

Architecture

How the Opera House tiles stay white

Journalist Helen Pitt and photographer Dylan Coker spend a day on the tiles of the Sydney Opera House to get a bird's-eye view of how the maintenance team work at the world-famous structure.

By Helen Pitt

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Opera House building operations manager Dean Jakubowski and height access specialist Dean Gillies drill in between tiles and use a borescope to inspect the inside of the shell of the sails. DYLAN COKER

After more than half a century of scorching sun, torrential rain and fallout from fireworks and bushfires, are the tiles on the Sydney Opera House looking a little less white? And what about mould, lichen, dirt, dust, chips, cracks and bird poo on top of the world's most famous set of sails?

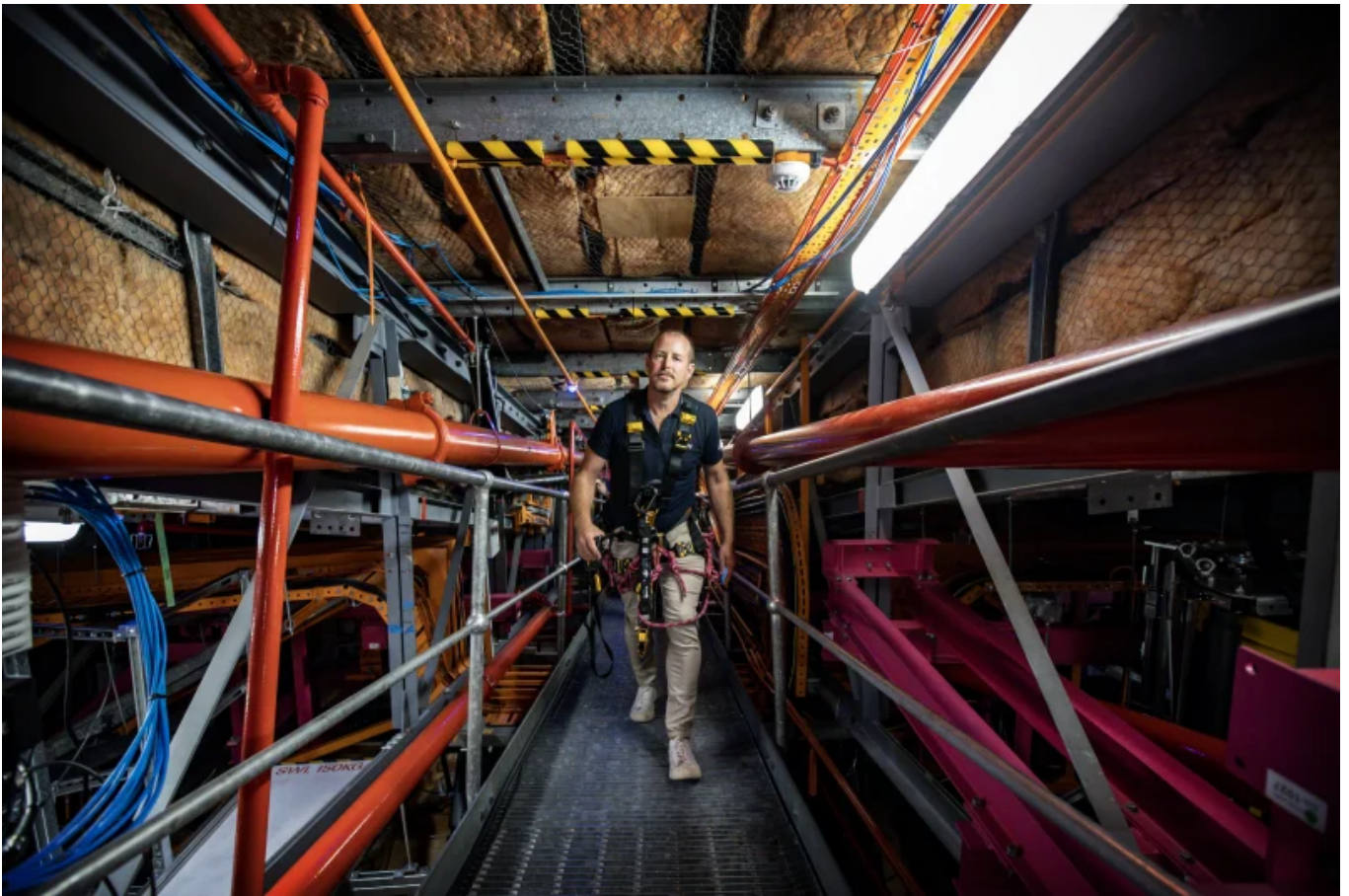
These are questions building operations manager Dean Jakubowski is asked often, including on top of the A2 sail – the building's largest – when this masthead spends a day with him.



