SAICE AWARD WINNERS
Photo Competition Winners
OUR SECOND PiCA AWARD!
ON THE COVER
The R1,5 billion Berg Water Project includes the first dam in South Africa to be built according to the guidelines of the United Nations World Commission on Dams. The project is also one of the first to be subjected to the New National Water Act of 1998.

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Civil Engineering | November/December 2008
INTRODUCTION TO AWARDS

SSI and SAICE shake up civil engineering!

THERE WAS AN EXCITED buzz in the air on the evening of the SSI SAICE 2008 Awards event. Awards finalists, clients and special guests made their way to the Bytes Conference Centre on 30 September 2008 and waited with bated breath to see who the final winners of each section and category would be. Richard Cock, our distinguished master of ceremonies, was there to see us through the evening as presentation after presentation was shown to a receptive audience.

First on the list were the Wiehahn SAICE Project Awards. Anticipation grew as the Community-based and Technical Excellence categories were presented. The entries are the winners from regional competitions, coordinated annually by SAICE branches countrywide. (No entries were received in the International category this year.)

The following projects were received in the Community-based category:
- Construction of the R300 Kalkfontein Pedestrian Bridge
- Ethekwini Zibambele Poverty Alleviation Programme
- USAID support of the National Bucket Eradication Project
- Emfuleni Water Loss Reduction Community-based Project

The Technical Excellence category projects comprised:
- Mkomaas River Pedestrian Bridge
- The Mangaung Activity Corridor (Upgrading of Dr Belcher)
- Rehabilitation of major bridges over the spillways of South Africa’s largest dams
- Kaaimans Pass slope failure retrofitted with half-viaduct bridge structure
- MacWest Bridge
- Umhlanga Hospital Extension
- Berg Water Project

The winning project in the Community-based category was the Construction of the R300 Kalkfontein Pedestrian Bridge, while the Ethekwini Zibambele Poverty Alleviation Programme received a commendation.
In the Technical Excellence category a commendation went to the **Mkomaas River Pedestrian Bridge**. The winner in this category was the spectacular **Berg Water Project**.

Commemorative engraved brass plaques, proudly sporting the SAICE crest, were handed to representatives of the winning teams.

Next up was the Most Supportive Advertiser Award, which went to Autodesk in recognition of their continued and loyal support of SAICE’s award-winning magazine, *Civil Engineering*.

The amazing photographs entered in the SSI SAICE Photo Competition were an absolute hit with the audience. Winning the competition with his photograph entitled ‘Dawn of 2010’ was Philip Bateman. The first runner-up was Marc Jermain with his photographs ‘Greenpoint Daylight’ and ‘Nightshift at Greenpoint’. The second runner-up was Larry Mills for...
‘Instructions’, and a commendation went to Alf Yssel for ‘Never give up’. Substantial cash prizes were received by all the winners in this section.

The exhilarating evening culminated in the handing over of the SMART Award, initiated in 2006 and growing steadily every year. The award is for an individual or group of individuals to recognise extraordinary achievements which have a civil engineering flavour. The award is also made to encourage the industry to aim for excellence and to create interest among learners, parents, teachers and students. The winner of the SMART Award this year was Luuk Hepkema from Africon with his innovation, ‘Collapsible Guard Rails’. Luuk walked away with the generous prize money of R20 000, sponsored by Sanlam Cobalt. A consolation prize went to Job Kordom for his inventive entry, ‘Blocked Cable Solution’.

Read more about the winning entries on the following pages.
The Berg Water Project is aimed at meeting the growing water demand from all sectors of the Western Cape. Its annual contribution of 81 million m³ of water to the Western Cape water system (an increase of 18%) will satisfy demand until 2013. State-of-the-art engineering characterised the design and construction of the 62 m high concrete-faced rockfill dam as well as the downstream abstraction works and pumpstation. The project also made an important contribution to the socio-economic development of the Franschhoek region and of the Western Cape in general.

**BERG WATER PROJECT**

**Winner: Submitted by Western Cape Branch in the category Technical Excellence**

**KEY PLAYERS**

**Client** Trans-Caledon Tunnel Authority (TCTA)

**Consultant** Berg River Consultants comprising Knight Piésold Consulting, Goba and Ninham Shand

**Main contractors** Berg River Project JV comprising Grinaker-LTA, Group Five, WBHO and WCEC; Department of Water Affairs and Forestry; Sulzer Pumps South Africa; Cycad Pipelines

**Other contractors** Donico Power Building JV; Bright Idea Project 632; Bright Idea Project 611; DWAF Construction; EXEO Khokela

**Numerous main suppliers and subcontractors**

**THIS YEAR’S WINNER of the SAICE Award for the most outstanding civil engineering achievement in the category Technical Excellence is the R1,5 billion Berg Water Project. The project includes the first dam in South Africa to be built according to the guidelines of the United Nations World Commission on Dams. The project is also one of the first to be subjected to the New National Water Act of 1998, which incorporated the legal concept of the ‘ecological reserve’ (defined in the Act as relating to the water required to protect the aquatic ecosystem of the water resource. The reserve refers to both the quality and quantity of**
the water in the resource and will vary de-

With Cabinet’s approval of the scheme and its institutional arrangements in 2002, the project authorities determined that the dam could start impounding water as early as the winter of 2007, although this was recognised as an enormous logistical chal-

ABOUT THE PROJECT
The Berg Water Project is being im-

The Berg Water Project is being implemented to meet the growing water

The Berg River Dam is capable of delivering 56 million m³ of water annually from its catchment, whereas the supplement scheme, can contribute another 25 million m³. The Berg Water Project yield will contribute to the system in meeting the needs of the City of Cape Town until approximately 2013.

The project comprises:

■ The dam, a concrete-faced rockfill trapezoidal section embankment 62 m high, with a crest length of 930 m and storage capacity of 130 million m³. The embankment comprises various rockfill and filter zones totalling 3,3 million m³ of earthworks, appropriately instru-

■ Flood water is released from the intake tower wet-well via the conduit and plunge pool

■ A unique dual-function intake tower, 63 m high, addresses environmental flood releases (up to 200 m³/sec) through the wet-well side and water supply through the multi-level 1,5 m diameter pipe intakes of the dry-well side. The wet-well, which is controlled by six large selector gates, discharges into a downstream radial-gate-con-

■ PRIMARY OPERATIONAL MODES
The project comprises at least nine dif-

■ Water is supplied to the Western Cape water system from the intake tower dry-well through Dasbos pumpstation to the tunnel

■ Irrigation water is released from Theewaterskloof Dam via the Wemmershoek irrigation release works

■ Irrigation from Berg River Dam is released via the intake tower dry-
conduit running through the base of the embankment to the plunge pool.

The Dasbos pumpstation immediately below the dam wall transfers water from the Berg Water Project to the City of Cape Town (CCT) treatment works via the tunnel system from Theewaterskloof Dam (Rivieronderend Scheme). The pumpstation houses the system operational offices and four horizontal split-casing pumpsets capable of pumping up to 6 m³/s into the CCT system.

A 1.5 m diameter pipeline from Dasbos, 2.5 km long, allows transfer of water from the Berg River Dam to the Rivieronderend Tunnel or by gravity from Theewaterskloof Tunnel as irrigation releases into the Berg River via the Drakenstein pipeline and irrigation release works. The Berg Water Project also allows for water abstracted at Drakenstein (or from the dam) to be pumped into the Theewaterskloof Dam or the CCT system as the need arises.

A diversion weir at Drakenstein across the Berg River, 10 km downstream of the Berg River Dam and four of its tributaries, is capable of diverting water from the river into a 4 ha balancing dam (of 70 Mℓ planned capacity).

The Drakenstein pumpstation comprises four vertical multi-stage pumpsets capable of pumping water at 4 m³/s from the balancing dam through a 1.5 m diameter steel pipe, 10 km long, back up to and into the Berg River Dam or directly into the Rivieronderend Tunnel and the CCT system.

A Scada system to keep track of the operational parameters of the project feeds into a programmable logic controller (PLC) that automates many of the critical operating conditions. This will be under the control of the Department of Water Affairs and Forestry (DWAF) as operating authority for the project. The scheme is complemented by six gauging weirs that monitor flows in the various tributaries.

A tarred access road from the R45/R301 to the dam site was built before dam construction began.

Eighty houses at the La Motte forestry village were built within a secure complex, together with a sports field.
and upgrading of access routes. These were initially intended for engineers and construction workers, but will ultimately serve as accommodation for the local community.

- A 4.4 km sewer line was built to upgrade the existing delivery system from La Motte and to accommodate the extra capacity required for the new houses.

**TECHNICAL PROCESSES AND CHALLENGES**

**Institutional challenges**

Various aspects required continuous attention during implementation. Some of these were:

- Stakeholder relationships and management processes enjoyed special attention.
- Mindful of the interests of the local community, the ‘Franschhoek First’ policy was adopted, particularly in respect of local employment opportunities and skills training in order to leave a positive socio-economic legacy in the valley.
- A thorough skills audit culminated in a 75% local labour content.
- Stringent environmental management processes were followed in order to comply with the record of decision by the Department of Environmental Affairs and Tourism (DEAT).
- Land impact and acquisition posed special challenges in an area of high agriculture values.

Spillway and conduit complex nearing completion

Four horizontal split-casing pumpsets in the Dasbos pumphouse, situated below the dam wall.
Design Challenges

Many design studies were undertaken from inception of the work in 2003, the most significant being:

- Dam type selection, particularly focusing on constructability in the tight programme and the Western Cape weather patterns
- Environmental flood investigations up to 200 m³/sec and implementation means via the intake tower/conduit, including physical model tests by the University of Stellenbosch (US)
- Physical spillway model tests (US)
- Physical outlet works and intake pipeline model tests by the University of Pretoria (UP)
- Physical abstraction works model tests to separate sediments under varying discharge conditions and to include a canoe chute and fish ladder (US)
- Numerical modelling of hydro-geological conditions in areas of potential impact on agricultural land
- Computational fluid dynamics (CFD) modelling of various pipe designs and pump inlets
- Pipeline lining alternatives studies (epoxy vs cement mortar), University of Cape Town
- Water quality studies and temperature stratification modelling in the dam
- Sediment disposal options from the balancing dam, and
- Seismic analyses and monitoring network

Berg River Dam during a ‘Black Southeaster’. The dam is spilling by 0.9 m at about 60 m³/s (photo: Larry Mills)

General layout of the Berg River Dam embankment
These are some of the rather unique aspects of the Berg Water Project that required an unusual degree of engineering ingenuity and innovation in bringing the technical aspects of the project to converge on acceptable construction and environmental solutions.

