The greening of engineering

AQUEDUCT TO LINK CENTRAL AFRICA WITH SOUTHERN AFRICA

Successful community-based sanitation delivery boasting many spin-offs

ECDC MAKES IT HAPPEN!

The world after 2020
TOSAS (Pty) Ltd, a joint venture between Sasol and Total, is one of the largest manufacturers of secondary bituminous binders in Southern Africa. The company supplies superior quality conventional and modified binders and products include bitumen rubber (the company’s flagship product), emulsions, modified binders and prime, as well as BituCote, a bitumen-based stone pre-coating material.
The greening of engineering

The climatic events that we have been witnessing recently have certainly raised awareness about the environment and where our planet is going with (or without) us. Not all of it is bad news and not all of it is good news. But we do believe the news, or don’t we?

What has happened is that at least some of the human race have now been sensitised, although I believe that a fair sprinkling of our civil engineering professionals have been ‘green’ for ages. But we do not like to be categorised with the greenies, who are often too much on the fringe for our liking.

I personally grew up with a strong ethic about waste not, want not; care for people and for my environment. I was aware of the need to make optimal use of scarce resources since my childhood days, when we had rainwater tanks and used bathwater to water our garden in the dry-dry periods of De Aar.

We made compost. We used vegetable and fruit peels and what little there was in the way of leftovers that was unfit for humans to feed our chickens. We saved lots of little things in case we would need it later. Socks were darned and shoes were resoled several times.

In 1977, one of my first major projects as planning and design engineer of the local authority was a mechanical workshop in Potchefstroom. That building would possibly today be called a ‘green building’ of sorts. Many of the ideas that went into the design focused on what would today be called sustainability, ergonomy, and so on. And the design was environmentally friendly. It was all about fresh air, natural light, long-life armoured floors and under-floor heating for the very cold winters.

After arriving in Richards Bay, my boss, Frik Bosman, said that the first thing I had to do was get myself on a coastal ecology course at Stellenbosch. Professor Retief and others changed my professional life – for the better – forever. But putting theory into practice often comes with a price. My novel ideas sometimes made me unpopular. Boardwalks? A pofadder road designed to go around and over the landscape? Why can’t we just bulldoze it straight and level? And going around a tree with a footpath? Well, that will cost more!

More often than not, nobody even noticed the houses in a scheme that I dutifully orientated to optimise the sunlight in winter and prevent heating the house too much in summer. The hot water from solar panels also went unnoticed.

But engineering professionals are generally not supposed to be architecturally aware, and often engineers and architects are/were at loggerheads. Or are we seeing a slow growth in understanding?

The time has come for green engineering and – on the other hand – to bring to the architects’ drawing table a wealth of engineering knowledge about sustainability, energy-efficient materials and designs, recycling, and so on. Engineers know how to use water responsibly, thereby harmonising humans and nature; how to go green in sanitation; how to reuse materials. As built environment professionals we should again become truly multidisciplinary and learn to optimise everything in our habitat.

The green building conference and exhibition of the Commonwealth Association of Architects in November 2007, at the CSIR, may create a platform to engage with them.

We need a rational approach to green buildings. We need to invest in sustainability. We need to assess total costs, also costs to the environment. It is no use having a house that runs on computers and fancy climate controls made in Singapore or Taiwan if the computers are costing us more in terms of environmental impact than simpler methods.

We can provide any number of solutions – but let’s not get carried away in a technical wonderland of our own, only to be blamed that we are actually the source of the misery, not the solution. The Engineers Corps of the USA is now being saddled with the woes of New Orleans …

Let’s engage – and may the gears mesh smoothly!
A brief outline*

It is generally accepted that at some time in the comparatively near future – say between 2025 and 2055 – it will be necessary to supplement the water supplies of the Republic of South Africa, as well as those of some other water-scarce countries in the SADC region. As it would typically take 30 to 40 years to bring a major international water transfer scheme to fruition, it is not too early to start looking at various possibilities. The authors suggest that the rivers of Central Africa could possibly serve as one of the future sources for water supplies for the dryer south. If a scheme to transfer water from the water-rich rivers of Central Africa southwards to Botswana, Namibia, Zambia, Angola, Zimbabwe and South Africa were to be tackled on a sufficiently large scale, considerable royalties could be generated for the benefit of the northern-lying countries

Although the whole of Central and Southern Africa is rich in natural resources, development has generally been skewed. To the south, particularly in South Africa, massive economic and structural infrastructure development has taken place whereas in the north, which is richly endowed with natural resources, the infrastructure needed for growth is spread thinly over the land.

Water resources, in particular, are very skewed, with large volumes of untapped water lying dormant in the north or being discharged fruitlessly into the sea while in the water-hungry southern-lying areas of SADC, water is being and will be used and reused to nearly the limit of its efficiency.

One of the keys to engendering a more rapid and even spread of development over the southern portions of the African continent would appear to be to market resources such as food, water and hydro-power throughout the region with cross-royalty payments from the consumers of the resources being used to stimulate growth in the infrastructure-stressed areas of the region.

In the light of the possible effects of climate change, it is urgent that consideration be given to the long-term destiny of Southern African countries. Thought must also be given to the potential for a massive migration of people.

In the future, as growth takes place, it may also become necessary to supplement the water supply to the southern-lying water-hungry lands of Zambia, Angola, Botswana, Namibia and Zimbabwe and, at the same time, transfer royalty funds to stimulate growth in the northern-lying lands.

Over the years, a number of schemes for transferring water southwards have been conceptualised. Most of these schemes have involved the use of large canals that passed through windswept arid areas and also through areas rich in wildlife. Associated with the canals were massive pumping systems with transfers along existing minor and major rivers and dry watercourses. Canals do, however, present major environmental and maintenance problems. In particular, the barriers and dangers that canals present to animal migrations and to local animal movements generally, and the ever present problems in the dryer areas of windblown sand being swept into canals have in many cases tended to negate the use of canals for large inter-country water transfer facilities. Furthermore, canals tend to exacerbate erosion by concentrating stormwater flows and animal and vehicle crossings with their approaches and generally to present a barrier to natural movements.

We propose an alternative type of water transfer facility or method that for all intents and purposes would eliminate animal migration problems and wind-blown sand threats. At the same time, it demonstrates that water transfers can be effected economically at a price consumers will be able to afford.

The Proposed Scheme

The scheme envisaged would typically be to abstract the proposed water supply from the Zaire River in the Democratic Republic of Congo (DRC) and to convey it to the upper tributaries of the Zambezi (see map). The Zambezi would be used in turn to convey this supply down to Chobe, whence it would be conveyed across Botswana and be pumped up to near the Hartebeespoort Dam area in South Africa. Obviously other routes could be considered and the most effective and environmentally advantageous road would ultimately be selected.

The special means to be used to effect this transfer in the gravity sections (non-pumping sections) would be an above-

*The four authors of the original report, a copy of which has been handed to the President of the Republic of South Africa, have had extensive experience in water engineering.
ground flume. Although, at first sight, this method may appear to be strange, we hope to demonstrate that the above ground flume would be an economical means of conveying large volumes of water over long distances. Above-ground flumes have been used for many centuries in many parts of the world. Obviously, the actual construction shapes, details and methods used for the flume would have to be optimised at a later stage.

The proposed scheme would naturally have to be developed in phases. Phase 1 would be to say to abstract a 50 m³/s supply at Lac Nzilo (an existing hydroelectric scheme dam) in the DRC which lies only 80 km from the watershed separating the Zaire and Zambezi rivers. Further phases using water from Lake Kabwe and Lake Lukanga respectively would follow and would involve abstracting water from further down the Zaire River as its catchment increases in size. It is anticipated that, ultimately, of the order of 450 m³/s might be transferred by this type of facility and from these sources.

The transfer of royalty funds to the Central African region – to Zaire in particular – for the use of this water would have a dramatic effect on development on the northern region. The availability of water along the transfer route would also stimulate local development and work opportunities, while the supply of such a large volume of water would stimulate the economies of the dryer southern lands.

ZAIRE AS A WATER SOURCE AND THE ZAMBEZI RIVER FOR CONVEYANCE

Although it would be possible to use an above-ground flume to convey water over the whole length of all the gravity sections, the use of a large length of the Zambezi River as a transfer mechanism has been proposed to reduce the total cost. (It must be stressed that it is the intention to use the section of the Zambezi River only as a transfer mechanism and not to use the river itself as an actual source. In fact, the transfer system could even to a certain extent be used to supplement the flows in the Zambezi River.)

The main plan would, however, be to use the Zambezi only to convey water from Zaire via Chobe, for use in Botswana, Zambia, Zimbabwe, Angola and South Table 1

<table>
<thead>
<tr>
<th>Item</th>
<th>Lac Nzilo</th>
<th>Lac Kabwe</th>
<th>Lac Lukanga</th>
</tr>
</thead>
<tbody>
<tr>
<td>River</td>
<td>Zaire/Congo</td>
<td>Zaire/Congo</td>
<td>Zaire/Congo</td>
</tr>
<tr>
<td>Catchment area (m²)</td>
<td>16 000 m²</td>
<td>54 000 m²</td>
<td>140 000 m² (1)</td>
</tr>
<tr>
<td>Estimated mean annual runoff (million m³ per year)</td>
<td>3 200 (4)</td>
<td>12 500 (5)</td>
<td>28 000</td>
</tr>
<tr>
<td>Estimated yield (million m³ per year)</td>
<td>2000</td>
<td>6 000</td>
<td>15 000</td>
</tr>
<tr>
<td>Available yield (million m³ per year)</td>
<td>1 500</td>
<td>6 000</td>
<td>15 000</td>
</tr>
<tr>
<td>Available yield (m³/s)</td>
<td>50</td>
<td>190</td>
<td>500</td>
</tr>
<tr>
<td>Direct distance to Zambezi tributary</td>
<td>80 (3)</td>
<td>260 (6)</td>
<td>300 (2)</td>
</tr>
<tr>
<td>Lift</td>
<td>60 m</td>
<td>790 m</td>
<td>810 m</td>
</tr>
</tbody>
</table>

1 Excludes Lac Nzilo, includes Lac Kabwe
2 493 km by flume with 22 km rising mains
3 115 km by flume with 20 km rising mains
4 3 270 million m³ per year (1921–1938)
5 Includes spillage from Lac Nzilo
6 330 km by flume with 21.3 km rising mains

Cross section of proposed flume
Africa. It could also be arranged therefore that additional flumes or pipes from Chobe be provided to convey water from Zaire or from the Zambezi for the cities of Bulawayo in Zimbabwe and Gaborone in Botswana. The Zambezi River is already subject to intensive development and is unlikely to be suitable as a basic source of water for transfer to the south. Accordingly, for the purposes of this article it was decided to examine the possibility of obtaining a supply of large volumes of water from three large Zaire River catchments further north in Zaire, where there is an abundance of water. Incidentally, these Zaire River sources are located close to the source of the Zambezi River.

Zaire as a Water Source
The details of the proposed three main sources in the DRC are given in table 1. It is fortunate that runoff figures are available for Lac Nziolo, so that this will give added confidence to estimates further down the river. The rainfall at the watershed is of the order of 1200 mm per year whereas further north at Lac Lukanga it would be approximately 1400 mm per year.

The Zambezi
It is proposed that the Zambezi River be used only as a conveyance. As any water extracted from the Zambezi is likely to have a negative effect on the generation of hydroelectricity downstream, it is obvious that it cannot be considered as a basic source of water for transfer to the south.

The Democratic Republic of Congo
It is suggested that the various phases in the Democratic Republic of Congo (DRC) would be as follows:

Phase 1 (50 m$^3$/s)
This phase would comprise a flume from Lac Nziolo (a hydroelectric scheme at Kolwezi – a copper mine), where the water would be pumped into the flume from the powerhouse tailrace. The flume would gravitate from its headworks southwards to near Kayeye, where water would again be pumped to the watershed in a series of parallel pumping mains.

The evaporation in a 50 m$^3$/s flume has been estimated to be 1.2%.

This phase would have a capacity of approximately say 55 m$^3$/s. The variation in the discharge from the existing hydro scheme outlets is not known at present, but the authors have assumed that about 55 m$^3$/s would be available at all times. In order to achieve this, alternative outlet facilities may be required. The total elevated flume length would be 115 km and there would be a 20 km rising main. The total lift would be approximately 60 m.

Phases 2 (a) and (b) – each 100 m$^3$/s
This phase (of 200 m$^3$/s) would comprise a flume from Lac Kabwe, where the Lubidi River joins the Zaire River. It would, however, probably be found to be more
economical to provide a 100 m$^3$/s flume, which could be duplicated at some time in the future.

It has been assumed that the water would be stored in the lake, but if this storage is found to be insufficient, a dam on the Lubidi River near Bukama may be required.

**Phase 3 (200 m$^3$/s)**

This would involve moving 100 km further north along the Zaire River to near Lac Lukanga, where the Lufira and Bungari rivers add to the discharge. If required, a dam could be built on the Lufira to balance out the flow.

This phase would have a capacity of 200 m$^3$/s making a total of 450 m$^3$/s for all phases – the target draft (400 m$^3$/s plus ± 10%).

**CHOBE TO HARTBEESPOORT**

After initial extraction pumping, an elevated flume would run south from Chobe, then southeast and finally south again to arrive at a low point east of the Makgadigadi Pans. At Makgadigadi, 38 km rising mains would be required to deliver water to the top of the escarpment in eastern Botswana. From the escarpment, the flume route is relatively straightforward down to the Crocodile River. Particular care would be required in planning the crossing of the Serurumi River valley. The balance of the route would be up the Crocodile River valley where a number of pumping stations and pumping mains would be required. The total length would be about 1 400 km, the pumping lift about 758 m and difference in level between the beginning and the end about 250 m. Branches could be provided to Bulawayo and Gabarone, if required, and to other areas.

**CONVEYANCE STRUCTURE**

It is proposed that an elevated flume of the required capacity be used for the gravity sections. The proposed flume investigated would be manufactured in precast yards located, say, 100 km apart along its length. The flume clearance could be increased at little extra cost. This high clearance has the advantage that animals in game reserves and other areas would be able to pass freely underneath the flumes. Furthermore, road and rail transport corridors could be passed beneath the flume and storm water passage could easily be effected without concentration and associated erosion. Outlets would be provided at intervals to provide drinking water for animals inside and outside game reserves and the possibility of water supplies for local food irrigation could be considered.

For details of the flume, see figure 1. It is not our intention to providing definitive and accurate total costings for the whole scheme, as this would depend on actual site conditions and myriad of other factors. As an illustration, however, the costing has been based on a 50 m$^3$/s flume at a slope of 1 in 5 000. Of interest is that a 100 m$^3$/s flume at a gradient of 1 in 2 000 is roughly the same size as a 50 m$^3$/s flume at a gradient of 1 in 5 000. Accordingly, the cost of water at 100 m$^3$/s would tend to be approximately half that of the 50 m$^3$/s flume and in any event a 100 m$^3$/s flume would deliver water at a lower unit cost (unit reference value) than would a 50 m$^3$/s flume.

**ESTIMATED COSTS**

The feasibility of this project would obviously depend on the delivered unit cost of the accompanying water.

At first glance the above-ground flume as a concept would appear to be unattractive. It would, however, tend to be 10% to 15% shorter in length than a conventional canal and furthermore it would have much
lower environmental costs. For example:
- It would not need fencing
- It would not need stormwater diversion embankments with associated culverts or superpassages and it would not be vulnerable to sedimentation
- It would not need farm and road bridges
- It would not need animal escapes and crossings
- It would not need special river crossings of minor streams
- It would not need under drainage installations and long weirs also to prevent uplift
- It would not need large embankments for access roads along its length
- Its spillways could easily be facilitated using frequent air regulated siphons
- It could easily be shut down for cleaning and maintenance as this would be relatively simple process
- It would have intrinsic safety and inspection facilities
- Rock excavation would not be a particular problem and would in fact be an advantage
- Its pumpstation costs would be reduced by providing extra NPSH and lower excavation costs
- Mass production would be facilitated
- It would generally have a lower environmental impact and would sterilise less ground

It would, however, have a higher visual impact and would of course be more vulnerable to sabotage.

**COST OF WATER**

We have been able to estimate the cost of bringing water from the DRC to South Africa to typically be of the order of R4 to R5 per cubic metre (These are basic costs and do not include royalty payments or payments for servitudes, transfer, transfer costs in rivers or other non-physical costs.)

We must emphasise that the costs have been based on a typical 50 m$^3$ per second flume at a gradient of 1 in 5 000. Many sections would be at 50 m$^3$ per second flume at a gradient of 1 in 2 000, which would require a smaller flume. No allowance has been made for this saving given the many physical unknowns and environmental concerns along the route.

A detailed costing of the flume, of the pumping mains, of the pumpstations, and of the total cost of operation, including pumping and electricity, was carried out by a costing expert using resource-based costing. The original report, which contains full details of the calculations including rainfall, run off evaporation, hydraulics and routing, also contained a full section on the costing. This full report may still be published in a scientific journal.

**CONCLUSION**

The scheme briefly outlined here envisages abstracting water from the Zaire River in the DRC and transferring it to some point near Hartebeespoort Dam. The basic method proposed would comprise the use of an elevated flume over long stretches of the DRC and Botswana, but would include pumping mains and the use over a certain length of the Zambezi River – this section being used as a conveyance and not a source.

The indicators are that if a scheme could be developed with a large enough flow capacity, water could be delivered at a competitive cost. The implementation of such a scheme would stimulate development in the northern-lying areas through royalty payments and the availability of more water supplies would allow further growth in the dryer southern-lying countries.

**Acknowledgement**

The authors wish to thank Francis Gibbons of SSI Consulting Engineers for his assistance in preparing the initial report.

Please contact Erlyn Snell on 072-491-6996 or ErlynS.ssi.co.za for more details. Obviously, we could only touch on the descriptive background of this interesting proposal. References are available on request – Ed
Liner design on to an existing wastefill area

BKS needed to address various practical and technical issues and apply some innovative thinking when designing the lining system that was to piggyback on to the existing wastefill area at the infamous Coastal Park landfill (GLB+) site.

