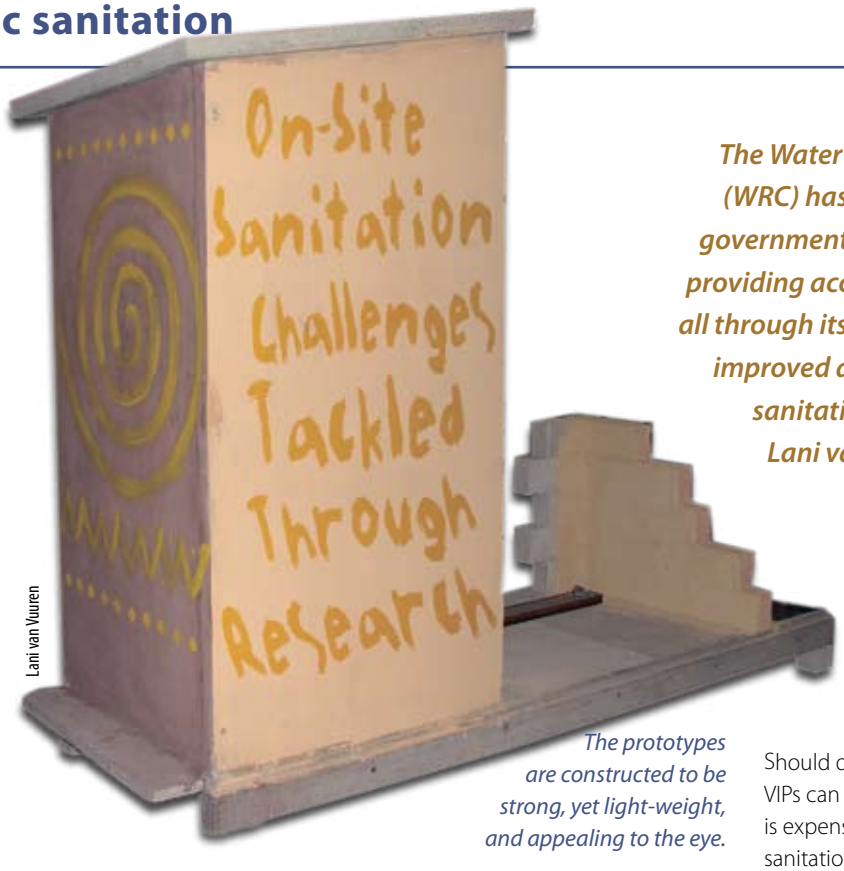

Lani van Vuuren

The prototypes are constructed to be strong, yet light-weight, and appealing to the eye.

The Water Research Commission (WRC) has put its weight behind government's commitment towards providing access to safe sanitation for all through its support for research into improved and sustainable on-site sanitation superstructures. Lani van Vuuren reports.

The latest statistics reveal that at least 6,5% of South Africa's population of 48 million people make use of on-site sanitation systems such as ventilated improved pit (VIP) toilets. Municipalities, who are now responsible for providing basic services, are increasingly rolling out these on-site sanitation systems, especially in rural areas. It is expected that in meeting the national sanitation target of 2010, it is expected that more than three million VIPs will be built.

It is reported that on-site dry sanitation technologies are able to provide long-term, safe and dignified sanitation to users. While VIPs are considered an appropriate basic sanitation technology choice, their lifespan is decidedly short term, with pits filling up after only a few years of use. This means that either the pit needs to be emptied or a new pit has to be dug. Compounding this situation is the fact that VIP superstructure construction as proposed by guidelines offer no easy access to the pit other than through the pedestal.

"Many VIP latrines have been built with permanent superstructures. Pits are filling up much faster than their design life," explains WRC Director: Water Use & Waste Management Jay Bhagwan. "Then, there is conflicting advice on what should be put into pits to keep them operating well. Unfortunately, a variety of undesirable non-degradable objects are usually found in full pits which may complicate pit emptying exercises."

"Pit emptying is not only extremely hazardous because of the harmful contents, it is also expensive."

Bhagwan explains that there is a tendency to use pits for the disposal of household waste, much of which is non-biodegradable. In addition, despite education and awareness programmes which strongly advise against this, many users are in the habit of dosing their pits with disinfectants to reduce odours and poisons such as sheep dip to reduce fly breeding.

"At the rate of current supply, this means that millions of pits will either be full or filling up in the next few years. Pit emptying is not cheap and easy. Research undertaken by municipalities such as eThekwini reveals that emptying one VIP could cost as much as R1 150," notes Bhagwan.

Should desludging prove difficult, new VIPs can be constructed. However, this is expensive and contributes to the sanitation backlog. The alternative is to construct a new pit and move the superstructure. The implications of these developments are profound, and will have a huge impact on the sustainability of the technology and sanitation in general. In many cases, moving the superstructure is not possible, due to the nature of the materials being used to construct the VIP (i.e. a conventional brick and mortar superstructure can weigh 1,5 tons). Critical skills shortages also make it difficult for communities to construct their own toilets, with sustainability often hampered by the use of sub-standard products and shoddy workmanship.