**CONSTRUCTION TECHNIQUES AND CHALLENGES**

Special aspects regarding construction techniques included:
- The concrete face sliding equipment commenced at a concrete plinth along the toe of the upstream face. South American experience was used in designing continuous sliding of the 15 m wide face panels.
- Dynamic compaction was undertaken to address a zone of potential liquefaction (under seismic conditions) underlying the right flank.
- Local river boulders were crushed for use as concrete aggregates.
- The long pipeline trenches adjacent to the Berg River in alluvial/boulder beds were dewatered.
- A multi-stage vertical pump solution addressed the wide range of operating conditions for the Drakenstein pumps.
- Stoplog closure of diversion works was used during mid-winter flows to achieve impoundment on schedule.
- Strict environmental specifications were adhered to throughout.

The project was subjected to stringent commissioning processes in order to ensure compliance with all design and operational parameters.

**OPERATIONAL REQUIREMENTS**

A multitude of operating conditions had to be accommodated in the Scada- and PLC-automated operating systems, including:
- As an environmental requirement, inflow patterns in the outflow conditions – as little as 0.3 m³/s in the dry summer months, 65 m³/s for three-day winter rains and high winter floods of 200 m³/s – were mimicked.
- Best-quality water was identified and drawn for the City of Cape Town.
- Pipelines and valves operate in either direction, requiring robust controls to avoid over-pressurisation.
- The ecological requirements of the river were balanced with the need to abstract water at Drakenstein, while ensuring adequate instream flow requirement (IFR) releases for downstream agricultural needs.

These were all subjected to hazard and operability (Hazop) and hazard analysis (Hazan) studies to address design limitations and downstream safety during commissioning and operation. Hydro geological monitoring in wineland areas affected by Berg River Dam near full supply level (FSL) has been instituted, based on the hydro-geological model developed.

**ADDITIONAL INFORMATION**

The following additional aspects are of significance:
- TCTA was directed in 2002 to implement and fund the Berg Water Project as agent for DWAF. The project was funded by the European Investment Bank, the Development Bank of Southern Africa and ABSA. The loans obtained from the above banks totalled R 1.5 billion.
- Cape water users will have repaid this loan by 2027 through a Berg Water charge added to the DWAF tariff.
- Participation of public/stakeholders in the project occurred through various forums, communication media and events, including major public participation before approval by Cabinet.
- A committee conducted a monthly monitoring of employment and training.

The public were kept informed through the *Berg Water News*, which was issued by TCTA from Franschhoek.

The ‘Franschhoek First’ policy set guidelines for contractors to promote local participation. A social monitoring strategy was also implemented.

TCTA instituted a sustainable utilisation plan to ensure long-term benefits from the project.

The project is on programme in all critical respects and within the original TCTA budget, based on strict financial controls/approvals.

Throughout the project, managerial and technical competence has been key. Competent people were employed and there was a strong emphasis on sustainability, supported by continual auditing and quality/technical review of all design and construction processes by TCTA’s specialist engineering review panel.
The Mkomaas River Pedestrian Bridge is the only prestressed concrete ribbon bridge in Africa. Its main span of 150 m equals the world record for this type of bridge. The bridge was constructed from concrete elements suspended from cables tensioned between abutments, which were then stressed along the length of the bridge by tensioning a second set of cables placed in ducts through the elements. Compression stresses induced in this way compensate for tensile stresses resulting from live loads on the structure. The project earned a commendation in the category Technical Excellence in 2004.

In August 2004, the Mayor of Sisonke District Municipality wrote to the KwaZulu-Natal MEC for Transport requesting assistance to overcome the difficulties posed by a swelling Mkomaas River in the wet season to children crossing the river to and from school.

Jeffares & Green were subsequently appointed for the design and construction monitoring of a pedestrian bridge over the river at the site. Because of environmental and construction constraints, the consulting engineer favoured the concept of a single long-span bridge over the river. A single long-span bridge would not impede the flow of the river and escaped classification as an activity requiring authorisation in terms of the Environmental Conservation Act of 1989. Therefore there would be no delay awaiting a record of decision from the KZN Department of Agriculture and Environmental Affairs.

**Other Considerations**

The Mkomaas River is known to be fast flowing and to experience flash floods. As construction of the bridge would require several months to complete, it was inevitable that some of the work would be carried out in the rainy season. The river’s potential for flooding also influenced the choice of a single-span bridge.

Owing to reduced construction time, the designers considered the use of precast concrete elements advantageous as several tasks could overlap. For instance, the deck panels could be manufactured before the abutments.
were in place. The use of precast panels also reduced the concrete work required on site under difficult circumstances.

Prestressed concrete ribbon bridges have found favour with some designers in Europe, Asia and North America, but as far as could be ascertained, this method of bridge construction had not previously been used on the African continent.

The following construction sequence is typical of this type of bridge:

1. The abutments are built and anchored back to rock on either side of the river (figures 1 and 2)
2. Main bearer cables are placed and stressed between the two abutments (figure 3)
3. Precast concrete elements are manufactured and suspended from the cables and slid across the river to their respective positions along the length of the bridge (figure 4)
4. The precast deck elements are joined by lapping reinforcement and placing in situ concrete, thereby turning the deck into a continuous ribbon (figure 5)
5. Longitudinal post-tension cables are placed along the length of the bridge in ducts inside the elements and tensioned in order to provide sufficient compression stresses to compensate for live load-induced tensile stresses (figure 6)
6. Handrails and other finishings are installed before the bridge is commissioned (figure 7)

Other long-span alternatives considered included suspension bridges, which are often used for pedestrian bridges, pipe bridges and other light structures in South Africa. However, the client had previously experienced problems with people refusing to make use of such bridges, as they tend to resonate under live loads. The introduction of stabilisers to dampen the resonance proved only moderately successful. The towers of suspension bridges also tend to have a negative impact on rural landscapes.

A prestressed ribbon bridge was determined to be a more viable option in terms of design requirements, cost effectiveness and time constraints.

**DESIGN**

Conventional software packages are unable to analyse catenary-type structures with their large deflections, as these packages are based on the assumption that plane sections remain plane and deflections are...
small in relation to actual dimensions. Therefore the design was based upon first principles done on self-generated spreadsheets. Subsequently the Institute of Civil Engineering at the University of Stellenbosch was commissioned to conduct finite element analysis on the bridge by using a sophisticated finite element structural analysis package. Results obtained from this analysis confirmed those of the self-generated spreadsheets.

The CSIR’s Dr Adam Goliger was employed to advise on anticipated wind loadings. His study was based on a computer-generated model, water tunnel tests and an extensive review of literature pertaining to wind loading on similar bridges. His report concluded that wind was unlikely to play a significant role in the lifespan of the bridge.

The maximum horizontal force that could be applied to each of the abutments under working loads is in the order of 10 MN, which meant that the abutments had to be securely anchored. As competent rock (charnockite with a compressive strength of approximately 50 MPa) was encountered on site, rock anchors were used.
The Mechanical Engineering School at the University of KwaZulu-Natal was commissioned to monitor the loads experienced by the rock anchors, with an option to re-stress if necessary. However, it turned out that the anchors behaved very similarly to the initial calculations and no further work was deemed necessary.

CONSTRUCTION
Remarkably, the contract for the construction of the Mkomaas River Pedestrian Bridge was won by a contractor who had never built a bridge before. The bulk of the labour force was recruited from the local community. Work commenced in November 2005 and was completed in April 2007. Difficulties were encountered in installing rock anchors through a 4 m deep boulder layer on the south abutment, but once that was completed the work went ahead without a major incident.

Deck elements were precast in Pietermaritzburg and transported to site.
The launching rate of these deck elements exceeded the designers’ best expectations, as up to 24 elements were launched in a single day, making the launching of the 93 deck elements no more than a five-day operation.

The most significant quantities for this bridge were 190 m³ of concrete, 37 t of steel reinforcement, 2 500 MN-m prestressing tendons and 31.5 MN prestressing anchorages.

The tendered price for the works was R3,73 million, which was well within the client’s initial estimate of R5,0 million.

CONCLUDING REMARKS

The Mkomaas River Bridge is a humble structure in so far as its walkway is also its main structural member. It spans the river without props, piers, stabilisers or towers that could detract from the rural landscape in which it was built.

The design was sensitive to the many challenges faced by a contractor building a bridge over a large river in a remote area of KwaZulu-Natal. It specified the use of precast concrete deck elements, which reduced the amount of construction required on site, thereby alleviating some of the burden on the contractor, who was able to produce a quality product under difficult circumstances. The use of a single-span prestressed ribbon bridge also did not require the contractor to work inside a river notorious for its flash floods.

The extensive use of concrete elements ensures that this bridge will serve its purpose virtually maintenance free for many years.
Slope failure retrofitted at Kaaimans Pass

The Garden Route, one of the main tourist attractions and also a major national road on the south coast of South Africa, experienced abnormally high rainfall in August 2006. A major slip failure occurred in one of the road cuttings, which severely damaged the roadway. Measures were immediately taken to restore this vital link, culminating in the construction of a R17 million half-viaduct bridge structure.

THE GARDEN ROUTE, one of the main tourist attractions on South Africa’s south coast, experienced abnormally high rainfall during August 2006. This national route is a major economic arterial serving heavy transport carriers and commuters as the steep mountainous topography in this region has resulted in very few alternative routes being available and these are of a substantially lower standard with significant additional travel time.

The combination of heavy downpours and unfavourable rock dip angle in one of the road cuttings, known as Kaaimans Pass, resulted in a slip.
failure that severely damaged the roadway.

The first evidence of this failure was a crack of about 80 m in length that developed in the outer lane. Within days, the road formation had sagged more than 0.4 m, signalling dangerous instability of the underlying formation.

The road was closed for several days while specialists assessed the damage and integrity of the existing structures and monitored the subsiding fill. This had serious implications for the Garden Route towns, especially for commuters travelling daily to their work places.

The client (SANRAL) immediately stepped in to restore this vital link and appointed consulting engineers BKS who had experienced geotechnical and bridge engineering staff immediately available.

Based on available knowledge from historical records and detailed site observations, the risk related to further damage became apparent and first one lane and subsequently two of the original three lanes were reopened, partially restoring the link. The complete reconstruction had to be executed in the shortest possible time and the consultant was instructed to programme their design and documentation activities such to ensure that tenders for construction could be invited within five weeks.

OVERVIEW OF CONCEPTUAL ALTERNATIVES

An extensive information gathering exercise, topographical surveys and subsurface investigation were immediately commissioned to establish the nature of the underground strata. Key considerations were the following:

- At least two traffic lanes (one in each direction) had to be maintained during the construction stages
- The 30 to 40 degree angle of the dip of the rock formation was away from the mountain side
- The weathered rock face on the outside of the slope under the talus was as steep as 70 degrees depending on local geotechnical profiles
Significant variations in founding depths could be experienced considering the nature of the rock and extensive weathering observed.

Future risks which may result in slope failures with a possible impact on the roadway stability had to be minimised.

Repair options would have to be combined with rock anchor and/or soil nailing systems.

Considering the weathered fractured and jointed rock, piling had to be done by using large-diameter oscillator piles. Their ability to penetrate rock and boulder formations and socket into bedrock was essential in this application.

The interaction of the roadway and possible adjacent structure had to be assessed carefully to limit future maintenance.

