



# THE HOUSE THAT BERNELLE BUILT

A beautiful timber house, perched atop a hill, is an integral reflection of its owner's passion for water and nature. The house, which has a nautical feel, cascades down the steep site like falling water.

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**T**he choice of site for bioprocess engineer Bernelle Verster's new house was guided by the position of the toilet. This serendipitously led her to a location on the steep slopes of the Muizenberg mountains, overlooking the Zandvlei lagoon in Cape Town's Lakeside area.

Verster decided to install a dry toilet that would not be connected to the municipal sewerage system, and designed the bathroom at the lowest point of the house. "The slope of the site means you can gravity-flow your grey water [from shower and basin], and design irrigation to work with the slope. The bathroom [and toilet] is at the bottom of the house and thus the house is connected to the land by the water," she says.

### THE WATER MAVERICK

Verster, who initially trained as a biochemist, says she was always interested in the idea of starting a biotech business, which explores applying a combination of technology and biological knowledge to systems to solve problems and create new products. Her decade-long journey to becoming a specialist in water and sanitation culminated in a PhD, working with professor Sue Harrison of the Centre for Bioprocess Engineering Research (CEBER) at the University

of Cape Town, which investigated the possibility of harnessing human waste as a resource.

Sewage is a complex waste product, Verster explains, because it is unpredictable and its contents vary all the time. "Combined with the taboo of dealing with your own waste, thinking about sewage as a resource is a field of study that has been neglected over the years."

She explains that on the Cape Peninsula alone, approximately 55million litres of untreated sewage (enough to fill 22 Olympic-sized swimming pools) on average is being legally pumped offshore from Green Point, Camps Bay and Hout Bay every day. If sewage can be viewed as a resource, new opportunities for innovation that contribute to the regeneration of the natural environment can be created. Simply by changing the way sewage systems are conceptualised and constructed, water pollution can be addressed at

### NUTSHELL

**Location** • Lakeside, Cape Town

**Site area** • 580m<sup>2</sup>

**House area** • 89m<sup>2</sup> over four levels

**Total Budget** • Approximately R2.5 million (including land R720 000)

**Construction start** • September 2015

**Foundations, concrete garage and bathroom floor** • Three months (October – December 2015)

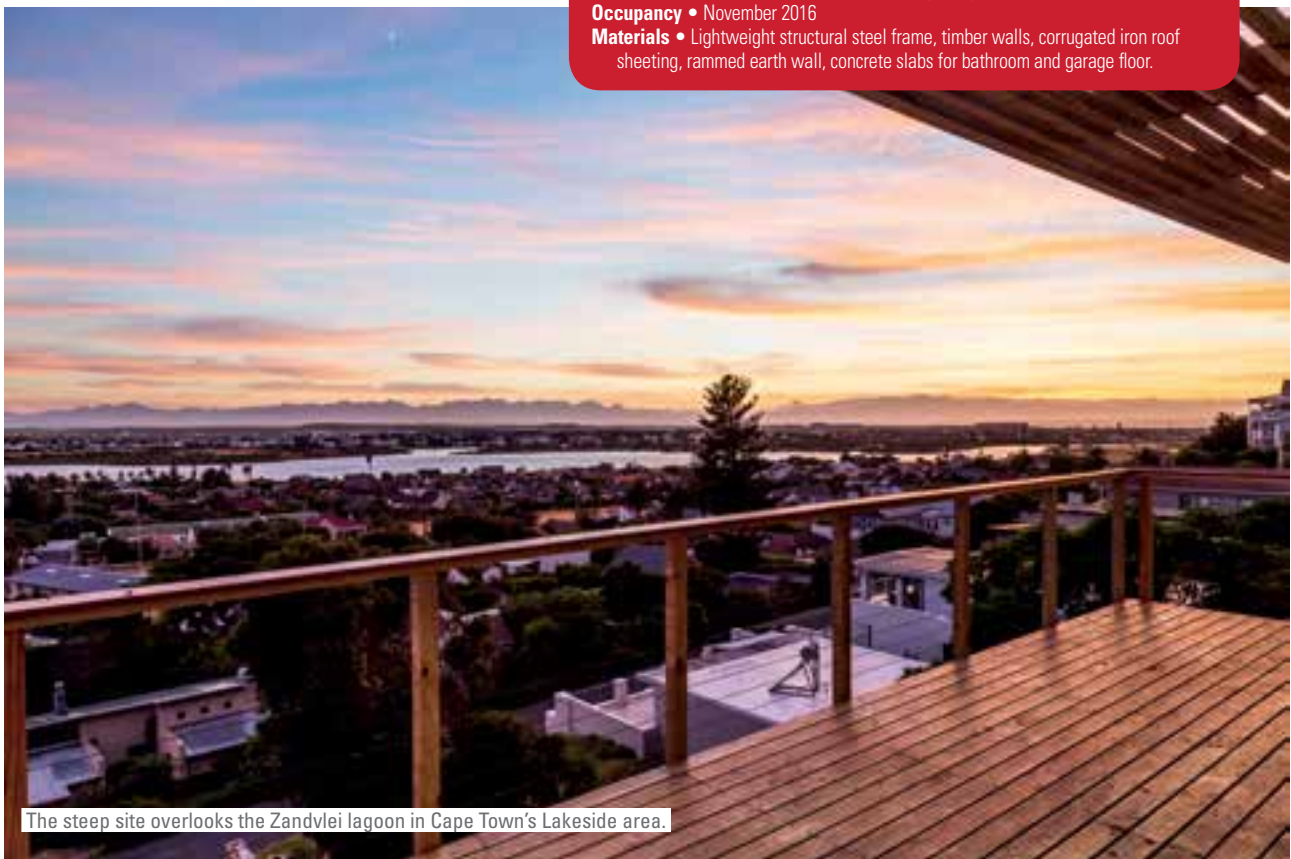
**Steel frame construction** • One day (24 February 2016)

