



## A TRIUMPH ALL ROUND

Innovation, imagination and pure genius make the new Dome Education Centre a feat of engineering. See page 18.



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# A 'dome' fine piec

An iconic new structure in Green Point Park, the Dome Education Centre, has made innovation and intense dedication. It has achieved several global firsts in the enginee

**G**reen Point Park's stunning new Dome Education Centre is the crowning glory of the just-completed Experiential Educational Garden (EEG). This rounded marvel is a triumph of imagination, innovation and extraordinary craftsmanship, and will be officially opened along with its surrounding gardens in late November.

Positioned on the very edge of the park, the Dome is a highly visible landmark that will become a distinctive feature of Cape Town's cityscape. Its conception goes back to 2016, when Lindie Buirski, acting manager of Environmental Management's Planning and Sustainability Branch and head of the Environmental Capacity-Building Unit, began considering how best to make use of an undeveloped corner of the Green Point Park.

Lindie imagined an educational wonderland where children could enjoy an interactive learning space that fed all the senses. The central element would be a long-desired indoor educational facility. The building's requirements were that it should be a simple, light structure that has natural air flow, follows sustainable building principles, is low-maintenance, and able to accommodate about 60 learners at a time. A small team from Environmental Management as well as Urban Planning and Design put their heads together to make it a reality.

## The point behind the curves

In designing the Dome and the EEG, Lindie's vision was to make the space a celebration of Cape Town's Khoi First Nation peoples, who once moved freely across this fertile land with their herds of sheep and cattle. The inspiration for the Dome's design was the simple yet clever traditional Khoi dome-shaped huts. In essence, the structures were a skeleton of flexible branches covered with a patchwork of reed matjies (mats) to give shade in summer, warmth in winter, as well as good ventilation. The design of the huts was perfectly suited

## No trick of the mind

What makes the Dome Education Centre's structure so exceptional is its absolutely smooth and rounded three-dimensional surface. Most domes are two-dimensional, using many flat panels laid between supporting beams. The more skeleton beams used, the smaller the flat pieces in between them are. This makes the dome look more rounded. Our brains are programmed to look at a dome-shaped roof and not see the flat portions, but visualise it as a three-dimensional curve. In the case of Green Point Park's Dome, what you see is what it actually is. This massive jump in engineering shows that it can be done – the reason why it has attracted worldwide attention.

to the Khoi's nomadic lifestyle, as they could be disassembled and carried when the tribe moved on in search of new grazing.

The initial designs of the Dome were drawn up by senior architect Ashley Hemraj and candidate architect Thaufir Davids, both from Urban Planning and Design. In partnership with Strategic Assets, the total project budget of around R9 million was approved, planning began, and the first sod was turned in early 2020. As with many other projects, Covid-19 set back the Dome's completion date, but the result has been well worth the wait.

## A fistful of construction firsts

The Dome is an ingenious example of eco-conscious and environmentally sustainable construction, and represents an impressive list of firsts that have attracted global attention.

In South Africa, it is the first mass-timber dome ever built. Mass timber is the newest and greenest system of carbon-conscious construction. It refers to engineered wood products made by taking smaller wood elements and connecting them with glues, dowels, nails or screws to create larger building components. It is, essentially, lamination on steroids, and is strong, durable, versatile and sustainable.

Globally, the Dome is the first mass-timber structure made of three-dimensional ply, the first three-dimensional mass-timber dome ever built, and the first ever to use curved steel plates to form a perfect three-dimensional roof, designed with hand-drawn geometry not used for more than 60 years.

## Proud of our local pioneers

Achieving those impressive results came with many challenges along the way. Lindie was supported by a core team that included Urban Planning and Design's Construction Management head Fabio Companie, project manager Leon Poleman, assistant professional officer Mikhail Adams from Urban Development Implementation, and professional officer Siyabonga Ndondo, who is now a project manager in Community Services and Health.

It is a point of great pride to all involved that local companies, without compromise, created what at first was deemed impossible. (See also "Look, Ma, no handbook!" alongside.) There were numerous stakeholders involved, but the woodworking and hands-on wizards were from subcontractor MEWA. This family business, which is based in Darling and dates back three generations, specialises in curved-metal and mass-timber products. The architect, Derek Kock, had used modelling software to create a 3D model of his plan. Entsha, the construction contractor, knew that if anyone could meet the obvious challenges, it would be MEWA's David Marks. It was a series of decisions that inspired a truly pioneering use of wood in South Africa.