Three design concepts were identified and further developed by the consultant’s bridge specialists, Abé Newmark and Martin Smuts, as well the client’s bridge network manager, Edwin Kruger. Ron Tluczek, the consultant’s geotechnical specialist, who had previously been involved in structures on this section of the route, provided critical geotechnical input.

In view of initial lack of geotechnical data, various rock dip angles were postulated to fast-track the assessment of these in terms of suitability and cost.

The first design concept comprised a tied pile anchor wall and reinforced concrete cantilever. The construction procedure involved excavation to a suitable work platform by stabilising the existing roadway with a temporary soil nail structure to ensure accommodation of two-way traffic during construction. This would allow space for a work platform to be created to drive oscillator piles to support a quarter roadway width cantilever.

It was envisaged that the horizontal stability of the piles would be secured by sloped rock anchors in this instance. The main advantage of this concept was minimisation of the risk as a result of the stabilising effect of multiple anchored pile shafts in the rock formation. In addition, the substantial lateral force component minimised relevant movement between the roadway and reinforced concrete elements. This concept was also suited to all the various rock dip angles that were postulated.

The second design concept involved a more conventional retaining structure consisting of a tied mechanically stabilised embankment, constructed by excavating to sound founding level, and the construction of a stabilised earth type backfill on anchored back-reinforced concrete footing.

The third concept comprised a half-width viaduct bridge structure. Similar to the first option, a permanent soil nail structure would be constructed adjacent to the road centre line to provide space for two-way traffic and a working platform to erect conventional piers. Longitudinal precast beams supported on the pier caps and abutments would carry the viaduct deck and pier footings would be anchored back by means of rock anchors. This concept was similar to the existing half-viaduct structures in the vicinity. The interaction of this structure with the adjacent embankment would require the provision of a longitudinal joint with resulting long-term maintenance requirements.

**ANALYTICAL OVERVIEW**

The selection of the most suitable option relied heavily on geotechnical findings of an extensive drilling programme undertaken to investigate the competency of the underlying rock substrata to a depth of up to 16 m. The profiles varied from initial imported material at varying depths from 1.5 m to 4.0 m, which was underlain by a layer of soft material and bedrock at depth. The rock was highly jointed and the degree of weathering from highly weathered
to unweathered was intermittent and inconsistent with depth. This was attributed to decomposition seams on foliation joint planes which were completely weathered in many instances and exacerbated concerns regarding future failures. The general angle of dip was found to be 30 to 40 degrees and at a depth in excess of 12 m, marked improvement in the rock mass quality was observed. Significant difference in the depth to bedrock was noted between outer and inner boreholes.

The main geotechnical factor influencing the choice of final concept was the steep angle of dip and highly weathered jointing that could result in possible block/wedge failure. This would significantly enhance risks associated with founding at isolated locations with a pier-type structure in a local contact zone. The second concept of a mechanically stabilised type of retaining wall was rejected as unsuitable owing to the possibility of future wedge or slip failures that could occur.

After due consideration of all alternatives, a modified version of the first concept was adopted. The final proposal was considered to provide the optimum solution considering interaction with the adjacent road formation and the bedrock profile (fig. 4).

The new half-viaduct is known as bridge B0015 and was completed in November 2007. It is supported on eight 1200 mm diameter reinforced concrete oscillator bored piles spaced at 8 m centres. The piles have a total average length of 14 m and are socketed 4 m into competent rock. The superstructure comprises a 7 m wide cantilevered reinforced concrete deck spanning between the piles and has an overall length of 60 m.

A novel feature is the counter-balancing of the cantilever with an integrated buried jockey slab which eliminated a problematic longitudinal joint and also reduced deck torsion and bending effects on the piles due to eccentric traffic loading. This not only removed fill material, but also ensured that all road loading was transferred to bedrock via the structure and piles and not via fill material. The structure is anchored laterally with restressable rock anchors ensuring the stability of both structure and rock formation. Two anchors are provided between each of the pile locations at third points of the spans.
The anchor forces are distributed to the pile caps by means of the horizontal deck beam which is integrated with the cladding. The anchors are located in concrete chambers for future accessibility. In order to minimise vertical movement between the roadway layer works and structure, the jockey slab is tied down onto rock with vertical rock bolts.

**OTHER ASPECTS**

The construction proceeded largely as planned and unforeseen delays that were experienced during construction mainly related to the piling process, which proceeded substantially slower than anticipated.

The concrete mix design was specified and carefully monitored in view of the aggressive environment surrounding the structure. The cementitious binder consisted of a blend of ordinary Portland cement and Corex slag, with enhanced durability properties and resistance to chloride ingress.

This structure, as is the case with all other bridges on the national road network, is to be monitored by means of the SANRAL bridge management system. This is a defects-based system rather than a condition-based system. Inspections are normally done on a five-year basis but provision for specialised inspections is also made, which would be the case in this instance with regard to the restressable anchors. The anchor loading is to be verified 12 months after the installation date and thereafter on a three-year basis.

In addition a precise levelling survey is to be carried out on this structure as well as on other structures in the area on an annual basis.

**CONCLUSION**

On completion, the portion of the road that once seemed destined to slide into the Kaaimans River now has four permanent lanes. Inspections after completion concluded that the design objectives have been attained.

The project provided the structural and geotechnical engineers with not only a challenging problem but also an opportunity to practise their art by restoring a vital transportation link and so enhancing the lives of the people and towns to whom this road serves as an economic lifeline.
Rehabilitation of bridges over the spillways of the Gariep and Van der Kloof dams

THE BRIDGES OVER THE spillways of South Africa’s two largest dams, Gariep and Van der Kloof, provide vital links over the Orange River for tourism, the surrounding rural communities, as well as agriculture-originated heavy vehicles. The complex interaction of routine maintenance and structural defects in the serviceability limit state led to the use of state-of-the-art vibration-based dynamic tests, combined with visual inspections and structural analysis techniques, to identify the root cause(s) of the deterioration.

Technically challenging retrofitment activities performed at the Van der Kloof bridge superstructure included the installation of new reinforced concrete transverse beams and the construction of a fully bonded concrete pavement (or roadway) while an epoxy-bonded steel plate strengthening system was used at the Gariep bridge. Remedial work at the bridges included concrete repairs, replacement of bridge bearings, and replacement of expansion joints.

BACKGROUND
In December 2005, BKS Engineering and Management were awarded the tender by the Department of Water Affairs and Forestry to provide consulting services for the rehabilitation of major bridge structures over South Africa’s large dams, namely the Gariep, Van der Kloof and Pongolapoort dams. At design stage, the envisaged work was split geographically into two contracts. This article covers the work performed under the Free State construction contract for the Gariep and Van der Kloof dams, comprising 70% of the total construction value.

Gariep Dam
The Gariep Dam is South Africa’s largest composite gravity concrete arch dam and forms the central structure of the original Orange River Project. The dam is situated on the border between the Eastern Cape and Free State and the dam wall is 88 m high with a crest length of 914 m. The original construction was completed in 1971.

The bridge over the spillway is curved horizontally and has a total length of 245 m along the centreline. It comprises 15 simply
supported spans, each with a length of 14.5 m.

The superstructure consists of nine precast reinforced concrete T-beams placed at 1.37 m centres with an in situ concrete infill slab section. The beams have a straight alignment and the horizontal curvature is accommodated by triangular infill at pier locations with two expansion joints on either side. The substructure consists of reinforced concrete piers founded in the concrete dam wall.

Van der Kloof Dam

The Van der Kloof Dam is the second largest composite gravity concrete arch dam in South Africa. It is situated 130 km downstream of the Gariep Dam on the Orange River on the border between the Northern Cape and Free State.

The Van der Kloof Dam is currently South Africa’s highest dam with a wall height of 107 m and a crest length of 765 m. The original construction was completed in 1977.

The bridge over the spillway is curved horizontally, has a total length of 204 m along the centreline, and comprises 15 simply supported spans of 13 m. The superstructure consists of nine precast reinforced concrete beams placed at 1.25 m centres with a reinforced concrete in situ cast slab 130 mm thick and 20 mm thick fibre cement permanent formwork placed below the slab spanning transversely between beams. In addition, four independent bridge spans are located over the radial sluice gates.

ASSESSMENT OF STRUCTURES

Observed defects at Gariep

At Gariep, flexural crack patterns were observed on the longitudinal beams, particularly the outer two beams on each side of the superstructure. In addition, varying bearing support conditions – overstressed outer bearings and central bearings lifted clear of the plinths – were observed. On review of the as-built information and computerised structural analyses, the cracking and variable bearing support conditions were attributed to transverse hogging induced by the long-term creep of eccentrically pre-stressed transverse beams. Limited distribution steel throughout the web of the longitudinal beams may have contributed to the cracking in the beams. These findings were confirmed through dynamic and vibrational assessment of the superstructure. The expansion joint system and the elastomeric bearing pads had fulfilled their service lives and total replacement was recommended.

Observed defects at Van Der Kloof

At Van der Kloof, road users had reported experiencing a ‘roller-coaster’ sensation and the road had been closed to public traffic. Longitudinally oriented cracking was observed in the deck slab, midway between adjacent longitudinal beams. The detail assessment indicated that the existing superstructure configuration utilised two end transverse beams in each span and relied on the deck slab to provide transverse stiffness. Specialist vibration-based dynamic testing and advanced computerised analyses were performed by the Department of Civil Engineering of the University of Cape Town. Inadequate transverse stiffness of the superstructure was determined as the main cause of the observed serviceability limit state defects. Total reconstruction of the asphalt surfacing, expansion joint system and elastomeric bearing pads was recommended.

DESIGN AND CONSTRUCTION STRATEGIES

Access

The greatest challenge facing the contractors was providing access to the bridges over the spillways. The physical constraints...
posed by the structures included the height above ground level, the inability to found on the curved spillway profile below, and the presence of local valley wind systems. The project specifications required that the temporary access platforms be restricted to a zone extending between 1.5 m and 2.5 m below the soffit of the existing longitudinal beams of the superstructure. The access platforms had to conform to the relevant safety standards, as well as to the Construction Regulations and Occupational Health and Safety Act.

Ibhayi Contracting utilised a segmental system comprising four independently supported platforms braced together under each span opening. The platforms were constituted from conventional scaffold components – that is, typical steel ladder beams and steel scaffold boards supported by steel bearing plates attached via dual steel wire cables. The supporting cables were placed at each of the four corners and fed through cored holes in the concrete deck slab and anchored to purpose designed steel anchor frames above the bridge deck. The platforms were erected with the aid of a crane truck with a 6 t capacity to lower the platforms (figure 2). Once lowered, each corner of the individual segments was winched into place using proprietary cable puller devices located on the anchor frames. A fixed-length safety cable and independent safety lines were secured before construction personnel were permitted to enter. All construction personnel used safety harnesses attached to the independent safety lines. Three platform sets were utilised at both the Gariep and Van der Kloof structures.
Structural retrofitment at Gariep Dam
The outer two longitudinal beams on each side of the deck were strengthened using epoxy-bonded steel plates, including shear straps bolted and tensioned into the compression flange of the T-beam configuration. The design analogy of a truss was utilised. After the exposed structural steel elements were coated with a proprietary paint system to prevent corrosion, the exposed superstructure concrete surfaces were coated with a highly flexible protective coating to bridge the observed cracking.