**Timber frame construction and infill** • Two months (early March – early May 2016)

**Rammed earth construction** • 7 weeks (May - July 2016)

**Occupancy** • November 2016

**Materials** • Lightweight structural steel frame, timber walls, corrugated iron roof sheeting, rammed earth wall, concrete slabs for bathroom and garage floor.



The steep site overlooks the Zandvlei lagoon in Cape Town's Lakeside area.



The house was conceived as a series of staggered levels flowing down the site. The south facade is clad with Nutec board and corrugated sheeting, painted navy blue, lending the house a nautical feel.

its source. “It’s only when we understand where our waste goes and how it does [or doesn’t] get treated that we can deal with the consequences, and change them for the better. Furthermore, decentralising our waste water treatment systems might mean that it gets treated in our own backyards, or on a neighbourhood level, rather than somewhere far away,” says Verster.

During the Dutch competition Moola for Amanzi that Verster organised in 2011 (conceptualised to coincide with World Water Day), the Dutch consul general nicknamed her the “Water Maverick”. And she is indeed a maverick. As part of her PhD research, Verster experimented at the Athlone sewerage works by diverting a stream of raw sewage and passing it through her own reactors. “I learnt so much from that and realised that I needed my own place where I could ‘play’ with this complex product. With a limited budget, the only place I could do that

was at home. So I sold my old house so that I could custom-design a new one.”

## LIKE FALLING WATER

Her definitive decision to place the toilet at the bottom of the site guided the design concept for a house that “flows” with the fall of the site and is thus deeply embedded in its natural context. House designer Jacques Cronje, of Jacques Cronje Timber Design, explains that as well as the flat portion of the site being relatively small, they wanted to keep the footprint of the house as small as possible for Verster to establish her carefully conceptualised garden. Thus the house has four levels that are connected internally by half flights of stairs.

Most of the house is situated below street level except for the double garage, which is directly accessible from the road and is intended to be part of the “laboratory” for some of Verster’s experiments. Down a timber staircase, the front door opens into a large double volume living area with expansive views over the lagoon and False Bay to the east. From here, steps lead up to a partially enclosed mezzanine bedroom level, and down to a study on the south side, and finally to the lowest level of the house – the bathroom.