The Coastal Park landfill site falls within the South Peninsula administration area and lies some 8 km east of Muizenberg on the Cape Flats. It is situated south of Zeekoevlei and 400m from the False Bay coastline. The Cape Flats sewerage works is on the eastern side opposite the site and is separated from it by the Zeekoevlei canal that drains into False Bay. The Capricorn development borders the landfill site to the west. The site comprises an area of 75 ha of land in total.

The site is divided into two phases, namely Phase 1 and Phase 2. Wastefill took place in Phase 1 before the site was permitted. Since obtaining the permit, wastefill has been moved to the Phase 2 area. Phase 2 is the first lined area of the site in accordance with DWAF and DEAT requirements.

The existing Phase 1 wastefill is at least ten years old with minimal treatment – that is, additional compaction, irrigation to aid settlement, etc. – coupled with minimal historical data to use in the analysis. The depth of the wastefill is unknown. The depth of the wastefill lifts used to construct this old wastefill is unknown. The compaction efforts used in the past are unknown. Records of the material disposed into the old wastefill area are also not available.

Design of the lining system onto the old wastefill pile involved aspects such as the following:

- Performance knowledge of the various liner types (geosynthetics) and options
- Financial implications
- Effects (movement) on the existing waste body upon placing a load onto the waste body
- Liner requirements
- Differential settlement
- General settlement
- Hydration of GCLs using pure leachate
- Slope design, slip slopes
- Shear strength relationships
- Interaction between the various synthetic liners

Initially the lining of the embankment was going to be an extension of the double lining system up a 1V:3H slope. Subsequent to a meeting with DWAF, the lining system was reduced to a single hydraulic barrier.

BKS then decided to reduce the grade to a 1V:6H slope to allow for earth moving machinery to travel on this embankment as the layer-works included sand drainage layers, natural mineral erosion protection layers, etc. By reducing the grade, many other required design investigations became redundant, because of a more stable slope.

Two critical items needed to be addressed in this embankment design, namely settlement stability of the slope under load and guaranteed performance of the single hydraulic barrier.

**SETTLEMENT OF THE WASTEFILL EMBANKMENT**

Knowing the threat of large-scale settlement globally over the embankment and local differential settlement, the synthetic material types in the lining system were limited to flexible synthetic membranes. No clay is available nearby. Being the only hydraulic barrier, the materials considered were HDPE, LLDPE, GCL and IPP.

As a result of the threat of differential settlement, and to achieve a functional hydraulic barrier, BKS incorporated three main items in the design:

- **Initial compaction of the embankment** It was a requirement of the contract to clear the embankment, ensure sufficient soil cover, clear the embankment over three times and measure the settlement for information purposes. (See table 1.) The sand cover ranged from 220 mm to 450 mm over the waste body. The aim was to compact the wastefill embankment as much as possible before installing the lining system.

- **Geosynthetic reinforcing grid** This is a new product by Kaytech called polyester yarn with a non-woven geotextile attached.
which has high tensile strength at low strain and directly interacts with sand-sized particles, that is, the aperture is such that the sand particles interlock and interact with the grid. BKs decided to install this grid to reduce the effects of differential settlement. This grid was placed simply (embedded) in the sandy subgrade layer.

**Convex shape of the embankment** The design principle was to place the GCL to perform as a hydraulic barrier only and to not necessarily take up tensile stresses in the embankment. Over and above placing the grid, the embankment was shaped to a convex shape to take up general settlement whilst a tensile grid was added to the subgrade to lessen any potential localised and general differential settlement. As settlement occurred, the geosynthetic reinforcing grid would start to strain and take up the tensile load (and elongation) slowing down settlement (as the load is transferred to the yarn). At the same time the convex shape of the fill slowly lost its shape while the GCL remained under no real tensile load.

**SINGLE HYDRAULIC BARRIER**

Knowing the threat of differential settlement, as stated above, the material options for the single hydraulic barrier considered were HDPE, LLDPE, GCL and FPP.

- The GRI specification for FPP has been removed from the Geosynthetics website for various reasons and the material is undergoing further tests.
- To DWAF, 2 mm nominal thick LLDPE was not an option as a single, primary liner. The material is also generally more expensive than 2 mm nominal thick HDPE and mid-grade GCL. There is also a shortage of resin, so the price is increasing.
- Although HDPE has a poor coefficient of elongation (typically 30% multi-axial elongation) compared to the other alternatives (LLDPE typically has 65% multi-axial elongation), it was nevertheless an option.
- GCL was eventually chosen, but various issues discussed below needed to be attended to.

**Extra overlap**

The GCL panels would require extra overlap to cater for movement in the GCL because of possible differential settlement. The design allowed for a 1 000 mm overlap in the horizontal plane and a 600 mm overlap in the vertical plane. A 300 mm overlap is generally recommended in ‘normal’ applications, depending on the supplier. This obviously affects the cost of installation per square metre; nevertheless, this alternative proven a viable financial option. It was required that the overlap be staggered along the embankment - that is, not all along the same horizontal plane - as the embankment is longer than the typical roll length.

**Hydration of the bentonite using raw leachate**

BKs needed to be sure that the bentonite would form a ‘impermeable’ paste when in contact with raw leachate from the site, being the only hydraulic barrier on the slope. To enable BKs to accept GCL as the suitable single hydraulic barrier on the embankment, a series of practical tests were carried out.

 BKs sent chemical test reports of the raw leachate (done over a period of time) to suppliers. In return letters of guarantee were obtained from suppliers to state that the use of GCL would be acceptable and the GCL would function when in contact with such leachate (leachate and bentonite interaction). Letters were received from suppliers stating their support for
this application, vouching that the GCL would function as required.

Crude on-site testing was done over a few days to visually inspect the hydration of the GCL using raw leachate. Basically the wheelbarrow has holes in the base, and the GCL was the only barrier stopping the leachate from leaking out the wheelbarrow. Raw leachate was extracted directly from the landfill cell and poured into the wheelbarrow and left. The area beneath the wheelbarrow was prepared in such a way that any drops from the wheelbarrow would be detected. The test was run over three days. The results were that little or no leachate managed to permeate through.

A sample of the GCL was sent to the testing laboratory in Durban together with a sample of the raw leachate for hydration and permeability testing. Twenty litres of the raw leachate was put into new fuel cans and couriered to the laboratory in Durban. A variety of tests were done, some pre-hydrating the GCL, some being tested from dry-to-direct contact with leachate. In all the tests, done over a length of time (30 days), the GCL did hydrate to acceptable levels.

Over and above all the tests, historically GCL has also been used at Bassasar Road Landfill in Durban with a slope of 1V:3.5H (albeit these slopes are relatively short). No problems have arisen thus far on this portion of the site.

1. Graph indicating the typical characteristics of the geosynthetic reinforcing grid
2. Section of convex-shaped embankment (image has been stretched)
3. Permeability analysis
4. Installing the grid
5. Wheelbarrow with holes in the base, lined with GCL and filled with raw leachate
6. Joles in the base of the wheelbarrow (the arrow shows one of the holes)
7. Sampling the raw leachate for the crude ‘wheelbarrow test’ and for sending to the laboratory in Durban
Successful community-based sanitation delivery boasting many spin-offs

The country is facing an enormous backlog in access to adequate sanitation by all citizens and the target of eliminating this backlog by 2000 seems to be unattainable at the current rate of delivery especially in rural areas. Attempts are being made to accelerate delivery while ensuring that the projects add value to the community in terms of improved skills and improved potential to access jobs and alleviate poverty.

The community-based delivery of sanitation offers the best potential for accelerating delivery and ensuring development of skills and maximum income for the community. In many cases, however, inappropriate planning and design as well as incorrect management of community-based projects has led to a general misconception that community-based delivery is slow and risky and cannot contribute to the accelerated delivery of sanitation.

The Phelandaba sanitation project implemented by the Mkhanekude District Municipality is a good example of how community-based delivery can be both effective and efficient and can help alleviate the sanitation backlog while contributing to job creation.

THE AIM OF this article is to share the experience gained in the Phelandaba sanitation project, which is located in the Mkhanekude District Municipality in northern KwaZulu-Natal.

The project was started in 2006 as a follow-up to similar projects implemented in the Mhlabuyalengana Local Municipality from 2001 under the BOTT Water and Sanitation Programme. The project was to build on the experiences gained during the BOTT phase and to deliver sanitation in the area using community-based methods and ensuring maximum community employment and income generation.

BACKGROUND
In 1997 the Department of Water Affairs and Forestry embarked on a programme of delivery of water supply and sanitation in the most underserved provinces of KwaZulu-Natal, Mpumalanga, the Eastern Cape and Limpopo. The initiative became popularly known as BOTT from its approach of Built, Operate, Train and Transfer whereby consortia of private sector companies tendered for the service in one of the largest public/private partnerships undertaken for rural services delivery. Under this approach the AquAmanzi consortium undertook sanitation in KwaZulu-Natal and from the onset of the programme massive studies were undertaken into ways of improving delivery while accepting the principle that sanitation facilities, unlike water supply systems that can be a community asset, are a household issue and without the involvement of practically every member of the community in the project very little sustainable sanitation can be achieved. It was also important to ensure that employment is maximised and that the...
bulk of the funds available for the projects are left within the community.

Subsequent to the end of the BOTT contracts, the Mkhanyekude municipality continued to use the sanitation arm of the AquAmanzi consortium to deliver sanitation in some of its projects, particularly where the projects were natural extensions of the former BOTT projects or infills in areas between projects. The Phelandaba sanitation project covers the area between the Mbazwana sanitation project and the Manguzi sanitation project. The project comprises the delivery of 6400 block toilets with a budget of about R24 million. Although the project has been running for less than a year, it has achieved most of the primary objectives set out above. Some of the factors believed to have contributed to the success of the project are discussed here.

**EFFECTIVE ORGANISATIONAL SETUP**

Sanitation projects are often regarded as ‘easy’ projects that can in some cases even be managed by people who are not qualified project managers or who have no project management background.

This perception has led to the failure of a large number of projects to deliver effectively and efficiently. This is still evidenced by the kind of service providers engaged by some municipalities to deliver sanitation. While a water project is almost always awarded to a firm of qualified project managers with good technical expertise, sanitation project agents are not always required to prove such competence.

The key to successful sanitation delivery is good project management. Considering the fact that each sanitation unit is almost an independent small project, even if the task of constructing in excess of 50 toilets (with 50 independent community contractors) at a time can be quite daunting and requires high competence in project management and construction supervision. This, in turn, is a function of the project organisational setup which has to be appropriate and as efficient as possible each of the members of the team must be given appropriate training to ensure competence in their roles. Figure 1 shows the organisational setup for managing the Phelandaba sanitation project.

**PROMOTION OF OWNERSHIP**

The key to the success of the Phelandaba project is the high sense of ownership achieved through true and meaningful participation by the community.

The community has elected a sanitation steering committee which was trained in various activities related to management of the project in order to enable them to make properly informed decisions on the project. The most important aspect of the participation is that not only is the steering committee responsible for the decisions on all the project aspects, with the guidance of the consultant, but they are responsible for all financial decisions on the project and they run and manage the banking account themselves. They generate, through the employed community staff members, all cheque requisitions and they sign all cheques for all payments on the project account including staff salaries and builder payments. (Contrary to popular belief, the consultant has experienced very low levels of financial mismanagement by communities in handling their own development funds.) The steering committee in turn assists the consultant in promoting ownership within the community at large by ensuring that the community contributes in kind in the form of digging of the pits (and in cash where they have to employ others to dig for them). Unless the household has demonstrated their readiness to participate in the project by digging the pit, they are not provided with the required materials and the builders are not assigned to the household. The promotion is, however, so successful that the project struggles to cope with the demand expressed by households through the digging of their pits.

This high sense of ownership is the major contributor to the project achieving high output as the community feels proud to have and manage their own project and have been trained and made aware of the need and the advantages of improved sanitation in their community. They also exert peer pressure on the few non-cooperative members, as they are aware that disease vectors will bring diseases from their neighbours to them unless everyone has an improved latrine.

**INVOLVEMENT AND PROMOTION OF LOCAL ENTREPRENEURS**

The project places a significant emphasis on the involvement and promotion of local entrepreneurs. To this end all builders are not employees of the consultant or of the steering committee, but are independent contractors who tender for their work on negotiated rates and in turn employ their own assistants and helpers. The project does not train community members to become builders, but uses and promotes existing builders in the community and offers them opportunities for participation. Interested builders are trained in the methods of building the toilets and are mentored until they are able to build the toilets to an acceptable standard. The project also promotes the use of local entrepreneurs for the production of blocks used in the project. Unlike the conventional system where a centralised entrepreneur, usually a well-established business person in the community, is used to supply blocks to the project, in Phelandaba, community, based block-making is used. Interested people from the community are trained and equipped with small portable block-making moulds. These block-makers move from house to house producing enough blocks for the toilet at each house. The quality of the blocks is monitored and the makers are only paid for acceptable blocks. This system has reduced the cost of blocks significantly as it cuts out excessive transport costs while maximising employment within the community.

The doors used for the project are also produced by a local wood factory. The design of the toilet requires the use of a non-standard door size. Local wood manufacturers are invited to give tenders for the production of the doors to the specified quality and dimensions. This also promotes a new kind of industry in the community and the local manufacture again translates to savings in transport and competition costs while enhancing employment.
ACHIEVEMENTS
Some of the achievements of this very successful community-based project are the following:

- Original budget for all phases (6 400 toilets): R24 million
- Start of construction: August/September 2006
- Amount transferred to community account: R2.6 million
- Number of builders trained: 70
- Number of blocks produced locally: 459 000
- Number of toilets built: 1 700
- Average rate of construction: 200 toilets per month

The biggest threat to the project is the uncertainty of budgets to provide cash flow for the ongoing financial years. This is due to the higher production than originally anticipated. The first phase of the project planned to deliver 2 400 toilets in 24 months, but the project has already produced 1 700 in 8 months. There is a need for more refined financial methods to be able to adjust budgets to sustain successful projects. There is also the need to streamline and simplify MIG processes for access to funding for sanitation projects.

By far the greatest achievement of the project has been the ownership of the project by the community. This has led to commitment and pride that have in turn translated to good delivery on the ground. Many contractor-based prefabricated toilet projects have reached construction rates in excess of the Phelandaba project, but the ownership, pride and sustainability of such projects have been compromised and community empowerment, employment and income generation were minimised.

LESSONS LEARNED
Effective management is required for sanitation projects
The issue of effective and dedicated management is very important for success of sanitation projects, especially community-based projects. The needs of the project are more complex, not simpler, than those of a conventional project.

Community-based projects do work
Community-based projects do work and implementers should ensure that the correct project management, training and community input are implemented. Inadequate project management and insufficient community involvement are usually problems that lead to the general apathy with regard to community-based sanitation projects.

Promotion of ownership of the project is important
Efforts put into the promotion of ownership of the project by the community as well as the participation of the community in line with true and not token ownership are essential to motivate the community for productivity as well as for sustainability of the project. The current shift from community contribution in the name of rights to free basic sanitation is detrimental to community participation and ownership and ultimate care and sustainability of the facilities.

Development of entrepreneurship at community level is important for accelerating delivery
The use of locally made materials contributes to avoidance of delivery delays and waiting periods that are usually experienced with outside deliveries. Casting concrete blocks on site ensure that there are no transport problems encountered, especially after rainy periods when heavy vehicles are unable to deliver blocks. This cuts down waiting time after the rains and leads to accelerated delivery.

Local entrepreneurs are essential for sustainability
Locally manufactured materials are likely to be less expensive (if the systems are set up correctly) and the use of such materials in the project promotes sustainability as well as improved access to ongoing job markets as the block-makers, for example, will continue to manufacture blocks for construction of houses even after the end of the project. The entrepreneurs will also be able to continue to provide materials for toilets for the community long after the project has ended while some of the prefabricated materials, used in some of the other projects, will be difficult to obtain outside the ambit of the project and at affordable costs.

Financial allocations are essential to ensure that national sanitation targets are met
Many successful projects are threatened by lack of continuous funding allocations. The consequences of discouraging communities such as Phelandaba through a lack of continuous funding allocations are much more serious than just a delay in sanitation delivery. They include a loss of confidence in the local authority and its consultants, the shattered dreams of people who took advantage of the development of skills to secure a better future for themselves, and a loss of skills from the community through the departure of trained people in search of job opportunities elsewhere. But above all, a lack of continuous funding may lead to the failure of a project that otherwise had the potential to meet the national goals for its inhabitants.
STANDING ON ONE of the hundreds of collapsed smallholder irrigation schemes in the former homelands, one has a tangible sense of unused opportunity which is starkly amplified by the surrounding poverty, unemployment and social need. It is easy to understand why inspired politicians imagine a sea of green and commit hundreds of millions of funding annually to rebuild infrastructure, in the hope that this will result in profitable production.

While this has been good news for some engineering firms, the hundreds of moribund pumpstations, centre-pivots and irrigation systems around the country are monuments to a techno-centred approach which has failed historically and continues to do so in current times. The harsh reality of the under-utilisation of natural and infrastructure resources, and limited returns on major investments in smallholder irrigation prompted intensive research under an assignment funded by the Water Research Commission. The four-year study by an Eastern Cape engineer and his experienced land-reform colleague has culminated in substantiated findings which show that the predominant emphasis on repair, rebuild, re-design, refurbish and rehabilitate must be replaced entirely and the problem statement re-defined. As important as technology is, it is only one of eight critical elements for successful change and if the other seven elements are not in place, technology alone will fail.

The result of the applied research is the publication of the Rough Guide for Irrigation Development Practitioners by the Water Research Commission, which sets out pathways to constructive change for collapsed schemes. The guidelines, which are based on extensive case-study research, multi-stakeholder workshops across the country and a review of major South African and East African smallholder ir-

Irrigation revitalisation
Beyond the engineering paradigm
Development of smallholder irrigation development.

