



A South African housing innovation

Tony Stone, a little sceptical, investigated this low-cost housing innovation and came away pleasantly surprised and totally persuaded.



HENNIE BOTES IS ONE of those unique individuals who is not only capable of 'blue sky' thinking but is also able to take his ideas and translate them into reality. A fitter and turner by trade and an experienced plastic injection mould dye maker, Botes established moladi in 1986 after one of those truly 'eureka' moments. Since then, his company has developed into a black economic empowerment and low-cost housing construction company that addresses the basic needs of the poor by providing SABS-approved quality housing that is not only durable but far more affordable than traditional construction methods, and, in the editor's opinion, ultimately far better quality.

Sense of social responsibility

Botes has an innate sense of social responsibility. His Christian-based philosophy builds

on the principle, "As you climb the ladder of life, reach down and help the next person up". Not only has he developed a sustainable low-cost housing solution but he has simultaneously developed, through this solution, the means to up-skill and economically empower members of poorer communities. In addition - and he is quite right given the vast numbers of poorly educated people in South Africa - the opportunity for creating "sweat equity" is also a great incentive for building one's own home. For many people this is the only equity they can muster. Communities that are building their own homes, good homes, do so in a state of excitement and eagerness. It gives them a sense of fulfilment, bringing peace and stability to the community.

Production principle

With quality and affordability in mind, Botes takes a leaf from another great product and productivity innovator of our time - Henry Ford. As in motor vehicle production, he applies the principle of a 'production line' to the construction of homes, where efficient, cost-effective production is achieved by simplifying the process of assembly through industrialisation, modularisations, standardisation and continuous flow processes. But, and perhaps more importantly, given South Africa's unemployment problems, while Moladi's approach achieves all of this, it also retains the human labour component.

It does so by:

- reducing the number of process steps and components required to produce the end product - this means less chance of errors occurring, of waste being generated, of rework or repairs being needed, or of time being lost

- applying the highest quality standards in raw material sourcing, cost optimisation through bulk buying and a disciplined approach to the construction method, and the cost of the entire housing delivery process is lowered without it negatively compromising the end product quality or the social acceptability of the structure
- addressing the six key challenges embodied in the affordable housing shortages, which all developing countries face - the lack of resources, insufficient funds, the shortage of skills, time constraints, work flow control and waste reduction.

Using moladi's technology and methods, we overcome the barrier between industry and the fundamental human need for a valued home.

The 'how' of it all

How does it all work? Quite simply in fact! Botes has developed an ingenious lightweight, reusable, patented injection moulded formwork system that is quickly and easily installed, and which overcomes many of the production and quality inefficiencies associated with traditional timber or steel formwork.

The moladi formwork is lightweight and robust, weighing 8kg/m for easy transportation and speedy assembly. Each precision-made component is fully interlocking and any dimensional adjustments to the desired structure can be made with little effort. Each modular component is produced to the highest quality and precision standards. This enables quick assembly into easy-to-handle panels that are configured into a mould of the desired structure. These panels are joined to form wall configurations of any desired length and height with a wall cavity of either 100mm or 150mm. Once the assembly of the panels is complete, it does not need to be repeated. The formwork panels can be reused 50 times - making the technology cost-effective owing to its repetitive application scheme, which reduces the



OPPOSITE Hennie Botes, SA innovator
RIGHT Demonstration formwork with reinforcing, pipes, conduits and roof tie in place ready for the pour.

RIGHT BELOW The finished demonstration product – quick as a whistle, solid as a rock. Toilets, taps and electrical fittings are quickly and easily fitted

cost of construction and transportation significantly. The steel reinforcing, window and door block-outs, conduits and other fittings are positioned prior to the wall cavity being filled with the mortar mix. The result is a wall with a smooth off-shutter finish that does not require any plastering, beam filling or chasing. Once the preassembled formwork panels have been removed, they can be immediately re-erected on an adjoining site to be used on a repetitive basis – again saving valuable time in the construction process.

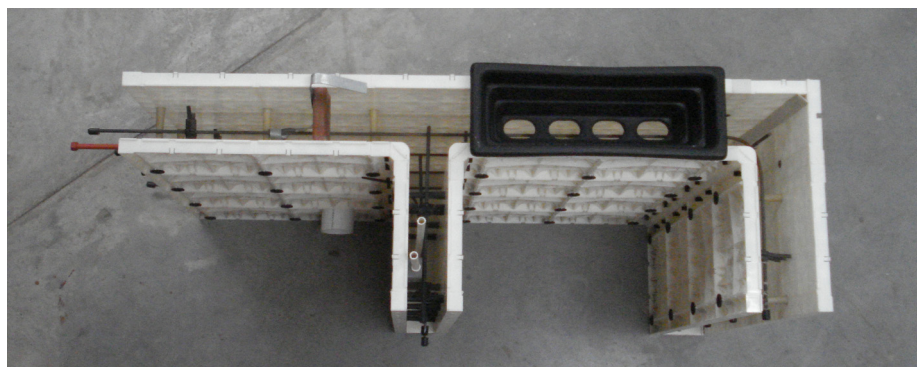
The mortar that is used to fill the wall cavity is essentially concrete without stone. The mix design of the mortar is specifically determined by laboratory tests that are carried out on local sand or aggregate to ensure that quality standards are adhered to. The density of the mortar will vary depending on the sieve grading of the sand used, but will range between 1 600 to 1 800 kg/m³. The mortar mixture produces a fast curing aerated mortar that flows easily, is waterproof and possesses good thermal and sound insulating properties.