Structural retrofitment at Van der Kloof Dam
In order to improve the transverse stiffness of the superstructure, each span was retrofitted with two internal transverse beams installed at third points, dowelled into the existing longitudinal beams and the deck. The specifications required that self-compacting concrete be used to install the concrete for the transverse beams through core holes in the existing deck. This design approach obviated extensive demolition and ensured that the existing deck could support all temporary access loads.

The self-compacting concrete was mixed in a pan mixer on site and every batch was performance tested for flow distance and flow time to verify the viscosity properties of the concrete.

An additional 100 mm thick concrete pavement, fully bonded to the existing scarified deck and dowelled directly into the longitudinal beams and new transverse beams, was then constructed to improve the load distribution characteristics of the deck slab. The dowels connecting the concrete pavement to the longitudinal beams were installed to add structural capacity to the deck slab. The pavement was finished with a burlap-dragged and grooved texture that was aimed at reducing noise generated by vehicular traffic and assisting with surface drainage.

Bearing-replacement operations
A total of 596 bridge jacking and bearing-replacement operations were performed at Gariep and Van der Kloof bridges. A cylinder-type hydraulic jack with lockable rings and a 60 t capacity was used to lift the superstructures.

A carefully displacement-controlled three-phase jacking procedure was followed. First the weathered bearing pads and epoxy mortar plinths were lifted and removed. The replacement bearings were then wedged into place against the beam soffit, lowered to a pre-calculated parabolic profile and embedded on an aggregate-filled epoxy mortar. The epoxy mortar was allowed to gain adequate compressive strength before the bridge was lifted clear of the new bearing pads to facilitate a final bonding step. A medium-viscosity epoxy resin was placed at the interface between the beam soffits and the new bearing pads and the loads were released from the hydraulic cylinders before the pot life of the epoxy resin had expired. The excess epoxy resin was squeezed out during the load transfer and immediately cleaned from the elastomeric bearing surfaces. Thereafter...
68 guide bearings, each with a 10 t and 40 mm capacity, were installed centrally at both ends of each span of the Gariep and Van der Kloof superstructures.

**Replacement of bridge expansion joints and reinstatement of joint gaps**

A total of 648 m of bridge expansion joints were replaced at the two major bridges to provide sufficient capacity to accommodate temperature movements. New concrete nosings were cast using a specialised concrete mix. The nosings were cured using a solvent-based curing compound and sheeting covering for three days. The exposed joint faces were prepared by reaming and cutting 10 mm by 10 mm chamfers to remove concrete laitance and to prepare for the installation of a fuel-resistant silicone sealant. At Van der Kloof, a further 60 m of asphaltic plug-type joint was installed at the independent bridges over the radial sluice gates.

**Asphalt surfacing and drainage improvement**

At Van der Kloof, the asphalt surfacing was replaced in the roadway over the dam wall, except where the concrete pavement had been constructed on the bridge over the spillway. Some 500 t of medium continuously graded asphalt surfacing was replaced. The new surfacing was reinforced over transverse block joints in the dam wall using 285 m of an asphalt reinforcement system consisting of adhesive-encapsulated fibreglass mesh. Additional scupper pipe outlets were installed in the drainage channel.

**HEALTH AND SAFETY**

The temporary access system designed by the contractor contributed to safe working procedures and systems on site. Monthly safety audit results indicated above-average compliance regarding safety issues. No incidents were recorded during the construction period.

**COMMUNITY INVOLVEMENT**

Although the rehabilitation works were of a specialist nature, more than 60 local people were employed and trained in various aspects of the construction works. A significant economic contribution was made to the local communities.

**CONCLUSION**

Despite the complexity of the project, the work was completed within the approved budget (construction value R21 million) and construction programme (53 weeks).
Top-down basement construction at Umhlanga Hospital

THE BASEMENT OF A NEW BUILDING adjacent to the existing Umhlanga Hospital was constructed using the ‘top-down construction method’. This is reportedly the first application of this method in the Durban region, and possibly in South Africa, although it has been utilised elsewhere around the world.

The advantages of the method are:
- Reduced cost of lateral support because ground anchors or temporary internal props are omitted
- Reduced time to complete the building because the superstructure can commence before the basement is complete, where after they are constructed simultaneously. It is estimated that application of the method saved about three months on the overall project programme.

METHOD
The method entailed the following steps.

First, large-diameter, contiguous, augered reinforced concrete piles were installed around the periphery of what would become the basement to provide lateral support as vertical cantilevers retaining up to 7 m of soil, thereby allowing bulk excavation down to the upper level (B1) of the basement.

Piles were then installed from the B1 level to support the columns that would later be constructed above.

A floor slab was cast on the ground at the B1 basement level, incorporating the tops of the column support piles, over the entire length and width of the building.
plan, and against the peripheral, contiguous piles. This B1 slab would prevent inward lateral displacement of the surrounding contiguous piles when the lower part of the basement was subsequently excavated below the slab.

The remaining, lower part of the basement was then excavated by ‘mining’ underneath the B1 floor slab using dump trucks, frontend loaders and large excavators, which all gained access through a 20x6 m opening in the slab, and down a temporary soil ramp. Such excavation required careful planning and supervision, as well as artificial lighting, ventilation and drainage. The upper portions of the piles were exposed in the process over a depth of 6 m, between the B1 level and the lowest B3 level of the basement.

Construction of the superstructure continued simultaneously above the B1 floor level while excavation for the basement was carried out below, as well as during subsequent construction of basement floor slabs B2 and B3.

Basement floor slab B3 was cast as a surface bed on the bottom of the completed excavation.

Basement floor B2 was cast as a suspended floor, attached to the piles under the superstructure columns that had been exposed by the excavation by means of pullout bars and drilled-in dowels.

- Installation of contiguous piles
- Installing column support piles after excavating to B1 level
- Casting the floor on B1 level
Shotcrete was applied over the contiguous, lateral support piles around the sides of the basement, as well as over the column support piles where they had been exposed through the basement.

FAVOURABLE FACTORS
Factors that favoured the top-down method of basement construction for this project were:

- Modern piling rigs that Afripile Pty Ltd had recently imported into South Africa enabled them to install larger-diameter concrete piles, and to greater depths, than had previously been possible in this region. Such piles could provide lateral support to the initial stage of this exceptionally deep excavation without ground anchors and support the heavily loaded columns, as single units, or in pairs, thereby limiting the space they occupied as finished columns through the parking basement. This could not have been achieved with the older piling rigs that were available previously.

- Concrete piles could be installed with minimum noise (important adjacent to the existing hospital) because the method entailed drilling rather than hammering (as might otherwise have been necessary to install steel sheet-piles for lateral support, for instance).

- The contiguous concrete piles around the sides of the basement provided lateral support during construction, as well as formed part of the permanent structure, thereby eliminating need for secondary internal retaining walls as would have been necessary if either steel sheetpiles or timber shoring had been utilised for temporary lateral support.

- The 800 mm diameter concrete column support piles were sufficiently robust to withstand impacts by frontend loaders and dump trucks used to excavate the basement while the piles supported the superstructure above, despite being exposed and unbraced over a height of 6 m below floor B1.

- It was relatively simple to attach the suspended basement floor B2 to the

Building above B1 floor while excavating below
Basement floor slab B3
Basement floor B2
Completed basement
piles, and to connect pairs of piles to form rectangular columns through the basement, by chipping away concrete to expose ‘pull-out’ reinforcement, and/or by grouting bars into holes drilled through the piles.

Modern piling rigs that Afripile Pty Ltd had recently imported into South Africa enabled them to install larger-diameter concrete piles, and to greater depths, than had previously been possible in this region. Such piles could provide lateral support to the initial stage of this exceptionally deep excavation without ground anchors and support the heavily loaded columns, as single units, or in pairs, thereby limiting the space they occupied as finished columns through the parking basement.

Gnite (or shotcrete) placed over and between the contiguous piles around the sides of the basement provided permanent support to the soil that had been exposed between the piles and also ensured a satisfactory finish.
Vital link to Bloemfontein CBD established

UPGRADING OF DR BELCHER ROAD, MANGAUNG ACTIVITY CORRIDOR

Submitted by Free State Branch in the category Technical Excellence

KEY PLAYERS
Client Department of Local Government and Housing, Free State
Project manager and the design of streets, bridges and civil services Ninham Shand
Environmental scoping report Botsitso Development Group
Geotechnical investigation for bridge design Moore Spence Jones
Rail track and signalling design R & H Railway Consultants

MANGAUNG, a formerly disadvantaged township area in Bloemfontein, can be described as a sleeping town with no central business district, no shopping centres, a few standalone shops, no office developments of note, few recreational facilities and hardly any job opportunities for the more than 200 000 people living there.

For many years, Mangaung had experienced limited economic activity as Mangaung and Bloemfontein functioned as separate local authorities. In the early 1980s the Mangaung local area was incorporated in the Bloemfontein Metropolitan transport area. This resulted in better-coordinated planning and implementation of transport-related projects, although land use planning and development remained the responsibility of the separate authorities. In the 1990s Mangaung was amalgamated with Bloemfontein and this led to integrated land use planning and economic development.

Congestion caused by limited road linkages between Mangaung and Bloemfontein severely strained the existing road facilities. The problem was exacerbated by township development,
conflicting transport nodes and dangerous pedestrian thoroughfare along the main roads.

**DEVELOPMENT OF THE CORRIDOR**

The Mangaung Activity Corridor was developed to alleviate transport and promote local economic activity between Bloemfontein’s CBD and Mangaung.

The first phase of the project entailed the creation of a corridor along the Dr Belcher Road and Fort Street linkage with the Bloemfontein CBD. The project included the provision of improved public transport facilities and a safe pedestrian environment, as well as the development of business nodes.

The upgrading of the second phase enhanced the development of the multi-nodal public transfer node, the remainder of the activity corridor.

The road corridor includes Mkuhlane / Brits / Ramatsoele / Moshoshojoe streets in Mangaung, as well as a portion of Dr Belcher Road. This has always been the primary access road into the Mangaung area.

Figure 1 shows the extent of the activity street, starting from the CBD along Dr Belcher Road and winding down the length of Mangaung all the way to Chief Moroccan Crescent in the south.

**PUBLIC TRANSPORT**

A high-quality, high-capacity public transport service will be introduced.

As the corridor develops and the desired activities start to happen, patronage of the public transport service will blossom, with potential lucrative

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1. Link with the CBD
2. Old bridges viewed from the east (before construction)
The new geometric standard of Dr Belcher Road being that of a four-lane road, it was not necessary to construct bus/taxi loading bays as public transport vehicles are stopping on the street, in the left lane at the boarding points. In Mkuhlane / Brits / Ramatsoele / Moshoeshoe streets in Mangaung existing bus and taxi loading bays were upgraded. This entailed the provision of bus shelters and the paving of dusty waiting areas.