The challenge for the project leader is to develop a team whose members think iteratively and in a highly integrated way, and where the influence of disciplines on each other is fully articulated and the resulting consequences accommodated. Engineering design directly impacts on costs, which influences crop choice and marketing strategy, which impacts on landholding size and institutional relationships, etc., and a change in any one alters the input criteria to the next. The isolation of disciplines is therefore impossible and the days of ‘let the engineers handle the design and the sociologists the people’ are long gone.

An additional challenge is that the range of ‘specialists’ must include members of the beneficiary community, who have local knowledge, insight and critical information. New planning processes were developed, such as the iterative-consultative approach (ICON), which combines conventional pre-feasibility processes with participatory rural appraisal (PRA) and rapid appraisal of indigenous agricultural knowledge systems (RAAKS). These are usually well outside the comfort zone of any one specialisation, given the technical, language, cultural, gender, political and other challenges of integrating a range of specialists and local knowledge in a dynamic planning process.

The guidelines set out a range of newly-developed planning concepts which are wider and more inclusive than those of the past, as well as step-by-step methodologies to inform smallholder irrigation planning in the South African context. Whether

- Irrigating with low-tech but high-efficiency short furrows
- Girls with produce from home-gardens at Keiskammahoek irrigation scheme
- Indigenous knowledge – woman farmer at Tugela Ferry irrigation scheme
- Farming styles as development pathways
- Hydraulic units as institutional and production planning units

...
ECDC makes it happen!

The Eastern Cape Development Corporation has facilitated R1,5 billion rand private sector investment in the poverty-stricken northeastern Cape – this is how they made it happen …

THE SMALL TOWN of Ugie in the northeastern Cape lies at the foot of the picturesque Maluti mountains and is surrounded by plantations. The economy of the area is based on the agricultural and social services sectors.

Twenty years ago forests were planted, originally for the paper industry. Recently, the Steinhoff Group purchased these plantations from Mondi with the intention of establishing a wood-processing plant – injecting about R1,5 billion into the economy of the area in the process.

In the last quarter of 2005, Steinhoff/Pg Bison approached the provincial government to solicit support in the form of the provision of bulk and connector services to ensure the successful implementation of the proposed development.

The project was evaluated and found to be aligned to the Provincial Growth and Development Plan (PGDP), specifically in relation to the manufacturing and tourism development strategy and approved projects in the agro-processing and timber clusters. The project also satisfied the requirements of the Accelerated and Shared Growth Initiative of South Africa (AsgISA), as the timber and forestry industries are focus areas for economic growth and job creation in terms of the programme. Much attention was given to ensuring that the project was aligned to the relevant municipal integrated development plans (IDPs), thus ensuring a bottom-up rather than top-down developmental approach.

It was agreed that the Eastern Cape Development Corporation (ECDC), as the provincial government’s economic development agency, would facilitate the implementation of the infrastructure projects associated with the project and act as the implementing agent. A tri-partite agreement was subsequently entered into between the Eastern Cape Province (funding the bulk and connector services), PG Bison (the developer) and ECDC (the implementing agent for the bulk and connector services).

From the project’s inception, it was clear that the development’s tight time-frames would have to be adhered to, since PG Bison required the plant to be operational by December 2007.

Working around the clock, the ECDC with its partners facilitated the successful implementation of the initiative within stipulated timeframes, and in certain instances ahead of schedule.

OBJECTIVES
While PG Bison’s main objective was to exploit a business opportunity, the provincial government – through the ECDC – saw the initiative as an opportunity for sustainable economic development in one of the country’s poorest regions providing work and income to thousands of people.

PROJECT COMPONENTS
The project comprises the following components.

Wood-processing plant and infrastructure
This part of the project will be completed by the end of November, well in advance of the operationalisation of the plant in December 2007.

Upgrading of water treatment works
In 2004 the Ukhahlamba District Municipality (UKDM) appointed Sintec Consulting to proceed with the investigation into the water services in Ugie. This resulted in the completion of a water and sanitation master plan for Ugie in January 2005.

By mid-2005, after the Steinhoff/Pg Bison investment in this area had been announced, it became clear that urgent intervention would be required with regard to the provision of water and sanitation.

As the development in and around Ugie unfolded, the UKDM decided to proceed with the implementation of a R100 million water and sanitation master plan. Sintec Consulting was appointed for both the bulk water supply project and the bulk sanitation project.

The bulk water project consists of four sub-projects, namely the upgrading of the water treatment plant from the existing 1,0 Mℓ/d capacity to a capacity of 6 Mℓ/d; the upgrading and replacement of the bulk water supply lines, new pumping mains and the installation of bulk water meters; the construction of two new potable water...
reservoirs with a total additional storage capacity of 6 M³, and the construction of a dam in Wildebeest River, about 10 km upstream of the town. The dam wall will be 20 m high and will have an estimated gross storage capacity of 3.75 million m³.

The bulk sanitation project consists of three sub-projects, namely the construction of a new 4 M/d biological nutrient removal sewage treatment plant with a sludge-handling facility (at present effluent generated in the town is transported with vacuum tankers to the existing oxidation ponds at excessive costs), the construction of about 32 km of outfall and connecting sewers; and the construction of internal reticulation waterborne sewers for the various residential areas.

On completion of the bulk water and sanitation projects, Ugie will be a model town in terms of water services infrastructure, not only in the province, but in the country. The remaining challenge will then be sustainable service provisioning and maintenance by the municipality.

An important and integral part of the bulk water and sanitation projects was the challenge to spend 5% of the available funding productively on community capacity building and training. This requirement imposed by MIG was addressed through experienced service providers and will be extended over the total project period of about four years. Apart from recruiting local residents for the construction programme, as well as accredited skills training of some other residents, the programme includes school and community interventions, including water awareness programmes for learners at local schools.

Another important aspect of this project is the development of a comprehensive asset management plan based on the International Infrastructure Management Manual.

A rising water main to and outfall sewer pipeline from the plant

UkDM appointed Ninham Sand Consulting Services for engineering services for the raising water main and sewer outfall pipeline to the oxidation ponds. Mamlambo Construction was appointed as the contractor to build the 3,275 m 160 mm diameter water rising main and 3,155 m 160 mm diameter outfall sewer.

Upgrading of power supply
The town of Ugie has been experiencing regular power outages and it became apparent that Eskom would not be in a position to provide in the power demand of the plant.

To supply the plant with the required electricity levels, a 132 kV feeder bay had to be constructed at the Qumbu substation, as well as a 68 km long 132 kV overhead powerline from Qumbu substation to Ugie, a 132/22 kV 2 x 20 MVA transformer substation near Ugie, and other network strengthening projects to ensure sufficient capacity in the network to supply the plant.

The substation has been built with two 20 MVA transformers and provision has been made for a third to be added if the need arises. The new substation and 22 kV lines will make a huge difference to the quality of supply to the entire area.

SPIN-OFFS

The investment initiative by the private sector partner, facilitated by the provincial government, has resulted in the development of a new middle to high income residential area. Housing units to accommodate staff of PG Bison are currently being constructed, which will add to the revenue base of the municipality and hence its financial viability. A new townhouse development in the area is under construction.

The area will also benefit from the construction of a hotel complex and associated tourism-related activities – once again adding to the economic growth and development of the area and ensuring accelerated job creation and skills development/training.

CONCLUSION

This development initiative, in which private sector investment has been linked with appropriate public sector infrastructure investment, has underwritten the growth and prosperity of the entire Ugie area. The provincial government, through the ECDC, has ensured an improved quality of life for communities of the surrounding areas – not only through job creation and skills transfer, but also by ensuring the improvement and accessibility of the infrastructure and services so desperately needed in this historically neglected area.

It is envisaged that the model will be replicated throughout the Eastern Cape Province, ultimately reaching far beyond the Ugie area – and benefiting all the people of the province.
Greenfield challenges

BUILDING A STATE-OF-THE-ART particle board plant as part of a greenfield development in the remote rural town of Ugie with little by way of supporting infrastructure or services presented PG Bison’s project engineers and contractors with unique opportunities and challenges.

Managing the logistics of keeping the works supplied with materials and tools is in itself a challenge, as there are no local suppliers and much of the plant and requirements are carted in from Durban, East London and Johannesburg. For example, to date, for the civil engineering requirements alone, over 4 600 truckloads of supplies, ranging from cement and aggregate to reinforcing steel, have been brought to site. Except for the aggregate, which was quarried locally, all other supplies travel long distances – in some cases 900 km or more.

Grinaker-LTA was responsible for the earthworks which involved some 350 000 m$^3$ of earth being moved in cutting and filling to establish the platform. The process was hampered by flooding and snow in July last year.

The civil engineering contract was awarded to a joint venture between Grinaker-LTA, Concor and Trencon. Footings and foundations required 43 000 m$^3$ of excavations, with substantial blasting needed. Seven hundred tonnes of reinforcing is being used.

Two batch plants are being used to mix the 35 000 m$^3$ of concrete, with 3 650 loads of aggregate quarried locally while 8 720 t of bulk cement was brought in, on 290 loads. The bulk cement was supplemented by 11 520 pockets used for building works, which, to date has consumed over 800 000 bricks.

The plant covers some 71 000 m$^2$ of covered hardtop and 85 000 m$^2$ of cladding is being used. The widest roof spans are 30 m, and have had to be engineered to cope with snow coverage load of up to 200 kg/m$^2$. Some 3 600 t of galvanised steelwork is being used.

The joint venture partners, have, to date, committed in excess of one million man hours in the civil engineering aspect of the project.

Says project manager Gerhard Victor: ‘It was a significant psychological milestone for the team to get the first sheeting onto the structures prior to the builders’ holidays in December last year. The sometimes severe weather conditions during the earthworks phase of the project put us back at times, but once the structures were covered, we were less exposed to the elements and we are on track to complete the project on time.’

Weather conditions are not only influencing the construction of the cluster – its impact on operations has had to be considered as well. During the production of particle board, the heat and humidity levels in the buildings are very high, which can lead to condensation forming on the underside of the roof which can damage the particle board. To overcome this problem, 71 000 m$^2$ of 75 mm thick insulating sheeting had to be especially imported from Germany in 179 containers. Tolerances on the steel structures have been particularly tight to ensure that the pre-fabricated sheeting fits exactly to avoid on-site installation problems. Local construction crews were advised by the manufacturer’s specialists.

Although some 78% of the total project costs is being spent locally, the project is dependent on several key components being manufactured abroad. The first and largest single component that was brought in is the particle dryer, manufactured by Recalor from Spain. The dryer was shipped in parts, with the largest weighing 30 t measuring 6.4 m in diameter. Vanguard assembled and lifted the 172 t dryer measuring 24 m in length and 6.4 m in diameter.

Vuncke Belgium manufactured the step-grate energy plant which will burn forest waste and bark as fuel, generating the equivalent of 45 MW to heat the 72 kℓ of thermal oil which will be used to heat the particle board press. The flue gas from the energy plant will be used to evaporate...
moisture from the timber particles (prior to being pressed into boards) at a rate of 45 tph.

According to Francois Pienaar, PG Bison’s mechanical engineer overseeing construction of the energy plant, managing the interface between locally manufactured components and imported plant proved to be as much a challenge as transporting the bulky components and reassembling these on site. Although the construction of the energy plant is exposed to the elements, Pienaar believes that the calibre of his boilermakers and their assistants has made all of the difference in sometimes difficult conditions to keep the energy plant construction on schedule. ‘They’re the best in the world. We can be proud of our South African skills which match the specialists brought in from abroad,’ he said.

At the heart of the particle board plant is a state-of-the-art Conti Roll press, supplied by Siempelkamp, the leading German-based manufacturer of wood beneficiation equipment, at €24 million. With an average output of 1,000 m³ per day, the press will feature the latest technology and be the largest of its kind in Africa. The plant will produce for both the local and the export markets. Specialists and artisans from Europe are supporting local crews in assembling the press.

The installation of a 132 kVA electricity supply line from Qumbu to Ugie has been completed ahead of schedule. The new supply line is expected to significantly improve the quality of supply to the Ugie/Maclear region. The costs of the improved electricity supply to the region are being shared by PG Bison and Eskom on the basis of required capacity. The particle board plant will have 16 MW installed power.

The electrical installations are being carried out by Cato Ridge Electrical and SGS Austria under the watchful eye of Gert Bezuidenhout, PG Bison’s electrical engineer. He is confident that the on-site electrical work will be completed to standard and in time for testing by the Siempelkamp engineers in October.
THE N6-REDDERSBURG rehabilitation project which was awarded in a joint venture by the South African National Roads Agency Limited (Sanral) began its construction phase in January 2006.

The N6 road forms part of the national road network of South Africa and carries regional and national traffic. It is also the main link between the industrial areas of Gauteng, the mines in the central Free State and the port city of East London on the southern coast of South Africa.

The N6 road serves a number of farming communities in the Eastern Cape and southern Free State who travel further north to markets in Bloemfontein. The route between Reddersburg and Onze Rust was originally built in the early 1950s and served as the National Route 1 to the Cape until 1972, when the new alignment of the National Route 1 was built approximately 10 km towards the west. The road was then under the jurisdiction of the Free State Provincial Department of Transport Works until 2003, when it was taken over by the South African National Roads Agency Limited, and renumbered National Route 6.

The venture, which went on construction in early January 2006, included the pavement rehabilitation, geometric improvements, drainage improvements and ancillary works of the existing road. The limit of construction started just south of Reddersburg, through the town and up north to Rustfontein, in the Free State on the main route between Bloemfontein and East London, and has a total project length of approximately 39 km, explains Christa Fourie from SSI Engineers and Environmental Consultants.

Although the project was a fairly straightforward one, it required extensive surveying information on the existing road. Data on the road was analysed so that a recommendation could be made to the client on a design speed according to the required standards. The project designs were detailed with the help of infrastructural design software Civil Designer and AllyCAD, programs that have been in use for many years throughout SSI’s branches. The existing road had an initial variable design speed of approximately 90 km/h but various cost estimates for an upgrading to 100 km/h or 120 km/h standard were also provided. In the end the client settled on an upgrade to an 80 km/h design speed towards Reddersburg with the rest of the road designed at 110 km/h.

Most works on the drainage system was done using labour-intensive construction methods. In addition, material from excavations was used so as to reduce the need for suitable dumping sites, improve the efficiency of operations and provide a relatively cheap source of material. We avoided excavation as much as possible on this project as it could lead to problems with unsuitable subsurface conditions. Another danger in excavation was the unforeseen hidden costs associated with the blasting of hard rock. It was therefore recommended that all sections marked for excavation be tested by means of drilling.
to enable a proper assessment to be conducted.

Existing borrow pits outside the servitude area were opened up on certain positions along the road which presented suitable construction materials for the project. According to Fourie, it was estimated that existing borrow pits along the road could provide material in sufficient quality and quantity so that there would not be a need to open up new borrow pits, except for a new quarry. Tests on the existing pits were therefore performed to confirm this. In addition, an environmental impact assessment was carried out on all the borrow pits and the quarry under consideration.

The project is currently in its final phase of completion and once completed serviceability between the industrial areas of Gauteng, the mines in the central Free State and the port city of East London on the southern coast of South Africa will improve dramatically over this section of road.
IN LOOKING AHEAD, world population is going to be the dominant driving force, reports Mbendi in their newsletter.

According to the 2006 revision of the UN’s World Population Prospects, the world is moving from high mortality and fertility to low mortality and fertility, driven by improvements in medical technology and raised standards of living.

The population of the world doubled from 3.2 billion in 1962 to 6.4 billion in 2005 and the Population Reference Bureau predicts that between 2006 and 2050, the world population will increase a further 41% to 9.2 billion, unless, of course, there is a nuclear holocaust or a global epidemic on the scale of the black death or the 1918 flu pandemic.

While we might breathe a sigh of relief that the increase in population is going to slow, these numbers mask a number of underlying trends.

Though the birth rate in developed countries has dropped, sometimes below the replacement level of 2.1 children per couple, birth rates in many developing countries remain high. According to Eurostat, fertility rates in every country in the EU in 2004 were below 2.0 with some of the former communist states recording rates close to 1. Japan’s birth rate fell between 2.1 in 1962 dropping by 12.9% with the working population recording rates close to 1. Japan’s population is forecast to diminish by 9.8%, with the working population reaching 1.26 in 2005 and between 2005 and 2030, Japan’s population is forecast to diminish by 9.8%, with the working population dropping by 12.9%. OECD (Organisation for Cooperation and Development) numbers for other countries are South Korea 1.08 in 2005 and the US 2.04 in 2003. Interestingly, in Algeria and Tunisia the fertility rate has also dropped below 2 while in Gaza it is above 6. Some 35% of the population of the Middle East is under 16 as a result of high fertility rates.

By and large life expectancy is also rising. By 2015, 25% of Japanese will be aged 65+. Average life expectancy in developing countries is 65 and the number of people over 60 in developing countries will rise from 8% in 2006 to 20% in 2050. HIV/AIDS will cause life expectancy to drop in many African countries, as well as Russia and the Ukraine.

However, living longer is not all good news. The OECD forecasts that, despite pension reform in 16 of 30 OECD countries, retirement benefits in rich countries need to be cut by 13% to 25% and people need to work longer. The California Healthcare Foundation forecasts healthcare costs will rise from US$3.9 billion in 2006 to US$31 billion in 2020 as a result of inflation, longer life expectancy and an ageing population.

Centuries ago Malthus predicted that food production would not grow as fast as population but somehow, mainly through improvements in agricultural technology, we have managed to feed everyone. Like Malthus, we must question whether this can continue, especially when agricultural land starts being used in the large-scale production of biofuels. The FAO (Food and Drug Administration) 2006 report says food insecurity affects 800 million people, most among the 1.2 billion extremely poor earning less than US$1 per day. Food production dropped from 2.6 billion tons in 1994 to under 2 billion tons in 2006, while food stocks dropped from enough to feed the world for 116 days in 1999 to 57 days in 2006. The FAO and the US Department of Agriculture reported that the 2006 harvest wasn’t enough to feed everyone for the sixth time in seven years. World wheat stockpiles are at the lowest level in 25 years, largely because of drought in Australia. Global wheat production is expected to drop causing stock levels to drop further to 20% below 2005. An article in Science forecasts that there will be no commercial fishing by 2048 as present levels of fishing would cause stocks to decline to less than 10% of maximum catches recorded.