One generic cubic metre of mortar typically consists of:

- 1 800 kg or 0.720 m³ of local decomposed granite/river sand
- 250 kg of ordinary Portland cement (OPC)
- 5 l of moladiCHEM, a non-toxic, water-based chemical cocktail
- 200 l of water

Please note: The above mix is a generic site mix ratio, which will have to be verified with trial mixes at the site mixing plant. The application of moladiCHEM is 1 l per 50 kg of cement. At the start of each project, cube tests are to be carried out. These tests determine the compressive strength of the mix design specific to each project.

Fly ash can be used as an extender to substitute the use of cement in order to reduce the volume of cement. However, it will still achieve the same ultimate compressive mPa strength where typically a compressive strength of between 10 and 30 mPa can be achieved in a 28-day period, depending on the cement to water ratio. Under normal



conditions the mortar usually sets during the night (12 to 15 hours) and the formwork is removed the following morning. There is no need to vibrate the mortar in order to achieve a smooth finish.

All assembled structures have steel reinforced internal and external walls. The reinforcing design is specified by an independent, certified structural engineer, according to the requirements of the structure, which is dependant on soil conditions such as clay, expanding soils, collapsing soils, dolomite etc. The engineer would also take into account the possibility of earth tremors, quakes or hurricanes. Because the structures are uniformly cast, with the reinforcing placed in strategic positions, the building is more resistant to seismic movement.

All the electrical and water piping is positioned onto the formwork prior to the location onto the formwork and cast in situ.

Local unskilled labourers are trained by a moladi foreman on site. The duration of the training process usually takes between one and two weeks, depending on the size of the units to be constructed. All the procedures and phases of the construction process are followed through and explained thoroughly. Working documents and assembly instructions, which are compiled for a specific

construction site, are supplied. After training has been completed, all trainees are graded by the foreman. Certificates are awarded for the completion of the training programme.

In summary, the moladi system is a comprehensive system that is entirely boltless, freestanding, and does not require the need for struts or bracing. It brings to the field (of construction) all the benefits of a factory assembly line – quality assured work by unskilled labourers at a maximum rate of production with a high production output capacity. The technology is versatile in that it is easily adaptable to the specified design requirements and is suitable for all types of buildings, yet highly suited for use in repetitive housing schemes. It also alleviates many of the logistical problems facing the construction of affordable repetitive housing projects. By utilising indigenous materials, the benefits of the technology are spread to and throughout local communities. Finally, the advantages of this construction approach are:

- It reduces the cost of construction without compromising quality.
- The construction process is not dependant on skilled labour.
- Panels are lightweight and robust.
- It represents the most advanced patented technology and innovation in the industrial



LEFT A typical 54m² floor plan
RIGHT A fully completed house, neat as a pin and quite capable of withstanding an earthquake. Safe as houses was never a truer word



construction of low-cost and affordable houses, schools, clinics and other structures and is a leader in the field.

- It is a reusable, interlocking modular plastic formwork system for moulding complex structures.
- Formwork components are modular which makes the adjustments in dimensions simple, adapting to endless design layouts.
- Structures are stronger and more durable than masonry structures.

- Structures are socially acceptable among a wide range of cultures.
- It is an affordable technique to build durable, earthquake and cyclone-resistant shelters effectively.
- It can be used to build one house in one day with one mould, or many houses in one day with more moulds.
- It is a realistic modern alternative to overcoming the widespread misuse of scarce materials.
- It is a building technology that encourages self-participation by means of technology transfer.
- It reduces pollution and environmental destruction of our natural ecology by addressing the poor living conditions of billions of poverty-stricken communities that are one of the major sectors of society that contribute to global warming.

- It creates jobs within unskilled communities.

Worldwide, the need for housing has become frighteningly out of reach for many people due to the rising costs of traditional construction methods that are pricing people out of the housing market. By contrast, moladi's construction technology and methods put home ownership within reach of the poor. All it needs is someone in government brave enough to look beyond his or her prejudices, to look at this technology as countries like Mexico and Germany among others have done, and do something meaningful – make a decision, the right decision. **3S**

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This Article has been extracted from IMIESA, *The official magazine of the Institute of Municipal Engineering of Southern Africa*, and written by Tony Stone.

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