PEDESTRIAN FACILITIES
Various measures were introduced to create a pedestrian-friendly environment in the Mangaung Activity Corridor:

- The pedestrian walking areas are at least 2 m wide to ensure two-way pedestrian traffic. Features such as the village square concept were encouraged, while sidewalks near identified development nodes were paved fully to allow the maximum pedestrian movement.
- Walking strips were provided in-between development nodes, along the road on both sidewalks. These are at least 2 m wide to cater for two-way pedestrian traffic and ensure the safety of people with wheelchairs.
- Unsignalled, raised pedestrian crossings were built at 200 m intervals along the corridor. These also act as traffic calming measures for motor vehicles.

PUBLIC TRANSPORT FACILITIES
Durable and visually pleasing passenger shelters were erected to shelter waiting passengers, who also provide a ready market for nearby traders in the activity street.

IMPROVEMENTS TO STREET(S)
Activity streets and parking facilities were improved and upgraded to the appropriate engineering standards.

The widening of the lower portion of Dr Belcher Road was the most important project without which the whole concept could not succeed. The work included the widening of the lower portion of Dr Belcher Road to four lanes (double-lane financial returns for operators.

The new geometric standard of Dr Belcher Road being that of a four-lane road, it was not necessary to construct bus/taxi loading bays as public transport vehicles are stopping on the street, in the left lane at the boarding points. In Mkuhlane / Brits / Ramatsoele / Moshoeshoe streets in Mangaung existing bus and taxi loading bays were upgraded. This entailed the provision of bus shelters and the paving of dusty waiting areas.
dual carriageway), the providing of pedestrian and public transport facilities, the widening and the improving of the clearance at the existing subway (rail over road) by constructing a new railway bridge, and the demolishing of existing bridge structures. The project cost amounted to almost R46 million.

**PROJECT IMPACT**

Overall, a better environment for business opportunities was created. As there is a huge improvement in traffic flow at the Dr Belcher subway, there has been a great improvement in deliveries to businesses along the activity corridor.

Old bridges viewed from the east (during construction)
New bridges viewed from the east (nearly complete)
New bus shelter, new centre island, sign for new raised pedestrian crossing ahead
THE MACWEST BRIDGE near Vereeniging lies about 100 km south of Johannesburg. The bridge links the new Maccavoel West coal reserve to the existing New Vaal Colliery Maccavoel East mining operation.

This project will facilitate the improved mining of the Maccavoel West coal reserve, which supplies the nearby Lethabo Power Station. The bridge carries an internal access road over an electrified railway line and provincial road in the Anglo Coal facility.

DESIGN

The mining operations of the New Vaal Colliery use a multitude of abnormally sized vehicles. The MacWest Bridge needed to be designed with these vehicles and their heavy loads and abnormal widths in mind. The design and positioning of the bridge, and the fact that it had to accommodate the severe live loading of dumper trucks and occasional heavy shovels, posed a challenge.

The bridge will facilitate the delivery of coal to Lethabo Power Station

The MacWest Bridge near Vereeniging is certified to carry 715 t
The road and railway lines over which the bridge was built also had to remain operational throughout the construction period, except during the erection of the precast concrete T-beams.

Anglo Coal required the bridge to carry, on a daily basis, fully loaded Euclid R170 rear dump trucks, each with a total static dead load of 352 t, and occasionally the single P&H 2300 rope shovel with a mass of 715 t.

The target payload for dump trucks is 211 t and they travel over the bridge at a speed of 35 km/h. The rope shovel has two crawler shoes each with a contact area of 6,6 m long and 1,8 m wide.

The bridge was designed within the principles of ultimate limit design methods, and only static load weights were supplied by the vehicle manufacturer as a guideline. An additional 1,5 dynamic factor for dumper trucks and 1,33 for the occasional shovel were applied. At the approach road, a bridge width of no less than 27,4 m was required to accommodate a carriage width of 21 m.

Another operational factor influencing the design was that coal falls from the dump trucks onto the road. This necessitates regular clearing of the...
gravel approach roads using a grader. The same applies to the bridge surface, which required the deck surface to be designed to accommodate the operation of a grader blade.

**CONSTRUCTION**

The bridge length is 36 m with three deck spans of 14 m, 10.3 m and 11.6 m respectively. The deck spans are simply supported and consist of 1.5 m deep inverted precast concrete T-beams with a 240 mm thick in-situ cast structural concrete slab. A topping of 100 mm with a grid of cast-in rails was provided to protect the structural concrete and expansion joints against the action of grader blades.

The two piers each consist of four wall-type supports topped by a seating beam. Each pier is founded with 24 augered concrete piles with a length of 12 m to 14 m on top of soft rock (coal).

Precast beams were required for the construction above the railway line and the road. Pre-stressing of the beams was considered, but as a result of the extreme ratio of live load versus dead load, it was found to be more economical and practical to use reinforced concrete.

To prevent material from falling on the railway line or the provincial road, a 2.5 m high barrier and a 3 m high steel screen wall had to be erected on each side of the bridge. Hollow triangular concrete elements were erected on either side to safeguard the dumper trucks while crossing the bridge.

Bridge construction consumed over 3 000 m$^3$ of concrete and 500 t of reinforcing steel. The contractor, WBHO Construction, completed the bridge in 11 months. The construction cost for the bridge with reinforced earth walls amounted to some R36 million.

**CONCLUSION**

The MacWest Bridge is expected to be in use for the next 30 years and will boost New Vaal Colliery’s supply to the Lethabo Power Station by an annual 2.7 million tonnes. This means that the mine’s existing output will rise to 17.8 million tonnes per annum.

The bridge, which is jointly funded by Anglo Coal and Eskom, forms an important component of the Maccauvlei West project. As such, it will contribute towards solving South Africa’s current energy crisis.
New pedestrian bridge promoting safety

The provision of a new pedestrian bridge connecting the communities of Belhar and Kalkfontein in Cape Town over the R300 has gone a long way to alleviate the plight of Kalkfontein residents looking to access essential services in Belhar.

The main objective of the R14 million project was to improve the safety of motorists and pedestrians using the R300 freeway. In doing so, the community of Kalkfontein was provided with safe access to basic amenities such as clinics and schools.

THE R300 IS NOTORIOUS as one of Cape Town’s most dangerous roads in terms of pedestrian accidents. Owing to the high operating speed and good driveability of the road, a high percentage of the pedestrian accidents occurring on the R300 are fatal.

In the late 1990s and early part of this century the government implemented (and continues to implement) a plan of providing low-cost housing to residents of informal settlements in and around urban areas. The settlement of Kalkfontein was started in this way; however, no provision was made for basic amenities such as schools and primary healthcare facilities. This led to the residents of Kalkfontein seeking these facilities on the other side of the R300, in Belhar.
In 2005 the South African National Roads Agency Ltd (SANRAL) identified a section of the R300 between the Stellenbosch arterial and Van Riebeeck Road interchanges as an accident hot spot. After preliminary investigation by SANRAL, three potential locations on this section were identified as points at which pedestrians cross the road and at which the provision of a pedestrian bridge could be warranted.

The final location for the bridge was chosen based on pedestrian traffic surveys undertaken and available accident statistics. Daily pedestrian volumes in excess of 500 pedestrians were recorded at the location of the bridge.

COMMUNITY INVOLVEMENT

The communities of Kalkfontein and Belhar were both involved in the preliminary design of the bridge. They were consulted to determine the optimum position of the bridge and to incorporate their comments into the design where possible.

During construction a large proportion of the labour force was sourced from the Kalkfontein community and a programme of providing basic construction skills to local labour was implemented. Local labour underwent training in erecting scaffolding, site safety, road safety, handling concrete and fixing reinforcing.

A community liaison officer was appointed from Kalkfontein to provide feedback to the community regarding construction activities and to source local labour. This coordination with the community was a particularly successful aspect of the project, with the community understanding the dire need for the bridge and assisting in every way possible.

TECHNICAL CONSIDERATIONS

The current lane configuration on the R300 is two lanes in each direction, accommodated on two separate carriageways. The long-term plan for the road is four lanes in either direction. In addition to the four lanes, under the proposal to toll the R300, a toll plaza is proposed.
to the south of the bridge location. The above considerations led to the long, unequal (27 m and 37 m) spans which are a feature of the bridge.

Owing to the long spans a prestressed, continuous structure was the preferred structural configuration. Other structural options considered were precast T-beams, continuous composite steel/concrete bridge and steel trusses, but these were all found to be unsuitable.

Two specific client requirements resulted in some innovative design:
- At no stage could normal traffic flows on the R300 be disrupted, with the exception of short periods on selected Sundays
- No formwork above the trafficked lanes would be permitted, due to safety concerns

In order to satisfy the client’s requirements, sections of the superstructure crossing the trafficked lanes were precast at ground level and launched into their final positions in the continuous deck, where they were supported on temporary props while the remainder of the superstructure was completed by more conventional methods. It was envisaged that the beams would be lifted and positioned utilising two mobile cranes each, under strict safety conditions.

The technical complexity arose because these two beams were 11.2 m long and weighed 55 t each. These beams were to be placed at their final positions in the bridge, approximately 7.0 m above the roadway, to a vertical and horizontal tolerance of 20 mm.

The longer span of the main deck required substantial design consideration in order to keep with the client’s brief of a light, aesthetically pleasing structure. This span has been designed at the very limit for this type of deck, with a span/depth ratio of 33.5.

**PUBLIC PARTICIPATION**

The main area of concern was the social impacts on the two communities of Belhar and Kalkfontein. For this reason an extensive public participation phase was undertaken during which all communities affected by the proposed bridge were approached for their concerns, objections and comments regarding the bridge.

The main concerns to emerge from the public participation process were the concerns of the two communities regarding safety. Objections were lodged by Belhar residents who were concerned that residents of Kalkfontein would cause an increase in the crime rate in Belhar. Similar concerns were expressed by some residents of Kalkfontein (that Belhar residents would increase crime in Kalkfontein).

**ENVIRONMENTAL CONSIDERATIONS**

A detailed EIA process was undertaken for the pedestrian bridge. The final design of the bridge was not affected by the EIA process, but mitigation measures were provided to certain properties close to the bridge on the Belhar side to increase the safety of residents. These included the installation of speed bumps, the installation of soundproof windows, the relocation and raising of certain boundary walls and the provision of solid screening to certain sections of the western ramp.

**AESTHETIC CONSIDERATIONS**

At an early stage in the design process the client indicated that aesthetics would be an important consideration in the final design of the bridge. Towards this end the structure was designed as a smooth-flowing structure with few ‘hard’ edges in plan and in the cross
In this project a technically complex construction process was used to respond to a fundamental need of the community – the need to access basic medical and educational facilities.

section of the deck. This curvi-linear design philosophy was continued in the design of the structural steel screening to the bridge.