It’s not just food, but also water that is starting to be in short supply. For instance, India’s urban demand for water is expected to double and industrial demand to triple by 2025, while China’s urban demand for water is expected to grow 70% and industrial demand 104% between 2010 and 2030. The World Bank estimates that countries of the Middle East and North Africa already consume 20% more water than they receive through rain and river flows, leading to depletion of groundwater supplies. This could get worse with climate change and, according to the United Nations Development Programme (UNDP), 40% of the world’s population will suffer water shortages by 2050.

The World Bank estimates that countries of the Middle East and North Africa already consume 20% more water than they receive through rain and river flows, leading to depletion of groundwater supplies. This could get worse with climate change and, according to the United Nations Development Programme (UNDP), 40% of the world’s population will suffer water shortages by 2050.

At the same time, standards of living continue to rise, leading to greater consumption levels. The World Bank’s Global Economic Prospects reports global income has doubled since 1980 and 450 million people have been lifted out of poverty since 1990. In another sign of increasing consumption, the Airports Council International expects the number of air travellers to double to more than 9 billion by 2025.

The world after 2020

[In a future issue, we’ll complete our summary of the impacts of continuing global population growth – Ed]
Slip-forming saves valuable construction time

GRINAKER-LTA CIVIL ENGINEERING, in joint venture with Murray & Roberts Civils, is providing substantial civil works for the new Khumani iron ore mine which is being developed by Assmang Limited on the Bruce, King and Mokaning farms in the Northern Cape between Kathu and Olifantshoek.

Assmang is jointly owned and controlled by African Rainbow Minerals and Assore Limited. Dra Mineral Projects (Pty) Ltd has been appointed by Assmang as managing contractor for the whole works and EPCM as contractor for the plants.

The scope of work for this R270 million civil engineering project includes the construction of civils for primary and secondary crushers, haulage workshops, on- and off-grade tertiary crushers, lumpy stockpile tunnel, on- and off-grade washing screen building foundations, 5.5 km long overland conveyor, product and lumpy, stacker and reclaimer foundations, ROM off-grade stacker and reclaimer foundations, primary thickener, various conveyors and transfer tower plinths as well as the process, dirty and potable water tanks.

‘Owing to the programme constraints and earlier mechanical access required to the primary crusher, the JV was requested to come up with an innovative and practical engineering solution that could speed up the construction process in order to meet the client’s requirements,’ said Frank Oliveira, operations director of Grinaker-LTA Civil Engineering. To this end, Karrena Africa was brought in. By using the method of slip-forming on the external walls the construction period for the primary crusher was reduced by two months. Karrena’s expertise in setting up the hydraulic shutters proved invaluable and the operation was extremely successful.

As Khumani is a new mine, construction of the foundations and ancillary items will require about 55 000 m³ of concrete, along with 5 700 t of reinforcing steel and 200 t of cast-in items.

The project is now running at full steam and is scheduled for completion during the second half of 2007.
AS WELL AS the Soccer City Stadium in Gauteng, Grinaker-LTA Construction, in Joint Venture with Interbeton, is constructing a brand new stadium in Port Elizabeth for the FIFA World Cup in 2010.

Known as the Nelson Mandela Bay Multi-Purpose Stadium, its white roof with leaf-shaped colonnades promises to make it a striking landmark for Prince Alfred Park in North End.

The 46 000 seater stadium is being constructed at a cost of just over R1 billion. The challenge is to complete it by mid-December 2008 so that finishing details can be installed and commissioned in time for the Confederation Cup in June 2009.

The Grinaker-LTA/Interbeton ibhayi Joint venture is responsible for the civil and building works for this five-level stadium which will have permanent seating for 40 000 spectators and temporary modular seating for additional spectators on the uppermost level. The scope of work comprises:

- Foundations comprising pile trimming, pile caps, conventional strip footings and bases
- Reinforced concrete surface beds
- Superstructure comprising cast-in-situ reinforced concrete columns, beams and slabs
- Pre-cast seat elements and raking beams to support the seat elements
- External and internal masonry divisions, complete with doorframes, windows, shopfronts, etc
- Installation of all finishes to floors, walls and ceilings
- The joint venture includes Grinaker-LTA Civil Engineering, Grinaker-LTA Building (Cape) and Interbeton, with HBM Stadion-und-Sportstattenbau, a German construction company that specialises in sports stadia, as advisors.

The most visible feature of the stadium is the roof, which appears to be levitating over the base of the stadium. It will have a structural steel frame covered with two layers of cladding – one being aluminium, the other a PTFE-coated glass fibre fabric. It has been designed to provide maximum protection from wind and rain to the spectators on the upper concourse and upper tier in particular.

Before construction began, earthworks comprising 138 000 m$^3$ of excavation and 98 000 m$^3$ of backfilling was carried out by Scribante Construction (Pty) Ltd and some 2 300 piles were driven into the ground by Franki to anchor the structure securely. Piles attached to the columns supporting the roof will have to be installed to be able to withstand uplift wind forces experienced due to Port Elizabeth’s notoriously windy climate.

In order to meet the scheduled completion date, plant on site include eight tower cranes, a batch plant and concrete spinner trucks. An on-site pre-cast yard will provide the raker beams to support the seating as well as the tier seating itself.

At the peak of the contract the JV will be employing more than 100 supervisory staff and a labour force of more than 1 000, most of whom will come from the local community and will be trained in construction methods. Local subcontractors and suppliers are participating in the project in line with set objectives.

In all, some 39 consultants headed up by the BKS/BTK-PMSA Joint Venture are combining their expertise to create a world-class stadium which will not only be used for soccer but many other sporting and entertainment events too.

Because of the international events already scheduled for this venue, keeping on programme is the most important factor in this project. Good communication between the many parties involved will be key to the success of this project.

Soccer programme exerts relentless pressure
Sustainable solutions in infrastructure design

THE 2010 SOCCER WORLD CUP has placed tremendous pressure on South African civil engineers. In a recent interview, SAACE CEO Graham Pinie said that ‘the 2010 soccer World Cup is not just about the event. Twenty-ten is about infrastructure, communications, transport, and emergency services. It is about the whole integrated approach that goes way beyond 2010.’

South African civil engineers operate in a unique environment. Multi-disciplinary projects have placed greater emphasis on infrastructure design software where integration across services is key. The recent infrastructural boom in South Africa has seen many infrastructural design programs evolve to offer sustainable solutions. According to South African civil engineering expert Vincent Bester, CEO of Knowledge Base, a track record is however not built overnight.

‘Understanding the unique conditions of the civil engineering industry comes with being in touch with the industry way before the first 2010 talks even began. In fact, building relationships with consulting engineers is an ongoing process that demands personalised attention and a dedicated support team walking the road with the consultant from start to finish.’

Vincent dedicated his South African-based company Knowledge Base to serve the needs of engineering professionals. The company produced the first integrated infrastructure design program customised to South African conditions in 1989. The well-known Civil Designer suite offers seamless integration across nine unique design modules and is currently used by the vast majority of consulting and municipal engineers in South Africa.

According to Bester, the uniqueness of Civil Designer lies in its ability to offer a range of fully functional design modules that handle complicated and intricate designs from inception to completion. Accomplades to the software’s credit include engineering excellence feats where Civil Designer was employed to produce the final design.

The organisation supports consulting engineers by publicising their engineering success stories in prominent trade journals. Some of the lasting monuments that were designed with Civil Designer and which were publicised extensively include the Addo Elephant National Park, the Coega Harbour project, Chapmans Peak road, the Potsdam Interchange and the N2 Gateway housing project.

But what is it about Civil Designer that makes it formidable in the industry? Civil Designer consists of nine modules which include Design Centre, Survey & Terrain, Roads, Water, Storm, Map, Turn, Sewer and CAD. Each module provides interactive functionality and is powerful as an individual design entity in its own right, explains Vincent.

In short, the various modules are the following:

- **Design Centre** lies at the heart of the system and contains the graphical and topographical engines
- **Survey & Terrain** is a digital terrain modelling program that provides interactive earthworks design and calculations featuring an interactive Strings function
- **Roads** provides interactive embankment design and calculations for urban and rural roads, freeways, airports, railways and dams
- **Water** provides analysis and extended time simulation of fluid handling networks for pipes, valves, reservoirs and pump stations and includes pipe sizing and a pipe/pump catalogue updater
- **Storm** combines runoff event network analysis design with interactive drawing functionality, and has made provision for a SWMM dynamic rainfall run-off model
- **Map** is designed for use by local authorities, government bodies and stakeholders that require physical entities to be represented with an associated database of information
- **Turn** simulates the low speed turning manoeuvres of a range of vehicles from cars through to trailers and semi-trailers, as well as user-defined vehicles, along specified tracking paths
- **Sewer** is a foul-water network analysis and design module that includes full sizing analysis for networks and is equipped with SABS 1200 quantities
- **Cad** provides the full CAD functionality required by a draughtsman

Other strengths include the fact that the design modules communicate through a common interface. The program therefore interactively indicates other services and service clashes when designing a road. This means that when the designer is defining for example the road long section (or vertical alignment), the designer will be shown exactly where existing or new pipes cross the road so that the route can be adjusted.

The software helps to avoid costly delays on site during the construction phase and saves the engineer time and money. This, coupled with dynamic earthwork design, TRH design criteria built into the Roads module, a kerb library, auxiliary lane routine, regression analysis and rendered 3D drives, has led to the software’s increase in popularity.

The popularity of the software has also extended to the educational sector with South African universities of technology offering Civil Designer in their curriculum. In addition, secondary institutions offer AllyCAD in their technical subjects. This investment equates to R80 million over the last nine years. Availability of local software like this gives South Africa the much-needed competitive edge in service delivery.
RURAL CONSTRUCTION PROJECTS, which are usually small in monetary terms, can impact greatly on the lives of remote communities. Two such projects have been completed recently, one in the province of KwaZulu-Natal, and the latest one reported here, in the Eastern Cape.

Following hot on the heels of the Pietermaritzburg office SAICE award for the best community project – the Qwasha bridge across the White Mfolozi – SSI’s East London office has completed another community-centred project, the Bozwana Village footbridge.

Bozwana is remotely located, approximately 30 km north east of Queenstown in the Emalahleni Local Municipal area, which falls under the Chris Hani District Municipality. The Bozwana Junior Secondary School (Grades 1 to 9) is situated about 300 m from the eastern bank of the White Kei River, which is the main river feeding into the Xonxa Dam, some 10 km downstream. The school serves approximately 400 children, most of whom live on the western side of the White Kei River and were forced to ford the river twice each day to get to and from school.

An extensive 1 300 km² catchment area feeds the White Kei River up to Bozwana Village, resulting in the river being impassable when there is any significant rainfall in the area, particularly in the summer months. A number of accidents have been reported where children have underestimated the flow rate in the river and were swept away. The Glen Grey Falls, situated some 1.9 km downstream from the bridge site, adds further danger to any person washed away by the river.

THE BRIDGE STRUCTURE
SSI engineers carried out a detailed geotechnical investigation, as well as an environmental scoping report including community participation, all of which resulted in several alternative designs for a pedestrian foot bridge. The preferred structure, in terms of safety and minimisation of environmental impact, was a four-span bridge with an 80 m long steel deck on concrete piers and piled foundations. The bridge structure has been designed to cater for a 1 in 50 year flood and has a deck height of 7,5 m above riverbed level.

CONSTRUCTION PHASE
Construction commenced on 29 January 2007 and was completed on 29 May 2007. In line with the Expanded Public Works Programme, the contractor made use of local labour throughout the construction period.

Construction included:
- Piling to an average depth of approximately 6 m
- Five reinforced concrete piers
- A 1,75 m wide x 1,3 m high lattice type structural steel deck
- Approximately 55 m² of gabion work
- Associated minor civil works

The local community were involved throughout the project via a project steering committee with selected members participating in the project site meetings. A community liaison officer was employed full time during the construction of the project. This project was completed on time and within its R3,165 million budget and Chris Hani District Municipality, the children and the community are pleased and relieved that the river can now be crossed safely.
THE AREA OF KIRKWOOD, located in the southern part of the Eastern Cape Province, has recently come under the spotlight with the Moses Mabida project.

Moses Mabida lies approximately 3.5 km from Kirkwood’s central business district along the Enon Road and is located within the Sundays River Valley municipal area.

‘The residential area of Moses Mabida is currently operating on self-constructed pit-latrines. This system is subject to pollution and is extremely unhygienic. The large number of pit-latrines in use has also identified the possibility of epidemic threats like cholera that could occur. Another concern is that the subsurface conditions in Kirkwood are not suitable for the installation of a sanitary system which relies on a septic tank since the soil is not sufficiently pervious. The effluent from pit-latrines will contaminate ground water, which will in turn surface in adjacent rivers,’ explains Jeffares & Green Design Technician Gerald Smith.

According to Smith, the Kirkwood area is situated in the southern temperate climate zone where moderate to fairly harsh conditions prevail. Rainfall is about 400 mm per annum, falling throughout the year. Undeveloped vegetation in the area consists of sparse valley bush with some fruit orchards found along the bulk sewage pipeline route. In areas where dwellings have been constructed the vegetation has been cleared.

‘To alleviate the raw sewage flow problems from Kirkwood, Moses Mabida and Emsengeni, Jeffares & Green Consulting Engineers was commissioned to construct a new wastewater treatment works (WWTW). We made extensive use of infrastructure design software Civil Designer during the sewer design and erf connection analysis on the project,’ notes Gerald.

The existing residential area of Moses Mabida comprises about 1 500 occupied erven with nearly all of them fully reticulated with a water standpipe on every erf. Informal settlement has taken place within the area resulting in some 230 additional erven within Moses Mabida. Many of the existing houses in Moses Mabida are occupied by more than one family with some erven containing more than one dwelling. ‘These conditions have led to VIP toilets being constructed, but has however resulted in pollution of the subsurface water. Consequently, there is a need for the development of appropriate sanitation to be provided in Moses Mabida,’ says Gerald.

The aim of the Moses Mabida project is to provide waterborne sanitation facilities to approximately 1 730 erven in the residential areas of Kirkwood, Moses Mabida and Emsengeni. This will ensure that imbalances with respect to the sanitation facilities in Moses Mabida are addressed. This will also reduce the health hazards associated with pit-latrine sanitation systems. The operation and maintenance of a single sewage system in Moses Mabida is therefore assured.

The full scope of the Moses Mabida project consists of the construction of toilets, sewer reticulation, minor water supply facilities and related sewer connections with outfall sewers from Moses Mabida forming part of the project. Toilet structures built on each site consists of a raft foundation cast in situ with a concrete block structure while the sewer reticulation consists of about 30 000 m of 100 mm and 20 000 m of 160 mm diameter UPVC pipes.

The project has been broken down into five phases as a result of its scope and the considerable amount of funds required to complete the venture. Phase I consists of the outfall sewer pipeline from Moses Mabida to the WWTW as well as the upgrade of 70 erven, with Phase II involving the upgrade of some 380 erven, Phase III of about 375 erven, Phase IV of about 400 erven, and Phase V of some 505 serviced erven.

The project forms part of the IDP which has been drawn up for the Sundays River Valley Municipality. All building and related structures of the WWTW has now been completed with the works in operation. The full works will however not be fully utilised unless sewers to some 1 730 erven currently served by a pit-latrine sanitation system are installed. Finalisation for municipal funding for converting all 1 730 households to waterborne sanitation is currently being finalised.
TOSAS
The leading South African roads ‘binder’

MORE THAN 35 YEARS OF SERVICE EXCELLENCE
TOSAS (Pty) Ltd, a joint venture between Sasol and Total, is proud to have served the African road building industry since 1971, serving diverse applications: from road construction and rehabilitation to agricultural dam-sealing, as well as dust suppression in the mining environment.

A committed South African company in every sense of the word, TOSAS provides the best in technical expertise, a premium product and a contractor service.

STRIVING FOR EXCELLENCE
As one of the largest suppliers of conventional and modified binders and various bituminous products in South Africa, Namibia and Botswana, TOSAS is committed to the development, research, manufacture and application of the finest modified binders. Backed by professional and experienced application teams who are trained and dedicated to providing the best levels of service and efficiency, TOSAS ensures that neither products nor any surfacing activities impact negatively on the environment.

COMPREHENSIVE CAPABILITIES
A unique company structure enables TOSAS to meet every conceivable need when it comes to bituminous road binders – TOSAS is manufacturer, supplier and applicator all rolled into one.

The company locally manufactures a wide range of bituminous products including anionic/cationic emulsions, polymer modified bitumens, bitumen rubber, damseal, dust palliatives as well as primers and pre-coats.

TOSAS conveniently supplies a wide variety of application specific products off the shelf; bitumens and modified bitumens, bitumen emulsion and modified emulsions, dust palliatives, waterproofing and DIY products.

TOSAS also provides a comprehensive application service, backed by a team of professionally trained technicians, to further assist clients who do not have their own application facilities. Services include spraying, slurry sealing, bulk and drum delivery.

The company offers technical support and its technical expertise ensures the optimum solution for applications including field marketing, product and application specifications, SHERQ best practices, certified products and R&D facilities.

Storage facilities offered by TOSAS include bulk, drums and site storage.

RANGE OF PRODUCTS

Bitumen binders
TOSAS is one of South Africa’s leading suppliers and applicators of bituminous products and offers a diverse range of bitumen binders. ‘We have a binder for all applications, including priming, seal construction, asphalt surfacing as well as treatment of existing surfaces,’ says TOSAS Marketing Manager Johan Jacobs.

Bitumen rubber
Bitumen rubber, the company’s flagship product, is a waterproof and flexible seal used in the preparation of road surfaces. The bitumen rubber modified binder has the excellent ability to prevent crack reflection in seal applications such as Stress Absorbing Membrane Interlayer, known in the trade as SAMI. Bitumen rubber used in asphalts has outperformed any other known binders in Southern Africa. This flexible interlayer is the ideal surface preparation for the subsequent asphalt construction intervention, Bitumen Rubber Asphalt Surface Overlay or BRASO, which is to be applied over the SAMI eighteen months later.