Sydney skyline is seen from the top of the A2 shell. DYLAN COKER

“People think when they come on site on a dull day that the sails aren’t so white,” says Jakubowski, a former carpenter who now gets to abseil all over Australia’s best-known building for a job. “But that was absolutely intentional.”

A rooftop visit is a rare honour, and comes 60 years after work began on stage two of the building – the roof and tiles.



Opera House building operations manager Dean Jakubowski makes his way through the passage to the crawl space leading to the top shell of the sails on section A2. DYLAN COKER

Like peeking underneath a haute couture garment, on the way up we get a glimpse of the fine craftsmanship in parts of the building the public never sees.

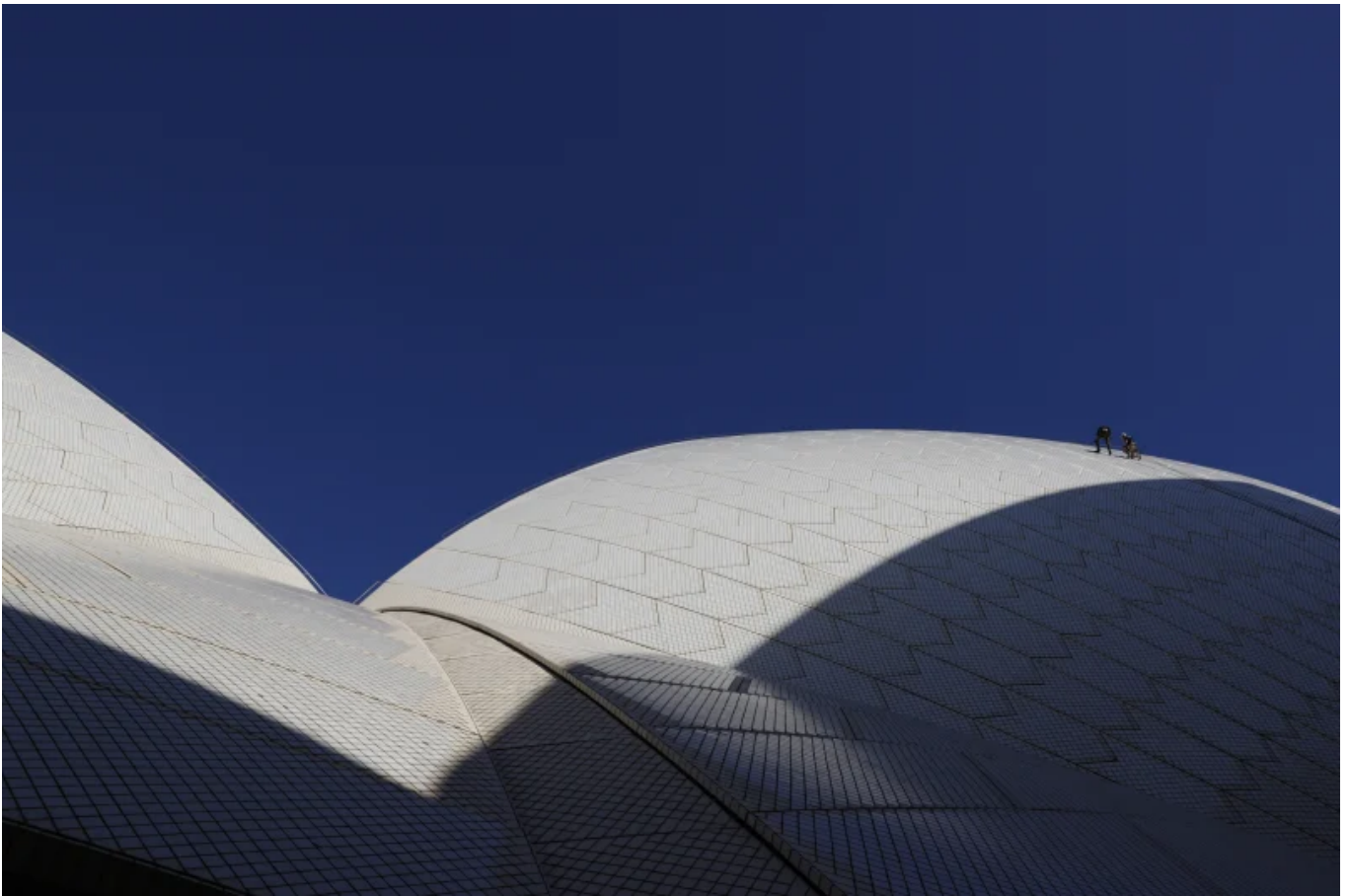
We scale spiral staircases made from original brushbox timber up to the “catwalk” above the Concert Hall ceiling to the crown of the building. We then shimmy up the spine of the largest sail through a confined space; a claustrophobic’s nightmare.