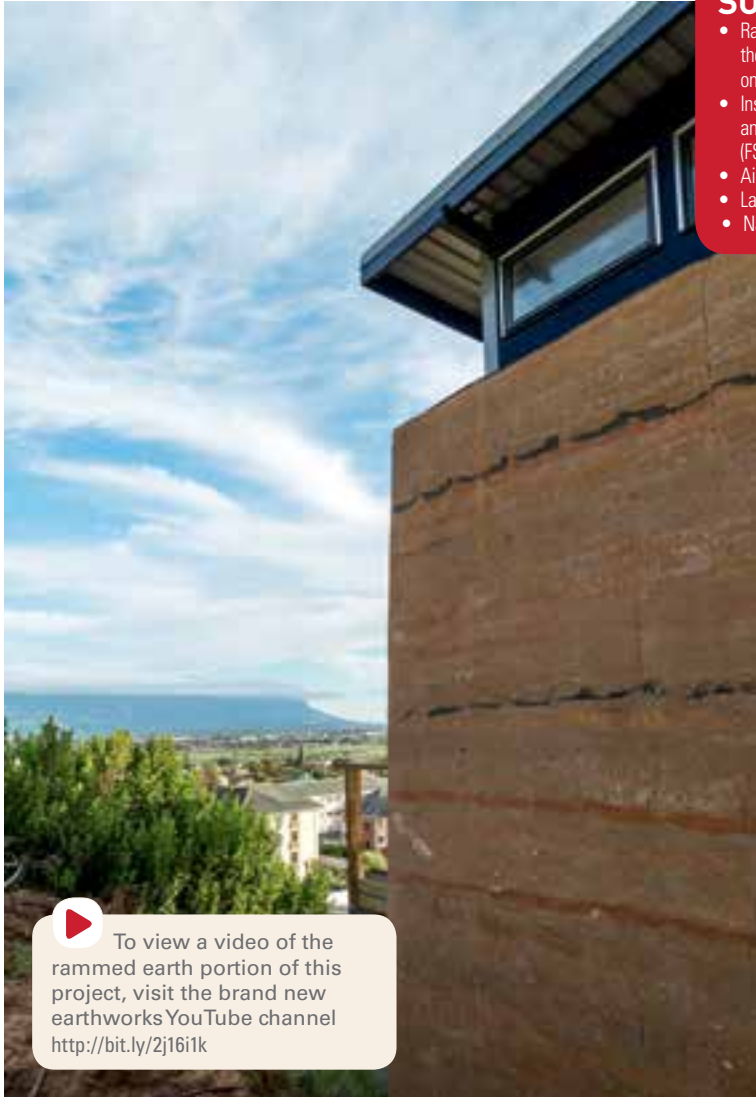
“The spatial arrangement of the house is like a journey, not a single destination. It was conceived as a series of staggered levels cascading down the site. Whereas in modernism the floor plan was seen as the ‘generator’, i.e. one first got the plan right and everything else followed from that, [for this house] the section is the ‘generator,’” says Cronje.

He explains that volumetrically, the varying ceiling heights and different sizes of each space create a sense of spaciousness in what is otherwise a small house.

## A MATERIAL CONNECTION

Materially, the house is a hybrid structure, combining a lightweight structural steel portal frame, a timber infill frame (floor joists and wall structure), timber and corrugated sheeting for wall cladding, and a corrugated iron roof. A six-metre-high tapered rammed earth wall forms a striking feature on the west side of the house. The layered earthy tones of the red-brown wall contrast with the industrial feel of the steel. The south wall, which is clad with Nutec board and corrugated sheeting, was painted navy blue, lending the house a nautical feel that unites it with its location on the edge of the bay.

“The hybrid design allows the advantages of each material to contribute to the internal comfort



To view a video of the rammed earth portion of this project, visit the brand new earthworks YouTube channel <http://bit.ly/2j16i1k>

## SUSTAINABILITY FEATURES:

- Rammed earth wall with high thermal properties using soil found on-site
- Insulated timber walls from locally and sustainably sourced SA pine (FSC certified)
- Airtight space
- Large overhangs – pergolas and roof
- Natural cross ventilation
- Locally manufactured double-glazed windows
- Dry toilet
- Greywater feeds directly into garden irrigation
- Solar geyser
- Rainwater tank
- Indigenous plants in garden
- LED lights in the house

mean the structure can be constructed off-site and installed on-site relatively quickly.

## A TEMPERATE ENVIRONMENT

A timber structure has a low mass but the cavity between the framing can be filled to make it a highly insulated material, which prevents hot or cold air from entering, Cronje explains. Therefore, in a building like this, what you are essentially heating or cooling is the indoor air, which is quicker to heat than an “object”. The thick rammed earth wall, on the other hand, has a high mass, which allows it to act as a temperature moderator by absorbing thermal energy when temperatures are high, and emitting thermal energy when temperatures are low. The wall absorbs the heat of the afternoon sun on the west side of the house. “Often the preferable solution is a combination of both highly insulated low mass and high mass elements in order to deal with fluctuating temperatures,” says Cronje.

The rammed earth wall tapers on the outside face from 950mm thick at the bottom to 400mm at the top, explains rammed earth specialist and

of the building as well as creating an interesting aesthetic that doesn’t conform to any specific architectural language but instead creates one of its own,” says Cronje.