According to Jacobs, bitumen rubber provides a good quality, immediately functional driving surface to ensure minimal traffic disruption, ‘as, under compaction and traffic, the
Bitumen rubber seal allows the road stone to re-orientate’, explains Jacobs.

**Bitukote**

Designed by TOSAS, Bitukote is an environmentally friendly pre-coat product developed as an alternative to tar-based pre-coats. This TOSAS bitumen pre-coat is a blend of certified products comprising base bitumen, aromatic cutters and adhesion agents. It can be used with varying sized aggregates under slightly dusty or damp conditions and is compatible with both conventional and modified binders. Other features include improved wetting and adhesion properties.

**Bitumen road emulsions**

TOSAS emulsions include SS Anionic emulsions, KRS, KMS and KSS Cationic emulsion, Fogspray and Stabilising emulsion as well as TOSAS QDP (Quick Drying Prime). Jacobs explains: ‘In order to produce an emulsion, an intimate mixture of two immiscible liquids, one liquid is dispersed in the other, in the form of fine droplets. The multitude of droplets produced has a vastly increased interfacial area. Consequently, in order to disperse the liquid, we have to create new interfaces, an operation to which interfacial tension between the liquids is opposed. The higher the surface tension between the two phases of the potential emulsion, the more difficult it will be to disperse the one liquid in the other.’

Bitumen in the grades commonly used on road construction is a very viscous liquid, almost merging on the solid state. ‘It must be converted into a fluid state to be used effectively and this lowering of viscosity can be achieved by heating the bitumen, by dissolving it in a solvent or by dispersing it in water to form an emulsion,’ says Jacobs.

Some advantages of emulsions compared to bitumen are that no heat is required during storage; there is no need for use of dry, pre-coated or dust-free aggregate; emulsions can be used during adverse weather or temperature conditions; they are easier to apply; and emulsions already contain anti-stripping agents.

**SUPERIOR STANDARDS AND PROVEN QUALITY**

‘Unless otherwise specified, all our products are manufactured in compliance with COLTO specifications, SABS standards or TOSAS Proprietary Products description,’ comments Jacobs. ‘Our range of bitumen binders covers conventional binders as specified in the Standard Specifications for Road and Bridge Works for State Road Authorities (COLTO), as well as modified binders and emulsions as highlighted in the Technical Guideline use of Modified Bituminous Binders in Road Construction (TG1).’

‘Our product range is manufactured from only the finest quality bitumen, supplied by the National Petroleum Refiners of SA (Naref). The bitumen is produced from dedicated crude oil sources to ensure consistent and reliable quality,’ says Jacobs.

**COUNTRYWIDE CUSTOMER SUPPORT**

‘We have established strategically placed TOSAS bituminous manufacturing plants in Johannesburg (Spartan, Wadeville), Bloemfontein, KwaZulu-Natal, Worcester, Queenstown, Vryburg, Tsunec and Gaborone to ensure an uninterrupted supply of essential products to our customers. Our rapidly expanding depot network further enhances our product availability and service support,’ comments Jacobs and adds: ‘We also market all our products into sub-equatorial Africa directly or through agents.’

**PROJECTS**

**Ben Schoeman Highway**

The company’s class leading product quality and impeccable service ethic are some of the factors that contributed to TOSAS having been selected as the partner of choice for a number of large road projects. The extremely busy section of the Ben Schoeman Highway in Johannesburg is undoubtedly one the most important success stories of road resurfacing in 2007.

Johan Muller, TOSAS Technical Manager, explains: ‘When our customer, KP Project’s client, South African National Roads Agency Ltd (Sanral), requested us to be part of the Ben Schoeman Concrete Freeway Overlay Project, we knew that meticulous planning and team work were of prime importance. The 12 km, eight-lane section between the Allandale and Buccleuch interchanges is one of South Africa’s busiest roads, carrying up to 165 000 vehicles per day.’

‘Owing to the high volume of traffic, only sections of the highway could be closed from Friday evening 19h00 to Saturday afternoon 15h00 in order to complete the project. It was a daunting task in anybody’s book, but we lived up to our reputation and, with careful pre-planning and superb teamwork, we delivered on time,’ states Muller.

**CARING ABOUT THE ENVIRONMENT**

TOSAS was awarded ISO 14001 Environmental Certification in 1996 and was the first company...
in South Africa to have received this certification in recognition of the company’s awareness of environmental issues. The bitumen rubber ‘flagship’ product contains 20% rubber crumbs manufactured from discarded buffings and peelings during tyre re-treading processes. ‘Tyres that have reached the end of their lifespan are health and environmental hazards,’ explains Jacobs.

‘They are often thrown away indiscriminately and when water pockets form, they become the ideal breeding ground for mosquitoes and other insects. Probably even worse is the highly noxious fumes released into the atmosphere when tyres are burnt. By recycling rubber peelings, we feel that, by using some of the tyre waste products in our product, we are making a contribution in keeping the atmosphere and environment cleaner,’ comments Jacobs.

The words ‘we care’ are incorporated into the company’s slogan and TOSAS endeavours to ensure that neither products nor re-surfacing materials have a negative impact on the already sensitive environment.

SUSTAINABLE DEVELOPMENT
The company’s culture of ‘caring’ extends to sustainable development of people as well as to the community it serves. TOSAS is therefore committed to transformation, entering into joint ventures with emerging contractors, based on technical expertise and commitment to service. The company believes that, by combining effective cross-cultural communications, investment and commitment, the TOSAS vision of establishing respected, vibrant business ventures able to provide excellent internal as well external engineering services, will be realised.

IMPECCABLE SERVICE AND CUSTOMER SUPPORT ETHIC
TOSAS prides itself on an expert technical support team that works closely with road authorities, consulting engineers and contractors. The team is always readily available to assist and to find the best possible bituminous product and/or application solution for the customer.

MEETING DEMANDS AND EXCEEDING EXPECTATIONS
TOSAS recently added eight new sprayers to the company’s existing fleet to meet increasing customer demands. A large, well-organised application division, an extensive supply network, a superior product range and impeccable service, combine to allow TOSAS to meet even the most demanding project deadlines with the utmost confidence.

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CSIR IN PROJECT TO ENABLE RURAL RESEARCH

THE CSIR IS PARTICIPATING in an international research consortium aimed at enabling people in rural areas to take part in research and the development of technology that could affect them.

Researchers from the CSIR Built Environment and the Meraka Institute, a national research centre managed by the CSIR, are involved in the project, which is funded by the European Union’s (EU) Framework Programme 6 (FP6).

The Collaboration@Rural: a Collaborative Platform for Working and Living in Rural Areas project, or C@R for short, will last three years and provides a platform for research and technology development institutions to collaborate with rural communities in developing effective methodologies implementing rural living labs in rural economies.

‘Rural living labs are user-centric, real-life research and development contexts, involving people, businesses and public players in the co-creation of services enhancing rural development,’ explained CSIR researcher Johan Maritz.

The CSIR’s involvement in C@R came about after SAP Research South Africa approached the organisation in March 2006 to explore joint research opportunities in the rural domain. SAP needed a ready context within which to deploy a South African rural living lab and the CSIR had been doing extensive work relevant to this in the Sekhukhune area in Limpopo.

‘The living labs concept is about research and technology development institutions setting up long-term relationships with the inhabitants of the real-world context in a way that will ensure active participation by the latter in the research and development (R&D) process,’ said Maritz.

The main objective of the C@R project is to promote the introduction, establishment and maintenance of collaborative working environments as key enablers of sustainable development in rural areas.

The technical aspect of C@R comprises three layers: collaborative core services, collaborative software tools and rural living labs.

‘The first layer will encapsulate all core services and resources, such as networks, sensors, devices, software modules and localisation sources, in reusable software components. C@R will therefore be highly customisable in the sense of providing mechanisms to incorporate any proprietary or open solutions, and any standard,’ Maritz said.

The CSIR’s efforts will focus primarily on the third layer, which will articulate rural living labs as innovative research instruments involving rural users, with some linkages to the first layer.

‘The user-oriented methodology of the rural living labs will ensure that the highly specific requirements of rural users are met, and will provide mechanisms to gather technical requirements for the project as well as develop and test possible solutions,’ Maritz explained.

The Sekhukhune area has been selected as the location of the South African rural living lab. Various relationships will be set up with small, medium and micro enterprises (SMMEs) and other public and private sector role players in the area.

The research team will collaborate with these entities on an ongoing basis to ensure the two-way flow of information, knowledge, responses and needs for the duration of the project, and beyond.

There is also a focus on the use of cellphones because of its potential as a catalyst for rural development.

‘Since it is not possible to study all service sectors, the CSIR’s research focuses on the nature of rural health service networks and rural logistics brokering,’ Maritz said.

CONSTRUCTION COMPLEMENTS AT MBASHE NORTH

TEN YEARS AFTER the first conceptual plans for the Mbashe North water supply project in the Eastern Cape were drawn up by SBA, construction has commenced.

The first phase of the project – construction of the bridge – is scheduled for completion in April 2008.

‘Local communities are benefiting from this project which is providing desperately needed employment in the area,’ says André Naudé, director of SBA. ‘New skills are being learned and transferred to the community. It is expected that in the 15 month construction period, a minimum of 5 000 manday jobs will have been created. This financial injection will impact positively on households in this poverty stricken area.’

WHEN CONSULTING ENGINEERS Vela VKE were given a brief by the KwaZulu-Natal Department of Transport to supply two pedestrian bridges over rivers subject to flash floods, the time span for design and implementation were very tight. These bridges were desperately needed as the flooding rivers cut rural communities off from access to schools and clinics.

Both bridges were designed comprising three 17 m spans consisting of simply supported galvanised steel truss decks, supported on reinforced concrete piers and abutments. One bridge was founded using 300 mm diameter steel tube piles and the other bridge was founded on spread footings on bedrock. The design was based, as far as possible, on a robust, maintenance-free approach.

The design allowed for the construction of foundations and substructure to take place simultaneously while the steel truss was being fabricated off site. This approach helped to meet the programme dates which was a four month period spanning the contractor’s year end shut down.

The design proved to be easy to construct in the short time frame available.

The opportunity to fabricate the deck off site whilst the substructure was being constructed contributed to the short construction period. Assembly of the pre-galvanised steelwork on site, in pieces which were about 5,7 m in length and weighing about 680 kg, proved to be manageable.

Further, the use of Bond-Lok permanent shuttering to the deck slab worked well and provided a ‘clean’, aesthetically pleasing finish. Both sites were within range of ready-mixed concrete plants and this further assisted construction.

This project was not only completed on time, but it was also below budget. The design certainly proved itself and may be useful for similar projects in the future.

MORE INFO
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KV3 ENGINEERS CELEBRATES 30 YEARS OF GROWTH

SOUTH AFRICA’S LARGEST black-owned engineering consultancy, KV3 Engineers, celebrates a 30 year milestone in the engineering industry. Opening in 1977 with a staff complement of only 39 employees, KV3 has grown over three decades to today’s 600 strong and multidisciplinary team.

The company operates from 27 branches within South Africa and from its international branches in Abu Dhabi, Kinshasa, Lusaka and Windhoek, staffed by personnel who knows the local environment and conditions, thus enabling KV3 to remain close to their clients.

KV3 covers the whole spectrum of consulting engineering under one roof with its eight divisions, Civil & Development, Environment, Energy, Mechanical Engineering, Project Management, Structural Engineering, Transport and Water & Waste Water Treatment.

The company began its transformation process in 2001 with the Kwezi Group; an empowerment company focused on infrastructure development services, mining equipment supply and information and communication technologies, acquiring a 40% shareholding in the company. In 2004, KV3 set a benchmark in the engineering fraternity by increasing Kwezi’s equity stake to 70%, thus creating the largest black-owned multidisciplinary engineering consultancy in South Africa.

The empowerment deal was an important milestone in the history of KV3, not only in terms of transformation and business growth, but also in terms of human capital development.

KV3 has achieved a 300% growth in turnover over the past six years with a R300 million turnover generated in the past financial year. Accelerated transformation has taken place across all tiers of management: the board of the company has changed completely over the past six years and is now representative of the demographics of the country.

‘Some 45% of our technologists, 54% of our non-professional engineers and 54% of our technicians are from previously disadvantaged backgrounds. Our goal is still to have stronger participation of previously disadvantaged backgrounds with financial assistance and training and mentoring programme, the company will select a number of schools nationally that are performing well but are constrained by lack of funding. We will augment educators’ salaries so that these schools can attract top class mathematicians and science teachers and will also become involved in additional mathematics and science classes,’ says Jacobs.

‘KV3’s current bursary scheme includes 95 students of whom 31 are at university. As part of the training and mentoring programme, the company also supports engineering students from disadvantaged backgrounds with financial assistance and practical training during their studies.’

Current projects on both a national and international scale include, among others Gautrain, for which KV3 in association with UK-based Atkins International was appointed by the main contractor, the Bombela Civil Joint Venture, for the preliminary as well as the detail design of the south–north section. In addition, KV3 has also been appointed as the lead consultant on the structural work for the 2010 stadium in Port Elizabeth.

The company’s continued success is not only evident in its past and current track record but also in the list of accolades attributed to them, among others, the Gold ESI Africa Excellence Award for Best Consultants, which has been awarded to KV3 in 2004 and 2006.

The current construction boom that has put the engineering profession under severe strain and has made the shortage of trained and experienced engineers even more apparent is being met by the company with increased investment in young talent.

‘We need to attract more young people to the profession, and to do this, among other things, we need to improve the quality of education at school level in subjects such as mathematics and science which are crucial if you wish to study engineering. We are about to become involved with selected schools through the KV3 Chairman’s Fund. We will select a number of schools nationally that are performing well but are constrained by lack of funding. We will augment educators’ salaries so that these schools can attract top class mathematicians and science teachers and will also become involved in additional mathematics and science classes,’ says Jacobs.

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Current projects on both a national and international scale include, among others Gautrain, for which KV3 in association with UK-based Atkins International was appointed by the main contractor, the Bombela Civil Joint Venture, for the preliminary as well as the detail design of the south–north section. In addition, KV3 has also been appointed as the lead consultant on the structural work for the 2010 stadium in Port Elizabeth.

The company’s continued success is not only evident in its past and current track record but also in the list of accolades attributed to them, among others, the Gold ESI Africa Excellence Award for Best Consultants, which has been awarded to KV3 in 2004 and 2006.

SCRAP BATTERIES HELP IN ARBOR WEEK’S GREENING OF SOWETO

CONTRARY TO THE POPULAR belief that old car batteries are dirty and useless, over 90% of a scrap battery can be recycled and used in the production of new batteries.

A programme introduced by Willard Batteries is showing South Africans that scrap batteries can and should be recycled. Their components can be re-used, and thus consumption of lead, plastics, acid and other materials reduced.

The savings made through this recycling initiative are channeled by Willard into tree planting – which also offsets the company’s environmental ‘carbon footprint’.
National environmental campaign Indalo Yethu is supporting Willard’s initiative, since it complements Indalo Yethu’s mission to popularise the notion that environmentally sound practices bring tangible economic and social benefits.

This Arbor Week, Willard Batteries and Indalo Yethu recently spent a day at Tiyimiseni Primary School in Meadowlands, Soweto, where they planted 20 trees in support of the Food & Trees for Africa Urban Greening Programme.

Indalo Yethu’s basic principle is that everyone can be part of eco-living by following the 3Rs – Use, Reduce and Recycle. ‘This is what the Willard Batteries initiative embraces – and we want to encourage other businesses from various sectors to seek creative ways to positively impact both on the environment and on their own operations,’ says Zandile Nzalo, Indalo Yethu’s CEO.

Nzalo says that partnerships and collaborative efforts such as the tree planting initiative are an example of the collective action necessary to move South Africans towards an eco-caring society. ‘At Indalo Yethu, we promote environmentally conscious living as a way to improve health and lifestyle – in addition to the economic benefits that can be derived from practising the 3Rs.

‘Recycling is a sustainable environmental practice that provides both economic and environmental benefits, which is why it is internationally regarded as a solution to a number of environmental ills,’ Nzalo points out.

With over 90% of a scrap lead-acid battery being recoverable, consumers are urged to adopt a habit of exchanging their old batteries when they go to purchase new ones. Funds raised thus by Willard Batteries support the Urban Greening Programme, which includes urban management, urban agriculture, permaculture and urban forestry.

WSP GROUP AFRICA has announced its multidisciplinary appointment on the Coega Industrial Development Zone (IDZ) near Port Elizabeth.

WSP Civil and Structural Engineers has been appointed for a large portion of the civil engineering infrastructure and the building infrastructure, while WSP Consulting Engineers has been awarded the consulting service for a large portion of the electrical and mechanical engineering services and infrastructure.

WSP Civil and Structural Engineers’ project manager Marius Weyers says: ‘Our initial appointment was for the building infrastructure, and I think it made sense to then also appoint us for the civil infrastructure feeding the buildings. Our appointment includes all roads, stormwater management, water, sewer and electrical services for the ± 87 000 m² trailer park area. In addition, there are in the order of 22 buildings, each with its own infrastructure, that need to be constructed over a three-year period.’

The head structural engineer on the project, WSP Structures Africa’s William Johnston, says: ‘The 22 buildings satisfy widely varied usage requirements, from single storey structures for change rooms and canteens, to a six-storey administration block. The site also requires ten sub-stations, some of which are double storey structures tying into underground service tunnels, as well as several mechanical workshops with overhead cranes and service pits. The structures pose some interesting founding conditions on the reworked sand dunes and coastal rock strata.’

WSP Consulting Engineers’ lead services engineer on the project is Gino Mazzucchetti, assisted by a support team of directors and service engineers. He says: ‘Our appointment incorporates lighting and power, air conditioning, fire and wet services and general power reticulation to select areas of the development.’

Construction work has commenced on the project, which is scheduled for completion within three years.

Grinaker-LTA is the main contractor on site, the architect is TPS Architects and the design and consultation team is Hatch Consulting Engineers who, together with Transnet Projects, are handling the infrastructure for the balance of the port.