VARIETY OF SYSTEMS

In response to these challenges, the WRC is supporting research by the University of Pretoria (UP) in the development of alternative materials for the construction of superstructures for on-site sanitation systems. The aim is to create a light-weight superstructure which can either be moved by the household or disassembled easily and the material reused to build another structure, explains Elsabe Kearsley, Associate Professor at UP's School of Civil and Biosystems Engineering, who is leading the research. The superstructure

will be applicable to either VIPs or urine-diversion (UD) systems.

Community buy-in and acceptance is a crucial aspect of the project. "The technology of a latrine is just one aspect of design. If it is intended that the latrine be widely accepted and desired by people, then it must be liked," explains Kearsley.

Therefore the choice of material becomes very important. The project team found that there are various systems available in South Africa for the construction of the superstructure of toilets. These systems can be divided into two main groups, mainly the lightweight systems that can be moved (for example, pre-cast plastic and/or fibreglass) and systems that cannot be moved, but the material may be reusable in the construction of a new superstructure (for example, Archloo, compressed stabilised earth blocks). It has been found that the only way of improving the systems already in existence would be to reduce the volume of material used by the toilet superstructure.

The systems with the largest community involvement are those where the bricks and slabs are manufactured by the community. Unfortunately, these systems are also prone to failure as a result of traditional lack of quality control. The systems that seem to work best are the pre-manufactured systems that are just assembled on site.

ALTERNATIVE MATERIALS

The UP project team has set out to create an alternative superstructure meeting the following criteria:

- The superstructure should be usable for different types of sanitation systems (including VIP and UD toilets);
- The slab should be manufactured to allow access to the pit other than through the pedestal;
- The superstructure has to be moveable;
- The superstructure must be adjustable to allow changes in layout (i.e. to accommodate a disabled person or a patient that requires assistance);
- The local community must benefit financially from the construction process;
- The superstructure has to be durable and aesthetically acceptable; and
- The risk of failure of critical components has to be limited.

Two types of systems are being investigated at present: a system that can be dismantled, and another system which uses foam concrete blocks that can be reused if the structured is moved. The volume of material used is being reduced by using very high-strength concrete in the panels and entrapping large volumes of air (more than 50% of the volumes) into the blocks.

Tests are being conducted on all the full-scale structures to ensure that they can withstand the forces that they will be subjected to during a typical lifespan without undue distortion or distress. These forces include wind loads, impact loads, loads from people or sharp-edged objects colliding with walls, door slamming and localised loads caused by various fittings.

FIRST PROTOTYPES

While the project team is only one year into the three-year project, the first prototypes have already been manufactured. The first toilet was completed using high-strength concrete panels

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UP concrete technologist Derek Mostert demonstrates the ease of casting foam bricks.

Lani van Vuuren

One year into a three-year project the UP project team has come up with a number of VIP prototypes using alternative materials, such as light-weigh foam bricks.

varying in thickness between 16 mm and 20 mm. The superstructure weighs only 450 kg.

"The technology of a latrine is just one aspect of design. If it is intended that the latrine be widely accepted and desired by people, then it must be liked."

The panels can be manufactured in a factory and transported to site where local labour can be used to construct the units. Alternatively rural communities can be provided with bags of blended material that can be mixed with a small mixer and cast into moulds without vibration. "By training rural builders and setting them up with basic equipment and moulds, it should be possible for rural communities to make their own pre-cast panels. These builders could operate in a type of franchise system where they do not have to pay for the materials and equipment upfront."

A second superstructure prototype has been constructed using lightweight foam concrete blocks. The blocks are 140 mm high, 90 mm thick and 300 mm long. They are stacked dry thus requiring no skills normally associated with constructing masonry walls. Because of the reduced weight the blocks are easily handled by, for example, female builders, and the size of the blocks can be adjusted to suit the application. This version weighs only 300 kg, still much lighter than its brick-and-mortar cousin.

To ensure that the walls are not blown over in storms, the blocks are manufactured with holes in the core, through which a steel bar is placed to tie the roof to the floor slab. After the blocks have been placed, a polypropylene net or carpet backing can be placed over the surface to strengthen it further. "If this system is used for a moveable superstructure, the net can be pulled off the surface, the bricks can be re-used and a new layer of net and sprayed concrete can be applied within a day," says Kearsley.

A modular floor slab has also been designed to allow for easier access to the pit. The floor panels can be adjusted to suit individual requirements for emptying of the pit as well as variations in superstructure layout.

More prototypes are being constructed to further improve the design and materials. In all of the cases the price of material is equivalent to the price of a conventional superstructure. It is hoped to eventually launch a pilot scheme in which one of various new superstructures can be evaluated and community input received.

Kathy Eales

Government is increasingly rolling out VIP toilets in an effort to reach its sanitation targets.