The choice of materials also demonstrates a sustainable approach to building. Cronje says they used locally and sustainably sourced South African pine. Timber has many advantages over conventional building materials. It is a renewable resource and there is less impact on site, which makes it “cleaner, quicker to build with, and less intrusive to the earth, plus there is less rubble and waste”, he says. Timber also comes in standard sizes from sawmills and suppliers, which means the design and form that a timber structure takes is more modular in nature in comparison to concrete - which is more “plastic” in its ability to take on irregular shapes. Linings used, such as gypsum board and fibre cement panels, also come in standard size increments so similar thinking is applied to the walls. These timber characteristics



Locally and sustainably sourced South African pine was used throughout the house.

1. There is a simple and honest visual expression of materials - here the steel structure is exposed above the kitchen.
2. The six-metre high rammed earth wall forms a striking feature on the west side of the house and adds an earthy warmth to the interior.
3. A koi pond will form the edge of the Zen garden.
4. Drums for bioprocessing the waste.
5. Verster's choice of striking colours and natural materials create a unique contemporary style in an unconventional bathroom.



architect, Paul Marais. Earth from the site was tested in varying mixes of clay, soil and lime – for stabilisation – until the appropriate mix was found. The resulting mix has 4% lime. “Combining the clay and lime forms a very strong bond,” says Marais. “The clay is supporting the soil and the lime prevents the soil being washed out by water, thus making it waterproof.” The wall is constructed by stamping down 10cm layers of soil at a time. A pneumatic rammer was used to compress the earth as the speed and consistency achieved is greater than hand ramming. Each layer has a slightly different colour created by using different types of soil from the site and occasionally adding natural oxide to the mix. The completed wall consists of 75 stamped layers. “We are not just building a wall but a work of art,” Marais says.

The house also has double-glazed windows, which help to insulate the space, keeping it cooler in summer and warmer in winter. Other passive design

features, such as roof overhangs, play an important role in temperature control by blocking out the harsh sun. A strip of clerestory windows atop the rammed earth wall, just below the roof, allow natural ventilation through the double volume living space by pulling hot air up and out through the windows.

### A SIMPLE LIFESTYLE

Design aesthetics inside the house are a reflection of Verster's uncluttered lifestyle. Like her decision to have a dry toilet in order to bring back the connection between the source and final destination of our waste, she has little storage space in her house, which she says forces her to connect with the consequences of owning too many belongings that never get used.

Inside the house, the timber walls are covered with a light wash. Throughout, there is a simple and “honest” visual expression of the materials from which the house is made.



The dry toilet is connected to a drum that can be emptied out once the waste has dried and reduced in volume. Sawdust helps to absorb moisture thus aiding the drying process.



### THE LIVING LABORATORY

Verster has big plans for her mostly indigenous garden, part of which will include a series of wetlands for her “living laboratory”.

The dry toilet, which will contribute the substrate for the bioprocessing of solid wastes in her wetland laboratory, is connected to a small drum that can be emptied out once the waste has dried and reduced in volume. The drum is ventilated so that the waste dries, and there is virtually no smell when it’s been installed properly, she says. The drum is emptied out approximately once a month, into bigger drums below the house, from where she will conduct experiments. “I want to discover what will grow in it, how it grows, and how it removes the nutrients. Once stabilised, the waste will become compost for the garden.

“I want to see if I can grow mushrooms – normal button mushrooms grow on cow manure – to extract industrial enzymes, organic acids and see how those can contribute to the non-food industry, for example paint additives.”

Near the entrance, a terraced vegetable and herb garden steps down from the street towards the house. On the north side a future wetland area is inspired by the formal geometric layout of the Spanish Alhambra Gardens, although using indigenous plants. The wetland will consist of a series of isolated water units connected to an irrigation channel. The other areas of the garden

will include a formal Zen garden with indigenous plants that mimic small Japanese flowers, a “secret garden” with a bench that surreptitiously covers a manhole, a forested area and “the sticks”, where low-maintenance vegetables will be grown. It is fitting that with this abundant vision, she has named her house and garden *jouissance*, a French concept that embodies delight, pleasure and abundance.

### THRIVING, NOT SURVIVING

Despite Verster’s passion for water and her dynamic vision for her garden, the house itself is a beautiful sculpture that bears testament to renewable materials and reflects the essence of the site with its nautical presence and flowing form. Its connection with the sea, the earth and the sky embodies the message of thriving and not just surviving. This, is the essence of intelligent sustainable living. ☉

### SOURCEBOOK

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