Inside, a privileged few who have come this way before have graffitied their names on the concrete cavity beneath the tiles. Workman Domenico Quaranta was here in 1964 and former Opera House Trust chair Joseph Skrzyński in 1997. Swimmer Sam Riley and the 2000 Olympic torch relay and the Jackie Chan stunt team in 2016.



Opera House building operations manager Dean Jakubowski and height access specialists Morgan Pugh and Dean Gillies prepare to inspect the shell of the sails on section A2, which includes the famous building's highest point at 68 metres above sea level. DYLAN COKER

Not only do we get a bird's-eye view of the city, the harbour and the 14 shells of the Sydney Opera House, we also get a close-up view of the tiles on top, and the tools – some of them drawing on video game technology – used by the maintenance team to keep the building shipshape.



Sydney Opera House building operations manager Dean Jakubowski and height access specialist Dean Gillies work on the shell of the sails in the early morning light. DYLAN COKER

“If you look closely at the pattern you can see that we have got gloss and matte tiles,” Jakubowski says. He says the lichen atop the building is not removed in order to retain the character of the building.

It’s the same situation for mould on the sealant between cracks in the tiles, which actually helps protect the concrete beneath. There’s the odd tiny crack or chip, but any bird poo has been washed off by rain.

The self-cleaning tiles never get a scrub down by anything but the elements. Danish architect Jorn Utzon planned it that way, the spherical shape of the shells allowing for good drainage so that cleaning would not be necessary.



The 4228 chevron tiles required to cover the shells were produced in a factory set up under the Monumental Steps. Tiles were placed face down in one of 26 chevron-shaped beds, each with a base shaped to match the curve of the roof. DYLAN COKER

He worked on the tiles, made from clay with a small percentage of crushed stone, for three years with Swedish company Hognas.

In the early 1960s, more than 1 million “Sydney Tiles” were shipped from Sweden. Some 940,840 cover the building now and the remainder are in an off-site storage facility. It’s not known exactly how many tiles are left or, indeed, how many Sydney bathrooms may sport some spares souvenired by workers in the 1960s.

“A lady in Rozelle contacted me once when parts of her 120-year-old house were about to be demolished, telling me the previous owner had tiles that were used in the construction of the Sydney Opera House,” Jakubowski says. “She said she did not want to throw them in the tip, as the last thing she would want to do would [be to] throw away part of Sydney’s history. I jumped at the chance to replenish our supply.”

A small pallet of 250 tiles was delivered, which was welcome given they are no longer in production.

Every five years Jakubowski and a team of six take six days to abseil all over the building to hand-test each tile.

“It’s pretty painstaking work, like using a glockenspiel and tapping every single tile,” Jakubowski says.

Like the musicians who work below the sails, a good ear is required to pick the higher-pitched drummy sound of a cracked or faulty tile.

Since he started work here in 2006, only 50 tiles have needed replacing; 12 in this most recent tile test, 14 and 24 in previous tests.

“When you are talking close to a million tiles, it is a bit of a testament to the people who built it,” Jakubowski says.

The Opera House tile-check method is the same used in home bathrooms, explains Szymon Stec, a civil engineer and qualified abseiler who knows the building’s external engineering like the back of his hand.

“Like in your bathroom when a tile debonds from the building ... if you tap it, it sounds hollow ... the same principle is used for the Opera House,” he says.

“Obviously we use slightly different tools, with our spring-loaded hammer, which, when it taps, doesn’t break the surface. You have to be very careful with the heritage site.”

Stec heads the 18-strong Sydney Opera House team at Arup – the consultant engineering company that has worked on the building since 1957.

It was founded by Dane Ove Arup, who contacted his countryman Utzon to help construct the building the day after his winning design for the international competition was chosen from 233 others.

Stec has worked climbing all over the Opera House for 10 years. “The first time you do it you take a lot of selfies because you are on the Opera House but then you kind of realise it is just work.”

The tile testing is followed by a borescope test that checks the condition of the underlying concrete structure.