When Lindie met David, he told her he did not think anyone could do it. She threw down the gauntlet. "The 3D modelling showed what I had envisaged," says Lindie. "David rose to the challenge and created a masterpiece of engineering." (See "No trick of the mind" alongside.)



**A visionary team:** Mikhail Adams (assistant professional officer in Urban Development Implementation), Paul Arends (facility manager in Urban Planning and Design), Lindie Buirski (acting manager of Environmental Management's Planning and Sustainability), Fabio Companie (Urban Planning and Design's head of Construction Management) and Ashley Hemraj (senior architect from Urban Planning and Design).



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## Doughnut keeps skeleton together

The construction began with foundations and the circular polished screed floor. Back in Darling, MEWA was making the structural elements to be assembled on-site. Twenty massive, glue-laminated, curved poplar beams, each 8,5 m long and weighing 450 kg, form the 'skeleton'. They were secured at the top by a 'doughnut' upper ring. This massive timber ring, with its huge dovetail joints, is a work of outstanding craftsmanship. It is 40 cm high and 1,5 m in diameter, and built from 20 angled segments that have been cross-laminated many times, making it stronger than steel.

Sixteen circular ring beams were crafted to fit over the skeleton, each beam having a different diameter and set of angles as they rose higher and became smaller.

## Maths made it happen

Next came the task of bending marine plywood for the panels in three directions. Bending ply in two directions is easy, but three needed some brilliance. It all came down to serious old-fashioned maths, meshing three different formula calculations into one.

Initially, the roof was not part of David's brief. However, he was so fascinated by the maths, he did the calculations anyway. While the ply layer was being completed, the consulting engineers discovered that the roof was much more complicated than it looked. The reality of building a symmetrical and smooth domed roof that looked like randomly placed reed matjies proved challenging. David submitted his calculations for comment and got the go-ahead.

Achieving the perfect curve, David says, was again pure mathematics. He used spherical geometry, a technique originally used to map the Earth's surface before the time of aerial photography. Not even 3D software was up to the task, so using a book from his grandfather's library, he drew the precise roof plan by hand.

## Roof, waterproof, with a cherry on top

The roof sheeting is locally made 3CR12, a stainless-steel compound. It needed to be pressed to the Dome's curvature and laid in perfect concentric rings that overlapped at the top and bottom, but not the sides.

The entire structure was then given three coats of top-quality waterproofing paint before the final layer of panels was attached. To achieve the weathered look, the outer sheets were finished with paint in different shades of brown. This 'patchwork' appearance mimics the varied colours of a Khoi hut, which change over time as different sections are replaced with new matjies.

The building features six double glass doors, also made of mass timber, the frames of which needed to be angled 90° towards the Dome's centre to accommodate the wall so that they could be perfectly square.

The final exterior building milestone was reached in March, when a circular metal ventilation vent and a two-metre-wide, curved, moulded-glass skylight weighing 144 kg were placed on top of the apex 'doughnut'. It is the proverbial cherry on the top.

## Honouring ancient ancestry

Inside the Dome, the ceiling is covered in Khoi reed matjies. Wall-mounted information panels depict the culture and history of the Khoi peoples, as well as the innovative methods used to create the structure. One of the panels features several artefacts uncovered during the excavation of the site, including ship ballast bricks, glass bottles, a kettle, porcelain shards, metal pegs and an anchor joint. An exquisite 9,5 m mass timber light that spirals down from the top of the roof was also created by MEWA. To provide the perfect finishing touch, a vibrant circular mosaic depicting a cooking fire is installed in the centre of the floor.

The intensive public participation process has ensured the involvement of members of the many different Khoi tribes from the beginning. A core group of seven



# e of brilliance

history. The Khoi hut-inspired building represents extraordinary ring of sustainable and carbon-conscious wood construction.



nominated members will help develop the Khoi exhibition panels, information booklet, lesson plans and activities. About 15 Khoi members will be trained to become independent tour guides, who can use their knowledge to bring visitors to the centre. This learnership will be funded through the national skills development levy. Before construction began, the Khoi held a ritual cleansing ceremony, and it is hoped that on 9 August 2025, International Day of the World's Indigenous People, they will have the opportunity to hold a cultural celebration at the Dome.