WSP’S MULTIDISCIPLINARY APPOINTMENT AT COEGA

WSP GROUP AFRICA’s KwaZulu-Natal branch provided two special products for the construction of about 180 000 m² of hard-standing area for the upgrading of the Pier 1 Container Terminal in Durban harbour.

The upgrading of the SA Port Operations pier forms part of a R2 billion development plan to establish Pier 1 as a high-performance facility in the southern hemisphere’s biggest and busiest container terminal.

The contract, carried out by Basil Read Construction, called for the laying of about 80 000 cubic metres of 0,45 m thick concrete to provide the hard-standing area that will annually accommodate hundreds of thousands of 20 ft equivalent unit (TEU) containers. Lafarge Readymix designed and supplied the concrete for the project, using PRO cement provided by NPC.

Basil Read Construction Project Manager Glenn Jardine said work on the contract was scheduled for completion at the end of August this year as a result of the client, Transnet, accelerating the completion date from March next year. Lafarge’s on-site batch plant is daily producing about 600 cubic metres of concrete, which contains 37 mm stone aggregate. The concrete specifications call for a strength of 35 MPa at 28 days, he stated.

‘Basil Read Construction not only managed to cope with the tight deadline but also on June 4 achieved a million hours lost time injury-free – a milestone that was honoured by a special award from Transnet,’ Jardine added. ‘We succeeded despite some major challenges, not the least being traffic congestion on site.’

Vishnu Beeput, Chryso SA’s regional manager in KZN, said the company supplied two products for the project: Chrysofluid Optima 207 ‘New Generation’ super-plasticiser and Chrysocure WB curing compound.

‘Chrysofluid Optima 207 imparts substantial water-reduction qualities to concrete, particularly ready mix concrete with its specific requirements of workability and high early-age strength. In fact, for this project, the presence of the admixture made it possible to comfortably exceed the stipulated target strength,’ Beeput stated.

‘Chrysocure WB, supplied in white-pigmented form, helped to retain the moisture in the broom-finished concrete surfaces. The resin-based compound’s formulation ensures...
that a non-penetrative continuous film is formed on contact with cementitious products thereby preventing excessive water evaporation. This results in efficient cement hydration. Chrysocure WB virtually eliminates shrinkage cracking of the concrete.

‘The contractors were also extremely impressed by the fact that the road marking signage could be applied directly on to Chrysocure WB,’ he added.

IN THE FOOTHILLS

IN THE FOOTHILLS of Mount Etna, the Sicilian volcano that can erupt with a plume of smoke and dust, and cause a tremor of the earth’s crust, a unique South African-made machine is creating an impression crushing old lava flows.

The TwisterTrac AC210 mobile vertical shaft impact (VSI) crusher, the first diesel hydraulically driven tracked VSI crusher in the world, has made its first appearance in Italy and is the rocky island that it is, the demand for sand is at a premium. There they are reducing the 8 mm to 15 mm unsellable material down to minus 5 mm sand from lava rock being quarried at the base of Mount Etna.’

The TwisterTrac, with a throughput capacity of up to 250 tonnes per hour, was conceived and 100% in-house designed by Pilot Crushtec’s engineers. It is a tracked, remote controlled plant consisting of a variable speed belt feeder, a Twister VSI crusher, and a discharge conveyor, powered by a 317 kW diesel hydraulic power pack, all mounted on a heavy duty track under-carriage with dual speed configuration, and 25 degree gradability.

A major feature of the TwisterTrac is that the entire machine is controlled via a PLC, which automates all the crusher’s features and facilitates ongoing monitoring of all aspects of the crusher’s operation.

In France, a plant dealer representing Pilot Crushtec, Lheureux & Cie, based outside Paris, has bought the first TwisterTrac AC210 mobile VSI crusher to be sold by Pilot Crushtec into that country. The machine has been hired out by Lheureux & Cie and is currently working in a quarry application making sand from waste aggregate near the French capital.

For Pilot Crushtec, these sales represent opportunities for expansion in these countries.

DELIVERING DOLOITTLE DEMANDING TASK

WESTERN CAPE PRECAST concrete contractor Concrete Units is currently handling the demanding contract of manufacturing nearly a thousand 20 ton dolosse in Cape Town and then delivering it by truck – one dolos by the time – to Yzerfontein on the West Coast.

The 956 dolosse have to be transported for about 100 kilometres from the Concrete Units plant in Airport Industria, near Cape Town to the Yzerfontein Small Craft Harbour where an extensive upgrading project is under way. Concrete Units utilises two 26 ton trucks to deliver the dolosse. Four dolosse are produced and delivered daily.

The concrete to produce the dolosse is being provided by Megamix Cape Town, the company that also designed the mix in which a water-reducing admixture supplied by Chryso SA is playing an important role in early strength gain. Chryso is furthermore supplying a curing compound for the dolosse directly to Concrete Units.

Danie van der Merwe, production manager of Concrete Units, says the concrete strength specified for the dolosse is a minimum of 2 MPa flexural strength at 40 hours. ‘We are currently achieving 2.9 MPa at 40 hours and 6.8 MPa at 28 days. The compressive average strength is 45 MPa,’ states Van der Merwe.

The main contractor for the Yzerfontein Small Craft Harbour is Marine Civil, a sister company of Concrete Units.

Concrete Units recently also produced the 650 dolosse required for the upgrading of Koeberg harbour. This also called for transporting individual 20 ton units by truck to the harbour 30 km north of Cape Town.

ROCKLANDS RDP HOUSING PROJECT

THE ROCKLANDS HOUSING PROJECT is a RDP housing initiative which entailed the installation of civil engineering services to 486 sites and the construction of 186 top structures, at a former informal settlement within the old Uitenhage Municipality (now part of Nelson Mandela Municipality).
The Nelson Mandela Metropolitan Municipality (NMMM) awarded the tender to Lesiba Construction (Pty) Ltd. A condition of the tender was that the tenderer employ a consulting engineer to assist with engineering designs, schedules of quantities, house foundation designs and site supervision. Lesiba Construction approached Vela VKE to fulfil these tasks, as the two firms have successfully completed civil engineering projects together in the past.

Labour from the nearby informal settlement, the beneficiaries, was used in the construction of the 45 m² houses and the sewer manholes. Of the 186 houses now completed, 86 families have already moved in. With the start of the new financial year in July, more houses will soon be completed and ready to come on stream.

**SECONDARY WATERMAINS BEING REPLACED**

ETHEKWINI MUNICIPALITY has embarked on a unique project to replace all the AC secondary watermains within the metropolitan municipal area, which will decrease the frequency of burst pipes that cause damage to roads, properties and pavements.

eThekwini Water & Sanitation estimates that 8% of the municipality’s water loss is due to leaks in the AC secondary watermains network, at a cost of R64 million a year. The project aims to replace 680 km of pipeline each year – approximately 4 km of pipeline per day. Although typically a project of this size would take about five years to complete, eThekwini Municipality is determined to complete this project by 2010.

To meet this daunting target, eThekwini Municipality has appointed four teams each comprising a design consultant, contractor and sub-contractors, under the programme management/project management of Ninham Shand Consulting Services. Each team will work simultaneously in one of four designated areas. The teams are Stemele Bosch Africa and iCon Construction; BKS and WBHO/In-Situ Joint Venture; Goba and Afriscan; and CBI and WK Construction.

The project is one of the first in South Africa that is based on the NEC3 model.

The project commenced in July 2007, and the target is to reach a rate of 88 km of pipeline being replaced every month.

eThekwini Municipality is also using the project as a means of social development through the use of local labour and resources, supporting local SMMEs, developing skills and implementing the Contractor Development Programme which will develop sub-contractors to a CIDB grading designation of at least SCE. Each of the partners in this contract is committed to ensuring that employment, skills development and mentoring are part of the project, and the result will be the creation of about 20 000 new jobs, as well as numerous business opportunities for emerging construction contractors.

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**BUILDING INDUSTRY STILL APATHETIC ABOUT SITE SAFETY**

THE GAUTENG CONSTRUCTION industry is still not paying sufficient attention to site health and
1 950 tons of structural steel for the 1-Octene detailing, fabrication and erection of over
COSIRA INTERNATIONAL h AS
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services of the GMBA for input on the steps neces
rectified by increasing awareness and training.’
shortcomings of sub-contractors in health and
safety, Neil Duncan, president of the Gauteng
Master Builders Association (GMBA), has warned.
Speaking at the GMBA’s Annual Health and
Safety Awards presentation in Midrand recently, Duncan said the situation had shown little im-
provement since he had expressed concern about
health and safety on construction sites a year ago.
‘Certain companies remain committed to health and
safety but too many do not take the matter seri-
ously. In fact, certain main contractors see the
shortcomings of sub-contractors in health and
safety compliance as an opportunity to delay pay-
ment to them. Sub-contractors then rush around,
getting forms signed, which merely “window dresses” the situation,’ he stated.
Duncan said smaller contractors and sub-
contractors either ignored – or were unaware – of
safety requirements. ‘This situation can only be
rectified by increasing awareness and training.’
He urged the building industry to use the
services of the GMBA for input on the steps neces-
sary to provide a safe working environment. ‘The
GMBA’s Safety Department continues to promote
awareness and assist members and also non-mem-
bers with health and safety matters,’ Duncan added.

BUILDING THE BACKBONE OF SASOL’S NEW 1–
OCTENE TRAIN 3 PLANT

COSIRA INTERNATIONAL HAS provided the
detailing, fabrication and erection of over
1 950 tons of structural steel for the 1-Octene
Train 3 Project at Sasol.
This is according to John da Silva, managing
director of the Cosira Group.
‘Our client, Linde AG, was awarded the detail-
engineering, procurement and construction con-
tract, and we were very pleased to be selected to
provide a large and pivotal portion of the struc-
tural steel for this project,’ says da Silva.
When the facility goes into production in the
second part of 2007, it will double Sasol’s existing
1-Octene output to 200 000 tons a year – and
will answer a growing demand for the 1-Octene
hydrocarbon molecule which is used in the manu-
facture of plastics.
‘Cosira was responsible for the detailing, fab-
rication and erection of the main support portion
of the plant. This steel structure will support the
vessels that will eventually contain the mechanical
elements, such as heat exchange drums, reactors
and absorbers. We also provided the pipe racking
and the access components in the plant such as
walkways, staircases, flooring and safety railings,’
da Silva explains.
‘For this project, we also provided customised
fabrication of specifically sized sections, which
were not available locally and were needed in
order to comply with design requirements. Appr
oximately 700 tons of the total amount of
steel fabricated was tailor-made, using our au-
tomated, submerged-arc welding facility to pro-
duce full penetration welds on the steel girders,’
he elaborates.
Project manager for Cosira, Manuel dos
Santos, comments: ‘While the actual amount of
steel fabricated for this project was standard for
Cosira, the project demanded meticulous attention
to detail. The complexity was an exciting chal-
lenge, which put the detailing division, and our
team’s skills during the erection phase, to the test.’
‘Cosira’s involvement began when we
received the drawings from Linde’s office in
Germany. Cosira has embraced a state-of-the art
production system driven by 3D Tekla Structures
– a CAD and CNC process which starts in our
drawing office and runs through to the fabrica-
tion facilities.
‘This was crucial to the successful interface
and collaboration with an organisation such as
Linde, as we were able to receive the electronic
drawings and 3D models from them quickly, and
smoothly transition them into our system,’ points
out Dos Santos.
‘3D Tekla Structures gives us the capacity to
not only be compatible with the most advanced
engineers and architects in the world, but also
has the advantage of ensuring we are competi-
tive in the global market in terms of accuracy.
Therefore the efficiency of this programme saves
the client both time and money in terms of the
approval process.’
Dos Santos continues: ‘We executed the
detailing and fabrication in-house, and then com-
pleted the erection on site. An adaptable combina-
tion of pre-assembled elements was used for some
components, as well as piece-by-piece “stick-built”
assemblies of the remaining structure on site.
In order to accommodate restrictions in space
and manoeuvrability, we had to shift between
these two modes of construction, thereby en-
suring maximum working safety and quality of
the overall workmanship.’
Rudi Blechner, site manager for Linde, com-
ments: ‘Cosira has an ethos of striving for zero
defect when it comes to project fit and handover.
They achieved this objective in terms of the quality
of their delivery on this project, as well as meeting
the stringent occupational health and safety re-
quirements that come into play on a project of this
scope, and for a client such as Sasol.’

FIRST BIO-ENGINEERING WORKSHOP ON TURF
REINFORCEMENT MATS HELD AT DINOKENG

ON 3 AUGUST 2007, the participants of the course
on Wetlands Delineation and Rehabilitation, held
under the auspices of the University of Pretoria,
had an opportunity to get hands-on experience
with some bio-engineering techniques used in
erosion control projects.
A wetland was identified in the Seringveld
Conservancy, Dinokeng area, north of Pretoria,
where the rehabilitation of a spillway and an as-
associated earth berm could be done by using ‘soft’,
environmentally friendly systems.
Says Piet-Louis Grundling, of the Department
of Geography, University of Waterloo, Canada: ‘The
purpose of this exercise is for the participants to
experiment with labour-intensive, but totally rock-
free systems; the use of rolled erosion control mats
has proven to be very cost-effective in areas where
rocks are scarce or not available, while integrating
the endemic vegetation right from the start. The
end result is a turf reinforcement system which can
be bio-degradable, as in the case of the BioMac
coir mat, or non bio-degradable, as with the steel reinforced, polypropylene made MacMat-R.

The participants have been divided into groups, some harvesting and preparing the sods, others trimming the slope, and others spreading the mulch on the spillway and the earth bund on top of the planted sods; the turf reinforcement mats, supplied by Maccaferri SA, have then been installed and pegged down.

In the space of a few hours, some 50 m² have been completed. Adriano Gilli, from Maccaferri Southern Africa, gave on-site technical advice and closely monitored the progress.

‘Considering that this was the first time for everyone, the result was more than satisfactory, and everybody learned in a practical, experiential manner,’ says Adriano.

THE INCIDENCE OF straight-sided paving block failure on trafficked areas and driveways is disturbingly high, according to the Concrete Manufacturers Association (CMA).

CMA director John Cairns says the cause is the specification of thin (40 mm) blocks for applications to which they are not suited.

‘We are seeing increasing incidence of 40 mm thick paving blocks being used in trafficked areas whereas a thickness of 60 mm is the minimum recommended by the CMA. A block thickness of 50 mm may be acceptable for applications where traffic is light, such as private driveways, but anything less than 50 mm for trafficked areas is asking for trouble. The use of 40 mm should be restricted to patios, paths and pool surrounds.’

Cairns explains that straight-sided paving blocks have no physical interlocking mechanism, which means they rely totally on the frictional forces and jointing material between them to hold them together.

‘On a 40 mm block those forces are 50% lower than on a 60 mm block and 25% lower than on a 50 mm block, and the stress on the
base material is correspondingly higher. This means there is far greater chance of movement, both horizontal and vertical, with the thinner blocks. Horizontal movement is probably the more common cause of failure because the joints between the blocks are often not filled properly. The chance of failure is even greater on a steep driveway or road where frequent braking and accelerating generates horizontal forces on the paved surface.

‘Horizontal and vertical movement leads to the blocks grinding against each other, chipping and block separation. Once this has happened water ingress and ultimately, paving failure occurs.

‘Most of the straight-sided paving blocks measuring less than 50 mm on the market today have been manufactured using wet-cast manufacturing, a process which requires less capital equipment than dry casting. While it is extremely difficult to manufacture a paving block less than 50 mm thick using dry casting, it is easily achieved with wet casting, and we have witnessed high growth in wet-cast manufacturing during the past two to three years.

‘There is nothing wrong with wet-casting as a paving block manufacturing technique. However, many wet-cast paving manufacturers, not to mention the paving contractors who use wet-cast pavers, are not aware that a thickness of 60 mm should be the minimum standard for paving blocks laid in trafficked areas,’ concludes Cairns.

THE DESIGN AND CONSTRUCTION of the Chilubi Island pontoon bridge on Lake Bangweulu, Zambia, won the Innovation category of the SAISC’s 2007 Steel Awards on 2 August.

The client was the Zambian Roads Development Agency and local firm UWP Consulting worked with manufacturing engineers Agri-Fuel of Lusaka. The project aimed to open up inaccessible rural areas.

UWP Consulting and Agri-Fuel won a ‘design

A typical example of a paved driveway surface which is failing. Vertical and horizontal (rotational) movement has caused these 40 mm wet-cast paving blocks to rub against each other, a process which has caused some of the blocks to crumble. Had the process been allowed to continue, whole sections of the surface would have broken up.

CHILUBI ISLAND PONTOON BRIDGE A WINNER

MORE INFO
CMA
T 011-805-6742
www.cma.org.za
Brick Paving Institute
www.bpisa.co.za
and construction’ tender package involving three bridges in the Northern Province of Zambia. One of these was a bridge to connect the Chilubi and Nsumbu islands located at the south-east of Lake Bangweulu, which are cut off by flooding in the rainy season.

UWP’s Structural Division designed a 100 m long floating pontoon bridge that would rise and fall as much as two metres with the fluctuating water level and provide year-round passage between the islands.

The structure was fabricated in Lusaka and transported in sections to the lake, where it was assembled in the water and towed 65 km to the site.

The project was completed, using local labour, on time and within budget.

MURRAY & ROBERTS CONSTRUCTION PUTS FINAL TOUCHES ON V&A BREAKWATER PARKADE

MURRAY & ROBERTS CONSTRUCTION, in a joint venture with Jolinde Construction, is putting the final touches on the V&A Breakwater Parkade in Cape Town. Designed by renowned local architectural firm Louis Karol Architects, the new parkade will add a much-needed 1 750 extra bays to the popular international tourist destination.

‘This is a prestigious contract for Murray & Roberts Construction due to its size and its location in the heart of the popular V&A Waterfront,’ Simon Dutton, senior contracts manager at Murray & Roberts Construction, says.

Following project commencement in February 2006, the scope was altered to accommodate a future pedestrian bridge to the adjacent V&A Link Mall.