In order to minimise edges and the appearance of unsightly shadows on the sides of the deck, most of the corners in the cross section of the deck have been radiused. These curved sections greatly increased the technical complexity in the construction of the bridge.

Every effort was made to give the impression of a light structure with as few supports as possible. This is particularly apparent in the eastern ramp, with the longest span approaching 20 m to minimise the number of columns.

TENDER AND CONSTRUCTION

From the outset of the construction process, the contractor identified the high traffic volumes on the R300 as a major safety concern for all site personnel. All site personnel received a site induction which outlined the basic safety requirements on site.

A key activity around which the project revolved was placing the precast beams into position. Despite the professional team’s recommendation of a tandem lift for the two precast beams, the contractor proposed the use of a single 225 t crane placing each beam in a single lift. This method worked exceptionally well for the launching of the beams, with both beams placed on one Sunday, commencing at sunrise and ending just as the sun was setting.

The lifting operation was a resounding success. Both beams were placed within 10 mm of the final position, which was within the required tolerance.

CONCLUDING REMARKS

In this project a technically complex construction process was used to respond to a fundamental need of the community – the need to access basic medical and educational facilities. This was done in a manner which provided an aesthetically pleasing structure that has already raised debate among civil engineering practitioners.

The project is a clear indication that technically complex construction methods can be successfully implemented in the South African context, even on relatively small projects such as this.
Zibambele programme
alleviating poverty in KZN

THE ZIBAMBELE POVERTY-alleviation programme was conceived in the early 1990s by the KwaZulu-Natal Department of Transport as a routine road maintenance system designed to alleviate poverty in the rural areas of KwaZulu-Natal.

It has now developed into a far more comprehensive developmental intervention that generates wealth and accumulates assets through organising beneficiaries of the programme into savings clubs and cooperatives.

The programme targets households headed by women. At present there are almost 30 000 beneficiaries deployed in KwaZulu-Natal with 4 500 of these being managed by eThekwini Municipality in a separate programme.

BACKGROUND
When the eThekwini Municipal Authority (EMA) was constituted, it increased the previous Durban municipal area by 68%. It now comprises 2 297 km² with only 35% of the area being predominantly urban.

In accordance with one of the key principles of the EMA IDP – to create a more efficient administration – the Roads and Stormwater Maintenance Department made a far-reaching strategic decision. This was to provide a balanced approach to maintaining the city’s infrastructure by contracting certain operations to both the formal and informal sector – the formal sector comprising established and emerging contractors and the informal

ETHEKWINI ZIBAMBELE
POVERTY-ALLEVIATION PROGRAMME

Commendation: Submitted by Durban Branch
in the category Community-based Projects

KEY PLAYERS
Client eThekwini Municipality, Roads and Stormwater Maintenance Department
Programme managers tpa Consulting
Social consultant Indumiso Trading
The department appointed tpa Consulting as their programme managers.

OVERVIEW OF THE PROGRAMME
The Zibambele contractors carry out routine low-intensity maintenance on both gravel and blacktop roads. The beneficiaries are expected to clear the road verges of vegetation and litter, keep the sidewalks, drains and road surfaces clear of silt and debris, and keep the grass short on the road edges. The contractors are issued tools such as wheelbarrows, hoes, brooms, rakes, slashers and safety equipment such as reflective vests, gloves and traffic cones.

The Zibambele overseers are also selected from the community. They must be literate and have some leadership skills. The overseers support some 50 contractors each. The Zibambele coordinators are technicians in training who are seeking experiential training. They support about 7 overseers and 350 contractors each. The EMA exercise audit control and strategic management of the programme while tpa Consulting are responsible for the programme management and support of the contractors, overseers and coordinators.

CONTEXTUALISING THE PROGRAMME
The Zibambele road maintenance concept preceded the government’s Expanded Public Works Programme (EPWP). The EPWP is also a short- to medium-term programme aimed at alleviating poverty and reducing unemployment, but

CASE STUDY
Ngeneleni Gumede (left) is a Zibambele contractor. Neliswe Mgobhozi is her overseer.

These two ladies are two of the many who can attest to the positive impact the Zibambele programme is having on their lives.

Ngeneleni Gumede started work as a Zibambele contractor in 2005. She has six dependants and a Grade 6 level of education. She maintains a blacktop road section in Ward 43 in Ntuzuma, north of Durban central.

She has been able to provide funeral cover for her family, pay for her children’s school and bus fees and provide food for her family.

Neliswe Mgobhozi started as an overseer in 2005. She has two dependants and a Grade 12 level of education. She has been able to obtain funeral cover that was used when one of her relatives died. She has also been able to build a two-bed-roomed house for herself and furnish it with a bed, fridge, television and a DVD. She is also able to pay her two children’s school fees and provide food for them.
there are certain differences between Zibambele and other EPWP programmes. The main difference is that the Zibambele programme assists economically vulnerable people on a long-term basis, thus allowing them to plan their future regarding food, clothing and education. Normal construction projects have a limited life span and are unable to offer this level of support and sustainability.

The programme was initially believed to fall outside the scope of the EPWP but inside the scope of the RDP strategic view. It was hoped at the time the programme was conceptualised that the EPWP would broaden its guidelines to encompass more long-lasting poverty-alleviation programmes. This has subsequently happened.

**SELECTION PROCESSES**
The essence of the programme is the selection of beneficiaries who are contracted to work on road sections near their homes. Fifty of the 100 wards in eThekwini were considered sufficiently destitute to accommodate the programme.

**SOCIAL ISSUES**
A fifth of the Zibambele contractors did not have valid identity documents and the majority did not have bank accounts. Contractors were assisted to deal with these issues. In addition, 15% of Zibambele contractors were not accessing the social grants they were entitled to. A simple means test was applied to ensure that after receiving all their entitlements, the beneficiaries still qualified to be part of the programme.

In the pilot phase this was as far as the department was able to go with regard to social benefits, but once the numbers of beneficiaries increased the department appointed a social consultant, Indumiso Trading, to establish savings clubs and help establish cooperatives and businesses.

The savings clubs have exposed beneficiaries to the mechanisms of civil structures. By accessing the clubs’ group savings, seed capital is made available to pursue business opportunities such as catering, sewing, light manufacturing or agriculture. Members receive formal training in business and social skills at their regular savings club meetings. To date, 85 savings clubs have been formed.

**TECHNICAL ISSUES**
The Zibambele programme monitors and records details pertaining to the programme’s beneficiaries and the authority’s infrastructure. Because of the magnitude of the programme many of these operations have been mechanised and an information management system has been developed to manage the process.

**CONCLUDING REMARKS**
To date, the eThekwini Zibambele programme has been a huge success. By augmenting its internal capacity with community-based structures, the EMA have been able to gain an operational advantage and also help achieve one of the key objectives of its transformation plan, which is to enable more citizens to enjoy an improved quality of life, now and in the future!
IN 2006 THE SOUTH AFRICAN Government decided to accelerate the eradication of the bucket sanitation system in established formal areas in order to ultimately supply acceptable sanitation facilities throughout South Africa, but early in 2007 the project was progressing very slowly.

To increase the roll-out rate, the United States Agency for International Development (USAID), in conjunction with the Department of Provincial and Local Government (DPLG), implemented a support project to help eradicate the use of 103 000 bucket toilets by December 2007.

USAID, which funded the project and provided technical support under the Increasing Sustainable Local Government Services (ISLGS) programme implemented by the Louis Berger Group, Inc, invested R9.5 million in the project.

Within six months, starting October 2007, about 80% of the bucket toilets identified at the start of the project were eradicated under the support project, with the remainder to be eradicated by the end of 2008.

PROJECT OVERVIEW

The support to the National Bucket Eradication Project comprised two parts: an assessment phase followed by an implementation phase.

Assessment phase

In the assessment phase of the project, a team of consulting engineers was tasked with providing technical and manage-
ment support to 56 municipalities in five provinces across South Africa, namely the Eastern Cape, Western Cape, Northern Cape, Free State and North West.

A national infrastructure delivery team was established that included representatives from DPLG, an extensive team of engineering experts, and a senior technical and project management advisor from the ISLGS programme. The team had to assess and evaluate the obstacles to bucket eradication based on existing municipal action plans, current progress and the technical capacity of the municipalities.

Assessing the obstacles required interaction with the officials of DPLG, relevant municipal officials, provincial departments of housing and local government, and the Department of Water Affairs and Forestry (DWAF), to determine the type of assistance most needed to advance the project.

The team proposed interventions required for advancing each individual municipality’s bucket eradication effort towards the national goal of eradicating the use of all bucket toilets by the end of December 2008.

Project execution plans were developed and approved for each of the targeted municipalities, all within the first month of the project.

Implementation phase

Once the assessment phase was completed, the project team was tasked with the implementation of the project.

Challenges and obstacles that were leading to slow rates of delivery and roll-out were identified and plans drawn up for addressing them.

As a lack of knowledge and poor communication were identified as the most critical reasons for the slow progress, a number of interventions were introduced to improve communication between communities and municipalities and to monitor the progress.

The project team resolved these issues in various ways:
- By facilitating dialogue between national, provincial and local government, as well as between contractors and municipalities
- By communicating best practice
- By educating beneficiaries about issues such as health and hygiene
- By training community members to maintain the new facilities
The team was also able to advise municipalities on current and potential environmental hazards such as overflowing sewers, and how to address the problem.

In addition to facilitating dialogue between the major stakeholders, the project team also provided technical support. This ensured that the quality of infrastructure provided was of the highest standard and was delivered on time.

The project approach that was used allowed for the optimal utilisation of resources such as people and funds. At its peak, some 25 technical staff members were working on the project.

**CONCLUSION**

The success of the project is evident from the three-fold increase in the rate of delivery. The number of buckets eradicated went from a pre-project average of fewer than 5 000 per month in early 2007 to a peak of over 17 000 per month when the project was in full swing.

The initial target forecast involved the replacement of buckets with VIP facilities. However, despite the need for bulk water supply, extensive infrastructure and the longer execution time involved in replacing buckets with waterborne systems, a large number of bucket toilets were or are being replaced with waterborne sanitation systems.

The project was tightly managed in terms of the deployment, support provided and reporting to the donor and beneficiaries. In this way the project team was able to accomplish substantial cost savings on the project — savings that will be used in support of the next government target, namely supplying basic water services to all South Africans.

Other positive outcomes of the project include a ‘lessons-learnt’ report. The report proposes models for supporting accelerated service delivery in the future. It also addresses ways of using the positive results learnt from the project to improve the delivery of infrastructure by municipalities through government grants.

In view of the results achieved and the impact the project has had on improving the lives of communities, this has been a hugely successful project. This outcome was made possible through strong partnerships between USAID, the DPLG, the South African Association of Consulting Engineers, and LBG and Africon as implementing agents.
Public participation in water demand management and conservation

ON 1 SEPTEMBER 2007 Emfuleni Local Municipality, in association with the Department of Water Affairs and Forestry (DWAF), launched a full-scale leakage reduction project incorporating social and technical interventions.