Strapped in only by abseil ropes and harnesses, the workers drill into the crevices between the tiles. They use a cord with a camera attached at the end to burrow into the building’s concrete. Footage from the tiny camera travelling through the pre-stressed concrete looks a little like the video game *Minecraft*.

Because the concrete contains steel, keeping water away from it is crucial to prevent corrosion. Water is one of the things the camera is looking for.



Building operations manager Dean Jakubowski and height access specialist Dean Gillies abseil down the eastern side of the A2 shell. DYLAN COKER

The information that it collects is put into a 3D map that tracks all maintenance on the building's exterior. The artificial intelligence tool is known as Ai3D and uses 3D renderings, animations and virtual reality, tools used in video gaming technology.

The technology has been specially developed over the past eight years and means rather than marking up a tile in need of work by pen on paper, a digital record is now available of every centimetre of the building.

“Every single tile has a number ... you can map that to track its history so when you put that into a model you have got its history for the rest of its life. If a tile appears drummy through the tap test, we mark it on the digital map and can go back to investigate to see if it needs replacing,” Jakubowski says.

Stec says the biggest tiles usually fall off in locations where people can touch them.

“It would be tempting for people to grab a piece of Australia and put it in their pocket. But up top, surprisingly, there hasn't been many [needing to be replaced]; and because we do our inspections on a regular basis, if there are drummy areas we record and then repair those as quickly as possible.”

Utzon always intended the two-tone white tiles to reflect the surrounding colours of nature – the blue of the harbour and sky, and the green of the trees. He claimed a two-tone roof was much better than a plain white roof, which would have no texture or expression.

“From a distance you will get a pattern of glossy tiles shining like fingernails against the flesh-like texture of matte tiles,” he told the *Herald* in 1963.

“No matter from what angle you look at the Opera House roof it will stand out very clearly – as clear as the Snowy Mountains.”

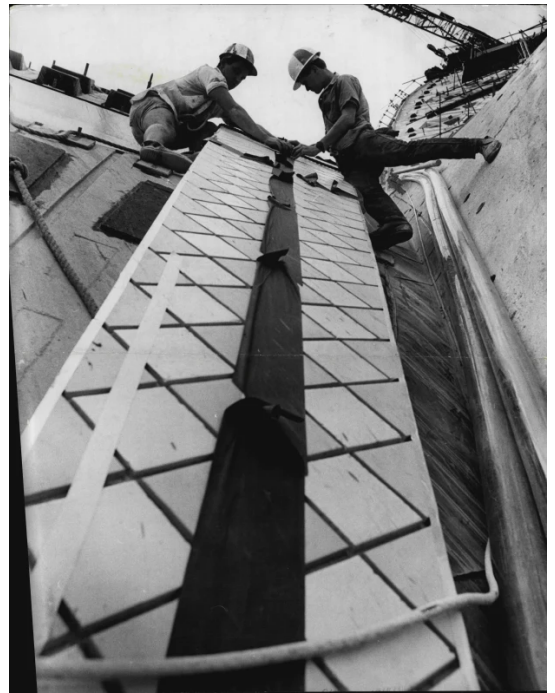
On top of the sails, Jakubowski points out the difference between the glossy “ice” and matte “snow” tiles, as Utzon described the 12cm x 12cm ceramic squares. You can also make out the chevron patterns – the upside-down V shapes – of the tile lids, 3382 of which cover the shells.

“If the sails were all gloss on a sunny day it would be too glary to look at. So Utzon came up with this design with the matte tile so it dulls it down a bit ... It was a genius design. You just don't see until you get up close the matte tile looks a little yellower.”

The Sydney Opera House will celebrate its 50th anniversary in October.



The Sydney Opera House under construction in April 1966. SMH



“Mountaineers” of the Opera House, workmen Phil Manion, of North Sydney (left), and David Bain, of Darling Point, perched high on a vertical sail roof as they inspect the first test strip of tiling in January 1965. SMH

The tile tally

- Utzon worked for three years with Swedish company Hoganas to produce the Sydney Opera House tiles.
- Number of “Sydney Tiles” shipped from Sweden: 1,056,000
- Number of tiles on the sails today: 940,840.
- Number of chevron-shaped tiled lids over the building’s concrete ribs: 3382
- The tiles were laid in beds in the designated pattern of cream and white/matte and smooth.
- Grooves were provided for drainage and the joints partially filled with heated glue to prevent grout getting into the surface of the tiles.
- The backs of the tile lids were then covered with galvanised steel mesh and mortar.
- After a steam curing over several hours, the tiles were installed on the concrete.
- Work on the concrete shells and tiles lasted four years from 1963 until 1967 and cost \$12.5 million.

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