The parkade itself comprises three undercover levels and one roof level. A feature on the ground level is that it provides a higher roof height to accommodate SUVs and other outsized vehicles.

Commenting on challenges posed by the project, Dutton says an existing 1,5 m diameter stormwater line ran through the site. Piling took place around this, and new manholes were inserted while the line was ‘live’. The outfall was diverted as well.

‘We encountered varying ground conditions during piling in the East Lobby area, which contained an old filled area above good rock shelving. This meant that piling had to be done to depths varying from 14 to 18 metres,’ Dutton says.

‘Another challenge was the need to divert a road for construction vehicles, which was a large undertaking in itself. A requirement of the project was that the roof of the parkade has to be able to accommodate a provincial specification road linking from an existing traffic circle.’

This meant part of the parkade roof had to be designed as a bridge, and be able to withstand provincial load specifications of up to 70 tons.

The primary slab comprised 400 mm of post-tensioned concrete (a total area of 3 000 m²) with a 150 mm thick secondary slab covered by various premix layers.

‘Safety and quality were paramount considerations. We tested the concrete and post-tensioning as work progressed. The project clinched a Murray & Roberts Construction biannual safety award as well as an award for best performing project in a six-month period,’ Dutton says.

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SOARING TRAFFIC LOADS MAKE CONCRETE ROADS MORE COMPETITIVE

CONCRETE PAVEMENTS ARE becoming increasingly competitive on the basis of both life cycle and costing, Nazir Alli, CEO of the South African National Roads Agency Limited (Sanral), has stated.

He was delivering the keynote address at the recent International Conference on Concrete Roads (ICCR) 2007 in Midrand. The conference was organised by the Cement & Concrete Institute (C&CI) and the International Society for Concrete Pavements (ISCP) and was endorsed by Sanral.

Alli told the conference that concrete roads had a well-deserved reputation for strength and durability – and that it was a misconception that concrete pavements took too long and were too difficult to repair.

‘The reality is that concrete pavements are well suited for an increasingly wide range of applications. Research is now assisting in finding new ways to reduce costs and the result is that concrete pavements are becoming more competitive,’ he stated.

Alli said although concrete pavements had long been considered the prime material for high-volume, high load-bearing applications, the material had also been considered too expensive because of comparatively higher initial construction costs.

‘However, these assumptions were based on historic traffic volumes which no longer apply today. Traffic loading achieved in the first 25 years of its existence on the N3 between Durban and Pietermaritzburg, for example, is now equalled in just two years. So the question is: are the models that found concrete pavements’ initial construction cost too high, still applicable today in view of the changes in traffic loading?’

He said sufficient data was now available to permit a critical review and development of a realistic life-cycle cost models for concrete pavements as well as for flexible pavements – especially for heavily loaded routes – and suggested that such a review would now be opportune.

Although South Africa currently had the necessary plant and labour-enhanced concrete pavement building mechanisms in place, there was still a need to develop maintenance and repair manuals, as well as fast-track methodologies for local conditions, Alli added.

THE COLOURS OF STEEL CONSTRUCTION

THE SOUTHERN AFRICAN INSTITUTE of Steel Construction (SAISC) has released the eighth edition of its Blue Book, which is an adjunct to the institute’s famous Red Book.

According to SAISC Executive Director Dr Hennie de Clercq, the Red Book has been the standard reference for designers, detailers and specifiers of steel structures in South Africa since 1987. It contains a massive amount of valuable information for engineers, architects and others. However, much of this information is not of real value to anyone who is not engaged in design.

‘If, for example, you are a quantity surveyor who is primarily interested in the weights of various steel products, or you work in a workshop where the dimensions of the steel elements are the most important thing, or you are involved in the commercial aspects of the steel industry, there are many things you would like to know about steel products without needing the design information.’

‘We have therefore extracted all the relevant information for these circumstances from the Red Book and created a separate, thin, easy-to-handle publication, called Structural Steel Tables or, because of its traditional blue cover, the Blue Book,’ says De Clercq.
Chapter 1 of the book contains information on the various types of steel used in construction. Chapter 2 deals with the properties of a wide range of steel products, chapter 3 deals with bolts and the last chapter is dedicated to welding.

‘The institute has invested a great deal of time and effort to ensure that the information contained in the book is up to date and current, as we appreciate that any incorrect figure could have serious implications,’ concluded De Clercq.

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Bridging Finance Available

NURCHA IS A SECTION 21 company (not for profit) whose main funders are the South African government (through the Department of Housing) and the Soros Foundation. Other funds are sourced from development agencies like SIDA, USAID, NORAD, as well as South African commercial lenders like FNB, RMB and Standard Bank.

Nurcha provides bridging finance for emerging contractors as well as established contractors who have tendered for and been awarded either an housing project, or an infrastructure or community facility project. Some 90% of all projects that Nurcha funds are government initiated – the balance being private developers involved in infrastructure and affordable housing projects, the bottom end of the bonded housing market.

Nurcha’s primary target market is the contractors who have valid and viable projects, and our objective with this group is to create awareness, educate and explain the Nurcha system, and elicit a response. The secondary target market is the (collective) group of provincial/municipal housing officials and the consultants who are employed by government to run the projects. The objective with this group is to create awareness, educate and explain and encourage them to endorse and on-sell the Nurcha system to contractors applying/tendering on their projects.

The lineup of Nurcha programmes includes:

- Loans for emerging contractors for the construction of subsidy housing
- Loans for established contractors for the construction of subsidy housing
- Loans for emerging contractors for the construction of community facilities and infrastructure
- Loans for established contractors for the construction of community facilities and infrastructure
- Loans for the construction of affordable housing

The programmes aimed at emerging contractors are managed through a system of Intermediaries – basically agents who implement the Nurcha system on the ground and provide construction support services. These contractors have no established capacity or project management experience and therefore need the ‘hand holding’ that the intermediary provides. Emerging contractors generally cannot raise finance through the formal financing institutions as they are considered to be ‘high risk’ and cannot provide the securities required.

The programmes aimed at established contractors are dealt with directly by Nurcha. These contractors generally have been in the industry for an extended period and have project management experience, and do not require the close management and advice provided by the intermediaries. They generally have the option to raise finance from a broad array of financing institutions.

More Info

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ON THE MOVE

VELA VKE’S NEW REGIONAL DIRECTOR AND TEAM, WESTERN CAPE

On the retirement of Peter Plantema and Shirwell Kipps, a new regional director for Vela VKE Western Cape, Mustapha Francis, has been appointed, together with a new management team.

Like Peter Plantema, his mentor of many years, Mustapha (known to most as Musty) is a UCT graduate. After completing the 168 km Aus–Rosh Pinah road in Namibia last year, Musty was recalled to his base in Cape Town to take over the position as office head and regional director.

Musty has been with the firm for 22 years and served as a director on the main board of Vela VKE for a number of years. He is experienced in general construction, road construction, road rehabilitation and bridge design and construction. He is also the only director in the firm who can read, write and speak Arabic.

Musty is involved in rugby administration, having played the game for many years, and is also an involved community man.

NEW BOARD APPOINTMENTS AT TWP

Two new board appointments have been made at project house TWP.

Digby Glover has been appointed as CEO of the main operating division, TWP Consulting, a position left vacant by the
appointment of Nigel Townshend as CEO of TWP Holdings Ltd. TWP Holdings Ltd plans to list on the JSE later this year.

Mr Glover was previously a director at TWP Consulting. He has significant experience in mine engineering consulting, having worked as an engineer at Goldfields and as a project engineer at Avgold before joining TWP in 2001. At TWP he served as a project engineer and project manager, and was appointed to the board in 2003.

In an external appointment Cynthia Schoeman joins the TWP Consulting board as human resources director.

Ms Schoeman has consulted to TWP for many years and has worked as an external lecturer for Wits Business School and Duke Corporate Education on academic, executive and in-company programmes in the public and private sectors.

**APPOINTMENTS IN BRIEF**

- WSP Group Africa (Pty) Ltd has announced that Richard Raven has been appointed an associate at WSP Civil and Structural Engineers SA (Pty) Ltd.
- Allen Liversage has been appointed as group financial director of The B &A Group (Pty) Ltd and is also managing director of a subsidiary company, Bosch Management Services (Pty) Ltd
- Ken Quick has been appointed chief executive officer of the Becker Group of Companies
**NEW FELLOWS**

**Henk Bester**
Graduated from the University of Stellenbosch in 1989 and after completing his National Service, joined Spoornet in Cape Town in 1991. He started off as an assistant engineer in Cape Town and Bellville, then in Johannesburg in the Track Testing Centre, then Saldanha in 1994 and was promoted to district engineer in Cape Town in 1996. He left Spoornet in 1997 and joined R&H Railway Consultants (Pty) Ltd in 1998 as senior engineer. He was later promoted to General Manager Design and, since 2004, has been the managing director. R&H Railway Consultants is part of the DAR Group of Companies and is currently handling the majority of design and maintenance management of private railways in South Africa. R&H Railway Consultants is also active in Africa and the Middle East.

**Andy Griffiths**
Was born and educated in Wales, UK, and has 30 years’ experience, the majority of which has been on dams, tunnels and large-scale engineering projects in the water sector. He has a BSc (Hons) in civil engineering from Leeds University, UK (1976), an MSc in the Numerical Solution of Differential Equations from Reading University, UK (1978), an MBA from Wits (1990), and an HDip in arbitration (2000). Andy began his career with Halcrow in 1976, working on marine, coastal and power station projects, and emigrated to South Africa in 1981, joining consultants Keeve Steyn. In 1988 he was seconded to LeSoto Highlands Consultants for the design and construction of Katse Dam and the Transfer Tunnel, becoming project manager in 1996. Since then he has been project director for the Mohale Tunnel and Matsoku Weir and Diversion Projects of the LHW Phase 1B, as well as a technical director and Exco member of Goba (Pty) Ltd, project director for the Durban Harbour Tunnel, chairman of Berg River Consultants, and policy committee member for VRESAP. He is a member of ICE (UK), a Fellow of the Association of Arbitrators, and the South African representative of the Dispute Review Board Foundation.

**Dorian Bilse**
Completed a BSc Civil Engineering at the University of the Witwatersrand in 1981. On completion of his degree he joined Spoornet at the Office of the District Engineer in Germiston where he spent two years working on railway track maintenance. This was followed by one year in the Bridge Design Office, Johannesburg, where he gained experience in the design of concrete structures and then four years on the supervision of construction works on the Coal Line. Dorian was promoted into the National Ports Authority (NPA) in 1989 (then named Portnet) in Port Elizabeth. After completing an MSc in Port and Coastal Engineering in the Netherlands, he was transferred to Durban and is currently based in Johannesburg. At present Dorian is the Deputy Chief Engineer and is responsible for technical support to the Port Engineering staff in the South African Commercial Ports.

**Andy Griffiths**
In 1980, under Fred Hartley, he ran the Technical Division at McLaren & Eger and introduced dynamic pile testing to Southern Africa. He has been with Moore Spence Jones since 1989, except for five years in Hong Kong and Australia, and does forensic and design studies in geotechnical and coastal engineering for contractors, lawyers and insurers.

**Andy Griffiths**

**Seetella Makhetha**
Graduated with a BEng (Civil) from the University of Roorkee (now the Indian Institute of Technology, Roorkee) in India and an MSc (Civil Engineering - Water and Waste Engineering for Developing Countries) from Loughborough University in the UK. He worked as a public health engineer with the Urban Sanitation Improvement Team (USIT) in Lesotho from 1982 to 1986, when he became senior public health engineer. In 1987 he was seconded to GKW Consultants as senior engineer in their Lesotho office. In 1988 he became senior water engineer for Masuru Water Supply, Water and Sewerage Branch in Masuru. He was later seconded from the Bophuthatswana Water Supply Authority to the Department of Water Affairs. Seetella joined Svirdov De Waal & Associates in 1990 as a senior engineer. In 1992 he left to start Makhetha Development Consultants with his wife, also a professional civil engineer and a member of SAICE. Seetella’s specialisation lies in appropriate technology for urban and rural development.

**Malcolm Jaros**
Learned geotechnical engineering from Jere Jennings and Tony Brink at Wits University and, with Arup’s sponsorship, from Skempton, Bishop, Vaughan and Henkel at Imperial College. In 1980, under Fred Hartley, he ran the Technical Division at McLaren & Eger and introduced dynamic pile testing to Southern Africa. He has been with Moore Spence Jones since 1989, except for five years in Hong Kong and Australia, and does forensic and design studies in geotechnical and coastal engineering for contractors, lawyers and insurers.

**Malcolm Jaros**

**Alan Parrock**
Graduated with a BSc in Civil Engineering from the then University of Natal in 1973. He was initially exposed to road and materials design at the Natal Roads Department and later as a researcher at the CSIR. He then completed a 15-year stint at BKS with appointments in Namibia, Johannesburg, Cape Town and Pretoria. Alan left BKS to co-found ARQ, where he heads the geotechnical department.
THE NATIONAL SCIENCE and Technology Forum (NSTF) announced the 2007 top achievers and contributors to the Science, Engineering and Technology (SET) sector at the NSTF Awards Gala Dinner in Johannesburg. These awards recognise excellence in science, engineering and technology.

**CATEGORY A – ‘INDIVIDUAL OVER A LIFETIME’**

This award is made to an individual who has made outstanding contributions to science, engineering and technology in South Africa over a decade or more. It aims at any field of activity, including research and its outputs or through activities in areas other than these, which therefore encompasses all other contributions such as managerial, technical, commercial and financial activities that are often necessary for the successful development and diffusion of new or improved products, processes or services.

**Fish for the future**

The recipient of this illustrious award is Professor Doug Butterworth of the Department of Mathematics and Applied Mathematics at the University of Cape Town. He has worked at the forefront of fisheries stock assessment science and management for the last decade. He has been a central figure in the major international debates on tuna fisheries assessment and management. He has made a major contribution in helping develop science-based management arrangements in Japanese fisheries and has contributed significantly to the improved understanding of fisheries stock modeling and assessment in the Southern Bluefin Tuna Fishery.

Through the development of mathematical and statistical techniques Professor Butterworth has provided the scientific basis for decision-making in the management of marine resources. This includes making contributions to and participating in the scientific committees responsible for providing advice on appropriate levels of catch for South Africa and Namibia’s major fisheries, and internationally for whales, Antarctic krill and tuna.

**Science research enhances fisheries management**

His research has had two major foci: the development of methods to assess the size of fish, invertebrate and marine mammal populations and techniques to determine the trade-off between risk and return associated with different management policies. He has for many years advised nationally on the development of various stock assessment approaches in the demersal, pelagic, rock lobster, abalone, tuna and squid sectors and internationally on whale stock assessment in the Antarctic and other areas of the world. His contributions have been characterised by independence and tenacity as an articulate leader, demonstrating scientific expertise, innovation and integrity. One of his key achievements has been in the field of developing management procedures and operating models for fisheries that assist fisheries managers to make decisions based on predetermined and agreed parameters for stock performance and recovery. He furthermore made a significant contribution in international fishing disputes.

**CATEGORY E – SMALL, MEDIUM AND MICRO ENTERPRISES (SMMES) OVER THE LAST THREE YEARS**

In Category E the award is made to an SMME operating as a business for profit, defined as having fewer than 50 employees or an annual turnover less than R30 million that has made outstanding contributions to
who has made outstanding contributions to science, engineering and technology over the last five to ten years and who represent role models for others to follow.

The recipient of this award is Professor Pragasan Pillay, Professor of Electrical Engineering at the University of Cape Town and well-recognised researcher locally and internationally. Research on renewable energy technology has enjoyed little attention and the DST has signalled a need for greater attention in this area. Professor Pillay's research programme responds to this by advancing renewable energy technology and energy efficiency and developing the much-needed human resource capacity in this area. A comprehensive range of research projects is being undertaken which includes work on wind machines in collaboration with overseas researchers, a composite flywheel as a low cost energy storage device, and other more conventional projects in the machines environment, an area in which he has published extensively on subjects such as core loss formulation and prediction and pole modulation for traction purposes.

Professor Pillay's current research will contribute toward the advancement of renewable energy technology and energy efficiency in South Africa and internationally. Furthermore, it will assist providing electricity beyond the reach of the utility grid.

In his research group, consisting mainly of previously disadvantaged persons, Professor Pillay is developing much-needed human resource capacity imperative for South Africa.

**Wind power**

His novel small permanent magnet (PM) wind generator design, where new iron powder material was combined with a novel machine topology to develop a wind generator for a turbine with contra-rotating blades. Aspects of this new machine were modeled analytically and then validated numerically before building a prototype, which was fully tested in a laboratory with its performance correlating with the theoretical predictions. The potential impact of this research is the development of small wind energy conversion systems that can capture more energy from incident winds than conventional turbines. This work is being done in collaboration with Warner Energy and Advanced Motors and Drives (interested in commercialising the technology) and Clarkson University, both in the US.

Professor Pillay's energy efficiency research includes improved traction motor design, application of white LEDs for lighting, and improved core loss formulation of electrical machines.

**Research applied in software package**

The main objective of the core loss formulation research is to accurately predict the losses in ferromagnetic steel used in electrical machines. Several proposed empirical models for these losses each have varying degrees of accuracy. A deeper understanding of the macroscopic loss phenomenon in these steels is being studied numerically before building a prototype, which was fully tested in a laboratory with its performance correlating with the theoretical predictions. The potential impact of this research is that machine designers can predict core losses more accurately during the design phase, which leads to the selection of better materials for the machine design. The theoretical core loss models are currently being integrated into a commercial electromagnetic Finite Element software package.

**Research for better use of battery in traction vehicle**

The traction motor research is focused on...
improving the output torque and efficiency of a PM traction motor, which is intended to replace the DC motor in traction application. This machine design effects better utilisation of the battery on the traction vehicle and hence improve operating cycles and productivity. This research is for an actual traction vehicle application.

**CATEGORY J – YOUNG BLACK RESEARCHER (OVER THE LAST 2–5 YEARS)**
The TW Kambule NRF Research Awards are made to distinguished young black researchers in South Africa, normally under the age 40 (male and female separately) who have made outstanding contributions to science, engineering and technology over the last two to five years.

