water would flood the whole thing, the entrance being about 1.5m above the water. In the event, there were about 30cm to spare.

wanted a way that would allow us to bring it to the surface if need be, for maintenance or repair. Pouring more concrete inside would make it pretty difficult to lift again.”

Mr Murphy’s solution was to fill it with sand – 80 tonnes in all. It was dried under cover on the beach (to prevent it corroding the inside of the unit), put into bags and physically carried on board. About 50 local workers manhandled the bags along a precarious plank boardwalk in 30-degree temperatures – “OSH would have had a field day”. Remarkably, they only took one day – even with a two-hour break for Friday prayers, as the Maldives is a Muslim country.

The sandbags were placed in compartments under the floor. If the structure should need to be raised, they will be removed, the structure disconnected from the piles, “and the whole thing will simply float to the surface”.

The gradual addition of the sand gave Mr Murphy time to monitor deflection in the acrylic, which he describes as “a bit of an art”. As

it sank the lateral water pressure pushed in on the acrylic, bulging it up at the top. Once it was submerged, the water pressure on the top then pushed it back down and out at the sides, so it eventually returned to its original shape. He had to make sure the deflection did not overly distort the silicone joints between the steel, which is rigid, and the acrylic, which was moving.

### Tsunami resistance

Beneath the unit, four 750mm steel piles secure the structure to the seabed. These were driven into the sand without damaging the coral; but the four metres to the coral bedrock was less than Mr Murphy had expected: “I did some calculations and it was borderline. We had to anchor the piles with extra concrete. It was better to be safe. The extra cost at that stage was money well spent.”

The result is that the top of the restaurant sits 1.8m beneath the water’s surface. Diners needn’t worry – although Mr Murphy did when he first heard news of the Boxing Day Tsunami.

“The factor of safety on the acrylic is quite amazing, about 15 or 20,” he explains. “I’ve also added a foot or so to the maximum design water level for potential global warming over the next 20 years – the anticipated life of the structure.”

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The US\$2 million project – it doesn’t sound much when you consider what a drawcard it could be – was completed in mid-March 2004 and opened on April 1. For Mr Murphy, it ranks as one of his most memorable projects: “It stretched the ingenuity a bit. It was a non-standard job, which I like, in an exciting location and



Mike Murphy with his 180-tonne masterpiece.



Local workers manhandle sandbags into position for sinking.

His biggest battles typically involve architects. On several projects the proposed structure has been “quite impracticable” because the architects have not designed aquariums before, and won’t simplify the design to make the engineering feasible.



San Sebastian Aquarium in northern Spain.

for prestigious clients. It was a fascinating project, and an honour to work on.”

### Career path

Mr Murphy graduated with a BE in Civil Engineering from Auckland University in 1971. He developed his career with consulting firms in New Zealand, South Africa and the United Kingdom, working on roads, bridges, industrial buildings and sugar refineries. As a

self-employed engineer – he set up MJ Murphy Limited in 1982 – he worked on coolstores, specialising in steel-polystyrene sandwich panel design.

During this time, he was approached to work on the design of Auckland’s 700-berth Westhaven Marina. The contractor for the Westhaven job was also involved with Kelly Tarlton’s. Thus Mr Murphy’s connection with aquariums began by chance. Although Mr Murphy wasn’t involved in the final building of the Auckland

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aquarium, the same people involved him in a project in Sydney, followed by one in Perth, then others in Queensland, Darwin, Hong Kong, Singapore...and the list goes on.

Word of mouth – along with the odd Internet enquiry – has seen Mr Murphy leave his mark around the world. His design for the San Sebastian Aquarium in northern Spain was a stunning 3.8-metre-wide by 10-metre-long oval, with an internal glass floor, and fish swimming all around. (He was a finalist in the 1999 IPENZ Engineering Excellence Awards with this project, losing out to the Sky Tower.) “It was my first full 360 degree acrylic tunnel – a world first,” he says proudly. He recalls the typical deflection problems as the aquarium was filled with water. The first time it was filled, he had to be inside the tunnel as the water rose to see how the acrylic moved and to make sure it behaved according to his calculations.

Mr Murphy says that his biggest battles typically involve architects. On several projects the proposed structure has been “quite impracticable” because the architects have not designed aquariums before, and won’t simplify the design to make the engineering feasible. “It’s a frustration for a lot of engineers, I’m sure. In the aquarium game, the architect wants to have sexy curves and take out the columns, but it’s got to be practical to build as well.”

## Dreams

Away from work, the father-of-four “jogs regularly to keep fit” and plays piano. But his passion – and something he toyed with as a new career for a while – is painting. He’s currently working on contemporary interpretations of works by some of the Old Masters. “I find it relaxing and inspirational,” he explains. “I’ve even sold a few but, sadly, not enough to live on.”

The art world’s loss, however, is engineering’s gain. For now, Mr Murphy is concentrating on finishing his Spanish shark tank and on a coolstore in Takanini. He’s happy to enjoy the lifestyle he has developed, which enables him to pick and choose his next “adventure”. Some of the projects that cross his desk he describes as “totally ridiculous”, but who knows what will appear next? If he had the choice he’d like to tackle a deep aquarium, with crossing tunnels – similar to plans he originally devised for a project near the Eiffel Tower in Paris, which didn’t eventuate.

“That is something of a dream of mine,” he added. On the evidence to date, don’t bet against it becoming a reality.

*Greg Adams is an Auckland-based freelance writer.*



**Diners enjoying aperitifs in huts on the jetty.**



**A barge with a 300-tonne crane transported the structure from Singapore.**