Lindie says this opportunity to showcase the history and culture of the Khoi peoples is an important one. South Africa has two First Nation groups – the Bushmen (San) and the Khoi – and the distinction between them has become muddled. The commonly used 'Khoisan' is a catch-all term for the indigenous peoples of Southern Africa who traditionally speak non-Bantu languages. The San were hunter-gatherers, but the Khoi were pastoralists who lived in the fertile areas around

Table Bay. Their specific cultural story has remained largely untold.

### Step into our humble Dome

The Dome can accommodate groups of up to 60 people for booked education and training programmes run by both the City and its various partners. It will also be used for appropriate functions, workshops and events. On weekends, the doors will be open from sunrise to sunset for visitors to wander through for some welcome shade while inspecting the information boards. As the 'mother dome', this unique building also complements the smaller, life-size 'Khoi matjies' huts installation in the Biodiversity Showcase Garden.

The completed Dome, in all its glory, not only honours history, but has made history. It is a fine tribute to Lindie and the team, and stands as a perfect example of the City's innovation and commitment to creating benefits for both residents and the economy of Cape Town.

### A green delight of discovery

The second phase of the Experiential Education Garden (EEG), which surrounds the central Dome Education Centre, is a marvel of discovery and exploration.

Textured walkways, a mosaic hopscotch pad, crawling tunnel, climbing tree and sandpit enable youngsters to physically immerse themselves in nature's textures while learning about our fauna and flora. Giant woven nests invite children to climb up, around and into them, teaching the little ones how and why birds build their homes the way they do. A spider's web climbing structure demonstrates the different shapes of webs, and their extraordinary strength.

The garden contains a variety of indigenous edible, medicinal and fragrant plants, encouraging visitors to hear, feel and smell as they learn about the plants' various uses and their growing conditions. At the spring-fed water feature, children can have fun splashing around and find out more about the history and importance of water in the Cape, as well as basic maths and science concepts.

The entire EEG is dotted with pergolas for shade, benches, wooden animal sculpture seating, beaded animals and mosaic stepping-stones, making every turn a new delight.

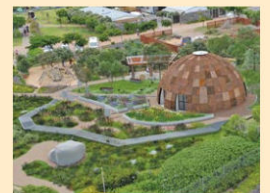
This exciting new space complements the many features that Green Point Park already offers, including the Biodiversity Showcase Garden, outdoor labyrinth, adventure play park, wetland garden and its various water features, open lawn areas and shaded spaces. It raises the value of this exceptional asset, which attracts more than a million visitors every year, even further.



1994: Where it all started ... at the Huguenot Memorial Museum in Franschhoek.



2010: Reconstruction of Khoi matjies hut structures in the Biodiversity Showcase Garden in Green Point Park.



November 2021: The Dome's final architectural design.



June 2023: First Nations cleansing ceremony.



2023: Skeleton of curved beams constructed to form roof.



2024: Construction of first outer layer.



June 2024: The completed Dome roof.



July 2024: The Dome in use.

## Look, Ma, no handbook!

South Africans have always been masters of innovation. So much of this was evident in the building of the Dome Education Centre. Few of the solutions followed any known handbook or existing design, but they worked. Pretty much like this amazing building itself!

- **Beam me up:** Unsurprisingly, the first question asked by the professional team was: "How do you keep 20 curved upright beams in place while attaching them to a central ring?" The short answer was to build a tower in the middle of the structure to support the beams first. Like an old-fashioned wagon wheel, that solid hub at the centre was paramount.
- **Timber is tricky:** What emerged quickly was how little even highly skilled professionals understood about timber and its moods, abilities and strengths. Dr Phillip Crawford from Stellenbosch University tested local white poplar (*Populus alba*),

which is dense and hard-wearing, naturally pest-resistant, and is sustainably sourced in South Africa. Wood is considered the only structural material that naturally and significantly decarbonises our planet, both through the growing of trees and harvesting them at the right time.

- **A safety solution:** At six metres high, safe working access to the Dome was yet another challenge. South African health and safety regulations do not address the issue of curved structures, and straight vertical ladders fell short. After considering anchored top ropes, mountaineering harnesses and helmets, City officials vetoed the idea as too dangerous. The brilliant solution was to build a curved steel ladder that was the exact shape of the Dome. It was anchored on the upper ring, with wheels below to push it around. Each tread was carefully angled parallel to the ground, and the handrails became higher as a worker moved upwards from a climbing angle to a walking one.