**Professor Thokozani Majoza**, Associate Professor of Chemical Engineering at the University of Pretoria, is the recipient of this award. His work has earned him local and international acclaim in the field of chemical engineering. He and his students won the prestigious Zdenek Buraneic Memorial Award at a chemical engineering conference in Italy (2005). This award was based on the novelty of research and its contribution to the industry. Whilst many researchers have been doing work on batch chemical processes since the late seventies, Professor Majozi’s contribution was the first of its kind to successfully exploit the structure of the recipe that defines the processing of raw materials to the finished products.

**S-graph breakthrough**
He has made six unique contributions in the field of batch process integration. He and his colleague in Hungary developed a graph theoretic framework based on the S-graph representation for the scheduling of batch plants under fixed time horizon. This is currently the only method of its kind which does not require any presupposition of time points. In essence, his is the only published scheduling method for batch chemical processes that completely overrides the binary dimension (‘Maximization of Throughput in a Multipurpose Batch Plant under Fixed Time Horizon: S-graph Approach’).

**Fuzzy logic used**
Research on optimising batch processes using fuzzy logic has been applied to the solution of problems in batch plants, which have flexibility and adaptability compared to their continuous counterparts and has aimed to exploit this. A further development has been a process integration technique for systems involving heat and mass transfer with the objective of minimising or eliminating effluent (liquid waste) in chemical industries. The efficiency of the chemical processing models built was tested for three real life situations, and has shown a 50% reduction in freshwater demand and wastewater generation in an agrochemical facility, a potential saving of R50 million through the design of a batch plant for manufacture for SASTECH, and the development of a continuous-time mathematical formula for scheduling.

African Explosives Limited (AEL) in Modderfontein has accepted the results of this work and it is expected that a savings of more than 49% in effluent generation and almost R1 million per annum will be realised.

Professor Majoza’s novel technique for wastewater minimisation in discrete chemical operations, ‘Wastewater Minimisation Using Central Reusable Water Storage in Batch Processes’, is being used in East London to reduce their effluent by 20% (2005). He has successfully demonstrated how this model can be applied to the minimisation of energy in time-dependent operations as well.

Professor Majozi has also been the first researcher in his field to highlight and successfully model the impact of human intervention in batch chemical processes (‘Impact of Personnel Allocation in Deterministic Planning and Scheduling’).
Revisions to SANS 10100-1:2000

The structural use of concrete Part 1: Design

A STANSA WORKING group is being formed under SC 5120.61A Construction Standards to proceed with a next revision of SANS 10100-1:2000 The structural use of concrete Part 1: Design.

Persons interested to be involved in the process are invited to contact the StanSA co-ordinator, Dirk Loubser, on 012-428-6474 (LOUBSEDA@sabs.co.za).

Substantial progress was made towards the end of 2005 on a next revision of SANS 10100-1:2000 Part 1: Design. Although the revision consisted mainly of editorial and grammatical changes, a few substantial changes were nevertheless considered. The process got delayed, and the working group have decided to channel their efforts towards a next generation of code rather than proceed with the current process.

For the revision of SANS 10160 (General procedures for loading in buildings and industrial structures), which is to be published in 2008, substantial use was made of EN-1990 and EN-1991 as reference documents. This approach set the stage for the next generation of material codes to also consider Eurocodes as reference documents for their revisions.

Originally BS8110 served as reference document for SANS 10100-1 Part 1: Design, but the British code will now be replaced by the Eurocode. The working group for the revision of SANS 10100-1:2000 Part 1: Design have therefore decided to commence a process in which EN-1992 is evaluated and to determine a manner in which this document can be used as reference for a next generation of the South African code.

Jan Wium
Chairperson of the working group for SANS 10100-1 Part 1: Design

Bringing engineering alive

Engenius, an educational initiative of the Engineering Council of South Africa (ECSA), was established by ECSA in 2006 as a joint initiative between ECSA and its strategic partners to create a greater pool of qualified engineering practitioners available to the engineering industry. These include the South African Institution of Civil Engineering, the South African Association of Consulting Engineers, Telkom, the University of Johannesburg, the National Housing Building Registration Council, Rand Water, and the national departments of Education, Labour and Trade and Industry.

INDUSTRY ENDORSEMENT

The Engenius campaign has since been endorsed by several organisations that have become industry partners in the implementation of the programme. Engenius aims to promote the profession of engineering to secondary schools and FET colleges in a bid to increase the number of learners (especially female and black learners) entering the engineering profession. This is done through school visits, participation in teacher workshops, mathematics and science camps, as well as Engineering Insight Weeks.

BURSARIES

Engenius also assists students and learners who obtain exceptional grades in mathematics and science by linking such achievers with companies who offer bursaries in engineering.

ENGINEERING INSIGHT WEEK

Engenius relies entirely on sponsorship from participating companies for the Engineering Insight Week. Those who would like to participate can call Busisiwe Dubazana at the Engineering Council of South Africa (011-607-9500).

SPECIAL OFFER STILL VALID!

Copies of The life and work of Charles Michell (reviewed in the September issue) may still be ordered from the publishers, Fernwood Press, at the special price of R295 (VAT included). Contact Pam van Schaik on 021-786-2460, or e-mail her at fernpress@iafrica.com.

Offer only valid till the end of November!
DR SIDNEY PARSONS, a senior researcher at the Council for Scientific and Industrial Research (CSIR), was named the winner of the 2007 J D Roberts Award. The award was made to Parsons in recognition of his groundbreaking research into the crucial role of architectural engineering processes in improving the design of healthcare facilities, particularly to prevent the spread of airborne diseases such as tuberculosis (TB).

The annual J D Roberts Award is sponsored by Murray & Roberts and is held in partnership with the CSIR. The award, instituted by Murray & Roberts in the late 1970s in remembrance of one of the group’s founding fathers, Dr J D ‘Douglas’ Roberts, recognises and promotes competitive and environmentally sustainable solutions to human dilemmas and encourages scientific research into technology that will enhance the quality of life of all South Africans.

Parsons’ work focuses on seeking evidence-based interventions to minimise risk within healthcare facilities. By combining microbiology with architectural engineering through collaborative research with partners from the Medical Research Council (MRC), Harvard University and the Centers for Disease Control and Prevention (CDC) in the USA, he has endeavoured to reach a better understanding of the spread of airborne diseases such as TB. He was responsible for the design and validation of the Airborne Infection Research (AIR) Facility, launched in February 2005 at the Mpumalanga TB Hospital in Witbank.

South Africa is facing one of the most devastating TB epidemics in the world. Currently, the World Health Organisation ranks South Africa second in the world in terms of TB incidence (or the number of cases per capita) and ninth in terms of the actual number of TB cases.

A serious complication of the TB problem in SA has been the emergence of multi-drug resistant tuberculosis (MDR-TB) in all nine provinces since the mid-eighties. ‘Patients receiving TB treatment usually become non-infectious in a few days; however, if treatment is interrupted prematurely, MDR-TB, a particularly serious form of the disease, may emerge. MDR-TB is much more difficult to treat, and has also been associated with extraordinarily high mortality in HIV-infected patients,’ Parsons explains.

The culmination of a five-year research project by a collaborative team from the MRC, the CSIR, the CDC and Harvard University, the AIR facility involves extraction of infectious air from patient wards to exposure chambers housing guinea pigs, which serve as living quantitative samplers of human-generated TB. The CSIR and its collaborative partners have developed state-of-the-art systems for ventilation, heating and cooling, and electronic monitoring, which enable the study of MDR-TB transmission under a variety of environmental conditions in the AIR facility.

Parsons, as the engineering research member of the collaborating research team, was responsible for all architectural engineering aspects of the research behind the design, development, operation and, in part, the bio-aerosol sampling techniques.
JOHN MILLAR MORRISBY-ROLFE

22 June 1926 – 30 September 2006

We were privileged to know John since the late 1970s. Our paths crossed when he walked into our offices and announced that he was considering leaving the then Rhodesia (Zimbabwe) and re-establishing his structural engineering practice in South Africa.

We soon agreed that cooperation could be mutually beneficial. The end result was a very successful consulting engineering joint venture partnership trading as Rolfe and Osborn under the parent firm Hawkins Hawkins and Osborn. In 1991 John and I established separate practices and continued our cooperation.

John was one of the first to graduate with distinction from the University of Cape Town. His early career was spent lecturing at the University of Zimbabwe and practising as a consulting engineer. Although John possessed in-depth knowledge covering most of the disciplines in civil engineering, his unequalled speciality was structural engineering, both in theory and practice. His extraordinary ability to unravel the behaviour of the most complex of structures into simple structural design elements always distinguished him as a very special colleague. In his designs he employed both the old-fashioned methods of hand calculations the most modern electronic finite element methods. He was a master at relating the theory and practice of structural engineering to his peers and junior colleagues alike.

His work stands all around us in the form of bridges and buildings. In particular, we must recall two of our very special projects that concerned the rehabilitation of the 80 year old Sand River Bridge and the 110 year old Jammersdrift Bridge over the Caledon River, both in the Free State.

In the Sand River Bridge, the structural steel latticed girder superstructure urgently required increased vertical clearance of about 1 m to accommodate modern traffic. This problem has been solved in a variety of ways over the years, but none so elegantly and structurally sound as in the award-winning design conceived by John. The elegant tied wrought iron arches of the Jammersdrift Bridge required no strengthening – after exhaustive finite element analysis of the 110 year old wrought iron – but only the replacement of the structural trough decking with an articulated reinforced concrete slab, resulting in almost no additional dead load.

John's integrity, modesty and manners were unsurpassed. During one of his early visits he requested whether I could safely keep a small sealed envelope for him until his next visit. I agreed and showed him the far right-hand corner of the top drawer of my desk, where he duly deposited the envelope. During his next visit about ten months later he requested the envelope, whereupon I anxiously enquired about its contents. He proceeded to show me the precious 15 one-ounce Krugerrands he had entrusted me with!

His many colleagues within South Africa and the United Kingdom will sadly miss his pleasant demeanour and keen sense of humour.

He passed away a few months after his 80th birthday, which was celebrated with a few special friends and close family. At the time he had been working on the publication of a valuable but relatively unknown form of applied mathematics known as Chebyshev's theorem. Although a recent paper on the subject was published in the Structural Engineer, special endeavours will be made to ensure full publication.

He sadly lost his first wife many years ago. John is survived by his second wife, Jean, daughter Elizabeth, son Michael and grandchildren Anton and Janet.

A P C Oosthuizen

PETER BOWEN

With the death of Peter Neville Bowen on 7 June this year – just a month short of his
79th birthday – another of South Africa’s senior civil engineers has passed on to Higher Service.

Peter was the embodiment of the creed of a civil engineer - to serve our fellow man, not only in our professional capacity, but also to the best of our ability in other spheres. He was an active member of initially Round Table and later the Rotarians, and he served in these two charitable organisations with zeal and assiduity.

He was active in the East London Club and as marketing director of the South African Grand Prix Committee in the 1950s and early 1960s, he was responsible for much of the organisation of these events. As a young man he served as a life saver in East London and over the years he was responsible for no fewer than 60 rescues.

Apart from being a PrEng and a member of SAICE, he was a member of the ICE (London) and the Institute of Housing for SA, and was registered as a chartered engineer (London) and the Institute of Housing member of SAICE, he was a member of the African Grand Prix committee in the 1950s and as marketing director of the south Michele over Union Development commission for the Ciskei government operating out of Bisho.

John Raymond Montague Beard

It is with regret that we have learned of the death of John Beard after a short illness on 4 April 2007 at the age of 68. John was a construction engineer par excellence who made significant contributions to contract administration and his insight will always be an inspiration to many construction professionals.

John was born in London in 1938, He attended Ridge Primary School in
Johannesburg and completed his schooling at Hilton College in Pietermaritzburg.

Before starting his engineering studies at the University of Cape Town, he spent a year with his mother, who was a medical doctor in Afghanistan.

John stayed in the Driekoppen Residence of UCT, more commonly known as ‘Belsen’ as it was created for the soldiers returning from the Second World War. Already at this stage John’s typical practical character was noticeable. For example, he took on the job of training the drum majorettes to lead the rag procession and to supplement his and a number of his fellow students’ meagre income, he made contact with Newlands rugby grounds and obtained work for them at rugby matches.

He graduated with a degree in civil engineering and after a short period with Randburg Municipality, started his professional life as a junior engineer with Scott & De Waal, where he stayed on for 35 years, retiring as a director. The start of his career in the road design section at a time when it was under considerable pressure to produce contract documentation for major freeway projects engendered in him a passion for road building which lasted of government departments to junior supervisors on the construction sites.

He foresaw the need to bypass or relieve traffic conditions on the Main Road through the Claremont and Wynberg business areas. These proposals are only now being considered for implementation.

He was involved in the development of Cape Town’s new urban expressways planning for directional signing for trian environment in the central city. The report Cape Town: City for the People was initiated by him.

He introduced the concept and did the planning for directional signing for Cape Town’s new urban expressways.

He was involved in the development of off-street parking facilities in the CBD with the metering of kerbside parking.

He promoted the provision of parking and bus termini at railway stations, thereby encouraging the use of public transport.

Later he was involved as traffic engineer with the ‘Shand Committee’ comprising overseas and local consultants appointed to resolve the planning of the Central City Ring Road and Foreshore Freeway schemes.

But Mr Lichtman will be most remembered for his pioneering work with traffic signalled area traffic control. Up to the
early fifties, traffic signals in the central city were coordinated on a fixed time basis by an electro-mechanical system located in a room in a small building on the south-west corner of the Grand Parade.

But the system was old, becoming unreliable and needed to be expanded to take in more intersections. After much study, tenders were awarded to Siemens to provide a specialised computer to monitor traffic and automatically choose one of several pre-calculated programmes to suit traffic conditions at peak hours and off-peak hours throughout the day. All intersections were linked by dedicated underground cables led to the computer. In addition, television monitoring was installed with cameras being able to be rotated, dipped and zoomed from the central control room, which was located in the Civic Centre Municipal Offices (now City Park Medical Centre). When all the municipal offices were relocated to the Civic Centre the control room also had to be relocated – a major project in itself.

Incorporated into this system was the signalisation of the traffic circles at Strijdom Avenue and Coen Steytler Avenue on the Heerengracht. This was probably the earliest application of traffic signals to traffic circles. The signals were required to assist pedestrians crossing the wide approach roads and to facilitate the movement of traffic through the very short weaving sections provided by the layout of the circles. The system operates to this day.

To have designed the Area Traffic Control system and supervised its installation in the central city was a major traffic engineering achievement, one of which the city was justly proud. It was the forerunner of the present metropolitan area traffic control system where the signals are linked by telephone cables and coordinated by the Plessey system using SCOOT software.

It is impossible to mention all the projects with which Mr Lichtman was involved. In addition to his work as a traffic engineer of Cape Town, he lectured at the University of Cape Town and the then technikon. Being one of the founder members of the traffic engineering profession in South Africa, he contributed considerably to the knowledge of this discipline to the benefit of all urban development in South Africa.

Important as these contributions were, his colleagues will remember him as a philosopher, never expecting perfection, but always ready to offer sound and just advice to those who were willing to be helped. In the words of his son, Adrian, ‘his astute mind and integrity will remain a legacy to us forever’.

The members of the Institution convey their condolences to Jeanette, his wife of 62 years, and to his family.

Ivan Speed

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**Table:**

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<td>J Falkner</td>
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<td>M White</td>
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<tr>
<td>24–26 October – Durban</td>
<td>71st IMESA Conference</td>
<td>ICC Durban</td>
<td><a href="mailto:confplan@afrika.org.za">confplan@afrika.org.za</a> +27-12-667-3680</td>
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<td>30–31 October – Cape Town</td>
<td>Technical Report Writing SAICEbus06/00014/08</td>
<td>Karl von Buddenbrock</td>
<td>Sharon Mugeri <a href="mailto:cpd.sharon@saice.org.za">cpd.sharon@saice.org.za</a></td>
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<td>6–7 November – Gauteng</td>
<td>Business Finance for Built Environment Professionals SAICEfin06/00004/08</td>
<td>Wolf Weidemann</td>
<td>Dawn Hermanus <a href="mailto:dhermanus@saice.org.za">dhermanus@saice.org.za</a></td>
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<td>4–9 November – Johannesburg</td>
<td>'HELP in Action’ – Local Solutions to Global Water Problems <a href="http://www.wisa.org.za">www.wisa.org.za</a></td>
<td>Taryn van Rooyen <a href="mailto:conference@soafrica.com">conference@soafrica.com</a></td>
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<td>12–16 November – Johannesburg</td>
<td>The Application of the Finite Element Methods in Practice SAICEstr06/00018/08</td>
<td>Roland Pruikl</td>
<td>Dawn Hermanus <a href="mailto:dhermanus@saice.org.za">dhermanus@saice.org.za</a></td>
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<td>19–20 November – Cape Town</td>
<td>Handling Projects in a Consulting Engineer’s Practice SAICEproj06/00003/08</td>
<td>Wold Weidemann</td>
<td>Dawn Hermanus <a href="mailto:dhermanus@saice.org.za">dhermanus@saice.org.za</a></td>
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<td>22–23 November – Durban</td>
<td>Advanced Microsoft Project SAICEproj06/00042/08</td>
<td>Dr A Holden</td>
<td>Suzette <a href="mailto:admin@classic-sa.co.za">admin@classic-sa.co.za</a></td>
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<td>22–23 November – Durban</td>
<td>General Conditions of Contract for Construction Works – GCC 2004 SAICEcon06/00078/09</td>
<td>Willie Claassen</td>
<td>Sharon Mugeri <a href="mailto:cpd.sharon@saice.org.za">cpd.sharon@saice.org.za</a></td>
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<td>24–26 January 2008 – Hong Kong</td>
<td>IStructE Centenary Conference <a href="http://www.istructe.org/centenary/conference">www.istructe.org/centenary/conference</a> <a href="mailto:ykchkcp@netvigator.com">ykchkcp@netvigator.com</a></td>
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