Metsi-a-Lekoa, the water services unit of Emfuleni, identified water demand management as a crucial stepping stone towards decreasing wastage.

Fifty one water services assessors were employed to educate local communities about water conservation, to promote the local municipality, and to employ service delivery.

Educational campaigns include door-to-door education, weekly clinic workshops and demonstrations on basic household leak repairs.

The media has been involved, including local radio stations and newspaper advertisements in the surrounding areas.

Following the highly successful pressure management project in Sebokeng/Evaton, the Emfuleni Local Municipality in partnership with the Department of Water Affairs and Forestry (DWAF) and WRP commissioned further interventions with particular reference to water conservation education and awareness in their mission to drive down leakage and wastage in the area.

Whilst the technical interventions implemented accomplished much in addressing the hard core concrete aspects of water demand management, they only addressed half the problem. In order to address the overall leakage and wastage of water in a municipality, the inefficient water use habits of the consumers also have to be addressed through continuous and consistent education and interac-
tion. Without this component of water demand management, technical interventions are difficult to implement and are often not sustainable.

Through pressure management installation, the initial wastage in the area of approximately 75 Mℓ per day was reduced to 50 Mℓ per day – a saving of some R3 million per annum to the municipality. A further R60 million in water losses remained to be addressed, the bulk of which occurs inside the properties.

The project approaches demand management from a different perspective in that it focuses on the role of the community in managing and decreasing water losses through altering perceptions and wasteful water use habits. The community awareness campaign helped to capacitate the community with knowledge to contribute constructively to the decision making process of the municipality by alerting the municipality to the pertinent challenges and thus the efficient channelling of funds and interventions to address the most crucial areas of water loss. The project utilised water demand management as a vehicle for employment creation and created an opportunity for 51 indigent community residents to participate in the implementation of the knowledge dissemination initiative and in managing the water demand. The project is aimed at improving the quality of life for the residents of Emfuleni and is a community-based project dealing with the softer issues of water use efficiency.

**PROJECT OBJECTIVES**

The public participation programme ran in parallel with the technical initiatives forming a support base and assisting in maximising the benefits from the technical interventions. The high leakage levels in the area have already been addressed to a limited extent by the introduction of the Sebokeng/Evaton pressure management installation which was commissioned in July 2005 and is already providing significant savings by reducing water pressure (and therefore also leakage) during off-peak periods. Limited technical actions can be taken during peak demand periods, due to existing water pressure already being insufficient to provide a reliable water supply in some areas.

From careful analyses of the water demand patterns and water use in the area,
it has been found that a major problem during peak demand periods is being created by residents using hosepipes and garden sprinklers. These are causing peak demands to increase significantly between the hours of 6:00 and 17:00 with the result that the water pressures drop to below the accepted minimum level of service (normally 20 m). Technical interventions are therefore of little value during these periods necessitating the introduction of education and awareness as the key intervention or strategy to address the problem.

**SCOPE OF WORK**

The scope of work included the appointment of water services assessors; preparation of educational material; the introduction of a schools awareness programme and a community awareness programme, as well as a water-wise gardening programme; and stakeholder participation.

**Water services assessors**

Some 5 000 application forms were received and the applicants screened according to the criteria set by the service provider and the municipality. Ultimately 51 people were employed on the project, including two water services assessor coordinators who were employed to monitor work.

**Educational material**

Educational materials in the form of posters, pamphlets and stickers were prepared for the programme. The material addressed wasteful household water use and tips on how to conserve water by changing wasteful use habits, fixing or reporting internal plumbing leaks and water-wise gardening. The material was produced in four local languages, namely English, Afrikaans, SeSotho and IsiZulu, to cater for the diverse population. Two articles were published monthly on water conservation in the local newspapers and water-saving tips were broadcast on two local radio stations.

**Schools awareness programme**

During the community awareness campaign various schools approached the water services assessors to present workshops to the school children. Workshops were also held for the educators in the Sedibeng district to equip them with further knowledge of water conservation and provide them with the expertise to convey meaningful information to the children.

**Community awareness programme**

A significant component of the project was training and capacity building. Before the commencement of implementation, the water services assessors were provided with social training to assist them to understand the nature of their working environment. The training dealt with topics such as water demand management; public participation; general communication skills; principles of community-based interventions; and sanitation.

The assessors were given further training in meter reading, domestic leak auditing and basic leak repairs to assist consumers with the repair of internal leaks.

**Monitoring and evaluation**

The water services assessors were issued with log books to record all the houses visited during the course of the campaign along with the name of the person in the household spoken to. Households were randomly selected by the project manager on a monthly basis and revisited to ensure that the assessors performed the tasks required of them.

**Water-wise gardening programme**

The water-wise gardening programme was largely incorporated into the community awareness programme. Part of the educational material was dedicated to water-wise gardening to encourage consumers to curb the use of hosepipes during peak demand hours and using buckets or watering cans rather than hosepipes for garden watering and other general household chores.

**Stakeholder participation**

The stakeholders from Metsi-a-Lekoa were involved with the logistics and implementation of the project. Valuable
input was also received from the ward councillors.

**PROJECT OVERVIEW**

Apart from the education and awareness component of the Emfuleni Water Loss Reduction Project, several community-based technical initiatives were implemented. The technical initiatives included the upgrading of the water reticulation infrastructure in Sebokeng Zone 14 and the installation and repair of consumer meters in Beverly Hills. All the technical contracts entered into during the course of the project were labour intensive. More than R9 million was budgeted for the project.

**ACHIEVEMENTS**

Unlike technical projects, the success of the social participation programmes cannot be measured in financial terms. One of the primary objectives of the project was to improve communication between the municipality and the public, and judging by the increase in leak and problem reporting experienced by the municipality, it is clear that this objective has been achieved. Valuable insight was also gained in terms of the problems faced by the different communities and the focus future technical interventions should adopt.

As a result of extensive public involvement efforts, no problems were experienced with the implementation of the technical interventions. Judging from the response of the follow-up interviews with some of the households involved, it is clear that the consumers are beginning to take water conservation seriously. It is also encouraging that a number of employment opportunities were created by the project and follow-up initiatives. In addition to the community members directly employed by the project team, 273 local individuals were employed on the subsequent leakage reduction programmes.

The primary objective of the project was not necessarily to decrease the water supply to the areas involved but rather to ensure that every individual has access to a basic supply of potable water and that the delivery of water services is improved. Through the identification of the challenges experienced by the communities the following was achieved:

- Intermittent supply problems in Palm Springs, Johandieo, KwaMasiza Hostel, Evaton West and Sharpeville were resolved
- The level of service to Sharpeville and Vereeniging was improved through pressure management
- The condition of the reservoirs in Sharpeville and Vanderbijlpark was assessed and a business plan for corrective measures drawn up
- New water meter connections were installed in Beverly Hills and the information registered
- Mid-block connections were removed
- Consumer meters were installed in Sebokeng Zone 14

With 35 650 households visited and educated about the importance of water conservation, the next phase of the project can now be undertaken. This should entail repairing the internal plumbing and getting consumers to maintain their fittings, which will assist significantly in the effective management of the water demand in Emfuleni.

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Pragmatic thinking leads to SMART solutions

THE SMART AWARD acknowledges innovative thinking and practical solutions by an individual or group of individuals in the field of civil engineering.

The achievements of members of the public and the profession in finding ingenious solutions to pressing problems, resulting in a better quality of life for all, are recognised and rewarded in this way.

The award also serves as an encouragement to the profession and the industry to continually strive for excellence and to reach out and create interest among learners, parents, teachers and students.

This year’s submissions for the SMART Awards were:

- **Upgrade of the Koeberg interchange** Allan Walker, retired civil engineer
- **Operational support system for the Berg Water Project** Mike Shand, Benjamin Abban, Mlindi Makhabane and Wageed Kamish, Ninham Shand
- **Collapsible guardrails** Luuk Hekpema, Africon
- **Textile concrete** Don Hourahane, Nikki Moerman Van Blankenber
- **Blocked cable solution** Job Kordom, Botes & Kennedy Manyano

**UPGRADE OF THE KOEBERG INTERCHANGE**

To facilitate the flow of traffic on the existing Koeberg interchange, Allan Walker proposed that an independent bridge for local traffic be built across the N1 national road east of Cape Town and minor modifications be made to the interchange in order to achieve a ‘free-flow’ design.

**Location**

The approximately 40 year old Koeberg interchange is located about 6 km east of Cape Town on the N1 national road from Cape Town to Johannesburg running via Bellville, Paarl and Worcester. It links with the M5 freeway – which in this area is called the Black River Parkway (BRP/w) – serving Muizenberg and Cape Town’s southern suburbs. The proposed new bridge would be located approximately 700 m east of the interchange.

**Existing problems**

Although the junction has all the necessary bridges, curves and ramps to provide adequate links between the N1 and the BRP/w, the design has never been a success and two queues, each 2 km to 3 km long, develop on weekdays, and not only at peak hours. One queue forms on the N1 west, with the frontrunners negotiating a major ‘weave’ to get to the BRP/w, while the other queue forms...
on the northbound carriageway of the BRP/w, with the traffic being delayed by two merges on the interchange.

An examination of the delays showed that the existing design is trying to accommodate too many movements, that is, too much local traffic is using the interchange.

**Solution**

Allan’s proposal of an independent bridge for local traffic across the N1 and minor modifications to the interchange would bring about free-flow traffic conditions.

The suggested modifications require:

- Lane markings that keep southbound traffic from Cape Town or Milnerton in the right-hand lane, thus denying them access to the Maitland off-ramp
- That the on-ramp for traffic from Maitland going north (across the N1) be closed. Its lane, which then becomes vacant, would be extended back to the BRP/w to pick up the Milnerton-bound traffic, while the (existing) right lane would be dedicated to traffic aiming for the N1 east

In both of the above cases the affected Maitland traffic would use the new bridge route.

With the proposed minor alterations the ‘new’ Koeberg interchange would be a totally different entity to the existing inadequate layout. It would deliver ten times the current peak flow on the two critical routes and would cost one tenth of the adopted but flawed flyover scheme, effecting a saving of more than R0.5 billion.

**OPERATIONAL SUPPORT SYSTEM FOR THE BERG WATER PROJECT**

Mike Shand, Benjamin Abban, Mlindi Makhabane and Wageed Kamish of Ninham Shand – commissioned by DWAF and with the support of TCTA and Berg River Consultants – devised a methodology to facilitate the implementation of the environmental reserve releases from the physical infrastructure of the Berg Water Project, comprising the Berg River Dam and the Supplement Scheme. Called the Berg River Release Tool, it is a decision support system that assists the operators of the Berg River Project to effect both low- and high-flow releases.

**First of its kind**

The first of its kind in South Africa, the release tool has been designed to interrogate databases and data files to obtain real-time and historical information which it utilises to make recommendations on environmental releases. Information is transferred to the databases and data files through the Berg Water Project’s telemetric systems that are currently in place. When the database connection is unavailable, the information that the tool requires can be entered manually.

The tool comprises three main models: a low-flow module, a high-flow module, and a water-quality module.
We set the pace with professional Consulting and Engineering services such as:

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- Environmental Services
- Geotechnical and Underground Services
- Hydro Power Engineering
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- Rail Engineering
- Roads and Highways Engineering
- Sanitation Planning and Engineering
- Structural Engineering
- Traffic and Transportation Services
- Waste Services and Engineering
- Water Planning and Engineering

Engineering the world through science and simplicity.

The low-flow module determines the required low flow releases for the dam and from the supplement scheme based on the average inflow to the dam over a given period (normally a week or a day) and the duration curves applicable for the particular month of the year.

The high-flow module uses real-time flow information and the rules for high-flow releases from the dam to determine when a flood release is required, as well as the flood peak and volume of the release hydrograph. The intention is to make a high-flow release that coincides as closely as possible with the natural flood event, and with a hydrograph shape which is similar to that of the natural hydrograph. Hydraulic relationships have been incorporated into the tool to enable the sequences of floodgate openings to be determined.

For the temperatures of the releases from the dam to correspond as closely as possible to the temperatures of the inflows (important for the downstream ecology), the water-quality module simulates the temperature profile in the reservoir on an ongoing basis and during the proposed releases, using the CE-Qual-W2 hydrodynamic and water-quality model. It uses the results of these simulations to determine the level from which water must be drawn so that the temperatures of the releases closely match those of the inflows.

WINNER!
COLLAPSIBLE GUARDRAILS

By conceiving a system that offers an attractive alternative to the existing balustrades and steel railings on the edges of bridges, Luuk Hepkema’s novel way of safeguarding the traffic on bridges has won him the SMART Award.

Problem areas

The concrete balustrades with steel guards on the approaches – designed for static load of 50 kN – which the South African road authorities specify for highways and important roads (NJ or F type) are very expensive, while in our neighbouring countries most bridges have a very light and unsafe steel railing, causing vehicle impact often to lead to fatal accidents.

In replacing the steel railings with concrete balustrades, one faces the problem that these balustrades are very heavy and the cantilevers on decks are often not reinforced to carry the extra load. They are also very costly, and they require a base width of about 450 mm, which is wider than the existing steel railing. Hence the effective roadway width, or sidewalls,
is severely reduced.

Should one opt for the replacement of light steel railings similar to the old railings, it would mean the re-erection of an unsafe system.

**Solution**

Luuk proposed that the use of guardrails on the bridge approaches over the bridge be continued, with the guardrails fixed onto the deck with steel posts.

The anchoring of the steel base plate on the deck is done with steel bolts. With impact loading the danger exists that the anchors of the base plate are ripped out with subsequent damage to the concrete deck, which would demand costly concrete repairs.

The posts should therefore be fixed with smaller bolts (Ø-M16) to the base plate, which will shear off before the baseplate anchors will be damaged. The benefits in providing such a ‘weakest link’ are:

- Simple repairs to or fast reinstatement of the balustrade.
- Where steel plates are bent these can be bent back into position fairly easily
- The traditional guardrail on timber posts acts as a tension membrane where the timber posts have broken, while the steel posts are much more rigid. By providing a ‘weakest link’ the post will give way and the guardrail can act as normally expected

The proposed system has been designed for an impact load of 25 kN, which is half of the capacity of concrete balustrades. The steel post is extended to a length of 1 200 mm to safeguard pedestrians.
To top it all, the cost of this guardrail system is about 30% of the concrete balustrade.

**TEXTILE CONCRETE REPLACES ASBESTOS**

Textile concrete (TC) is a South African concept that was created as far back as 1995 by Don Hourahane in the universal search for a replacement for asbestos in concrete products.

TC belongs to the class of civil engineering materials referred to as high-performance fibre-reinforced cementitious composites (HPFRCC), and is essentially a multi-layered laminate produced by casting textile fabrics in cement paste, mortar, or fine-grained concrete.

The mesh fabrics are commonly produced from polypropylene (PP) because PP offers a combination of attractive properties such as resistance to chemical attack in the highly alkaline cement medium, resistance to degradation under moist environments, high elongation at break with low specific gravity, and no major handling difficulties. Thus, in South Africa, PP textiles – locally referred to as CemForce – have been specially manufactured for application in cementitious matrices.

**Wide range of applications**

Owing to a wide range of applications, the material has many uses in thin element formats such as architectural and industrial cladding, simulated rock features for gardens, waterproofing, permanent shuttering forms which can protect steel reinforcing bars from oxidation, and for the manufacture of non-pressure pipes.

It was first used on the local market for the manufacture of roofing for low-cost houses followed by mine-drainage channels for the gold mines. According to John Sheath, marketing manager of the Cement & Concrete Institute, the rustic effect achieved by TC is utilised extensively by the landscaping industry and is ideal for decorative use. Examples can be seen in the Mitsubishi Penthouse in Sandton Square, Johannesburg, which has TC fascia panels, and the casino at Gold Reef City, which is decorated with wet-bonded TC tiles to create the effect of built stone arches.

An unusual exploitation of the material is found in the floating model of Robben Island at Wemmer Pan in Johannesburg where TC has been used to create thin concrete shells on computer-generated styrene foam mouldings. A most recent application is in a TC composite roof – or canopy – for a hotel in the Seychelles. Don reports that the surface of the roof is a textile concrete watertight protected membrane with UV blocking, weighing 90% less than the ferro-concrete roof it has replaced.

“TC products are well suited to compete for market share with other construction products such as timber, cast iron and aluminium,” is the view of John Sheath.

**CONSOLATION PRIZE!**

**PRACTICAL SOLUTION TO A BLOCKED CABLE**

For his down-to-earth solution to a niggling problem, site agent Job Kordom of Upington was awarded a consolation prize in the SMART award competition.

Originally appointed as a labourer by Botes & Kennedy Manyano more than 20 years ago, Job was asked by colleague Hannes van der Merwe to use his own initiative in coming up with a solution to clear a blocked cable duct in a new concrete settling tank at the Upington water purification works where Ninham Shand was the consulting engineers.

Job battled on his own for a few days and reported with great enthusiasm one morning that he had succeeded. Instead of submitting notes covering the method he had followed for future use by the company, he offered the specification-cum-drawing which is reproduced here in its original format.

[Practical solution to a blocked cable (See page 70)](##)
Indien cable sleeve draad of tou gebreek of uitgeruk het, of wat ook al, sit dit maklik – no sweat – terug:

2. Maak gaatjes dwarsdeur om tou deur te ryg.
3. Maak patent of kokkenoster* met compressor pyp kop bo om dig in pyp te pas, of om pyp in sleeve te sit dat wind nie bo uitwaai.
5. Koppel op met compressor pyp en laat air deur.
6. Siedaar!! Tou is deur met bal …
7. Maak tou aan punte stewig vas. Maak ook openings aan kante dig dat niks kan in – nie eens ’n muggie nie!

*A ‘kokkenoster’ is a local term for a gadget of which the correct technical term is unknown.
Photo Competition
**Winners**

1. **WINNER**
   - Dawn of 2010
   - Photographer: Philip Bateman

2. **FIRST RUNNER-UP**
   - Greenpoint Daylight
   - Photographer: Marc Jermain

3. **FIRST RUNNER-UP**
   - Nightshift at Greenpoint
   - Photographer: Marc Jermain

4. **SECOND RUNNER-UP**
   - Instructions
   - Photographer: Larry Mills

5. **COMMENDATION**
   - Never give up
   - Photographer: Alf Yssel
OTHER INDUSTRY AWARDS

Five precast concrete projects win CMA awards

This year’s Concrete Manufacturers Association (CMA) Awards for Excellence competition was exceptional in that five rather than the normal four projects were awarded Cathay Industries Trophies. In addition sixteen National Awards were also presented on 11 October at a gala dinner held at the Theatre on the Track in Kyalami, Midrand. This glittering event, the twelfth staged by the CMA since the competition was first launched in 1986, was attended by more than 450 guests.

Of the five projects awarded Cathay Industries Trophies, three were Inland projects and two were Cape-based. The three Inland projects comprised the following:

- Bridgeview, a Suspended Concrete Floor Slab project in Braamfontein, Johannesburg, which was entered by Echo Prestress
- Pinnacle Estate, a Residential (between 50-100m²) Concrete Roof Tile project in Sandton, Gauteng, entered by Marley Roofing
- Waterfall Equestrian Estate, a Residential Concrete Block Paving project in Gauteng submitted by SmartStone

The Cape-based trophy-winning projects were:

- Suikerbossie Nek, a Concrete Retaining Block (CRB) wall project situated in the Cape Peninsula and entered by Terraforce
- Red Location Museum, a Commercial and Community Masonry project near Port Elizabeth, submitted by Deranco Blocks

This year’s awarding of trophies to five rather than four projects stems from the fact that two projects, Suikerbossie Nek and Bridgeview, share a trophy. Normally only one trophy winner is selected from the combined categories of Concrete Retaining Block Walls, Suspended Floor Slabs and Innovative Products, the other three going to the overall winners in the Concrete Roofing, Masonry and Paving categories. This year, however, the judges felt that Suikerbossie Nek and Bridgeview were outstanding projects, both of which were worthy of the premier award. Therefore, instead of choosing one at the expense of the other, the decision was taken to split the honours.

The awards were jointly handed over by Garth Gregory, CMA president, and Hans Wiegand, managing director of Cathay Industries SA. Trophy award certificates were presented to each member of the project team, but the actual trophy will reside with the product manufacturer. In the case of the shared trophy, each manu-
manufacturer will keep the trophy for a year as opposed to the normal two-year period.

John Cairns, CMA director, notes that the competition serves to highlight the significant role that CMA member companies are playing in the provision of educational buildings, access to fresh water, improved sanitation, roads, housing and infrastructural products.

The judging, conducted over two days on the basis of photographic and written submissions, took place earlier this year at the CMA’s headquarters in Midrand. The two groups of judges, one group per day and each group comprising five people, represented a broad spectrum of disciplines, including architects, landscape architects, consulting engineers and quantity surveyors.

“Each group gave up an entire day for the competition and some of them flew up from the coast. We owe them a big vote of thanks,” says Cairns.

INFO

John Cairns
011 805 6742

1. Bridgeview
   Joint winner of the Cathay Industries Concrete Retaining Block Walls / Precast Concrete Slabs and Innovative Products Trophy, was Bridgeview, a five-storey high-density apartment project in Braamfontein, constructed with Echo Prestress hollow-core concrete slabs

2. Suikerbossie Nek
   Joint winner of the Cathay Industries Concrete Retaining Block Walls / Precast Concrete Slabs and Innovative Products Trophy, was the Suikerbossie Nek project near Hout Bay on the Cape Peninsula. The retaining wall blocks used in its construction were manufactured by Klapmuts under licence to Terraforce

3. Pinnacle Estates
   A roofing project at Pinnacle Estates, a townhouse complex in Sandton, won the Cathay Industries Concrete Roof Tile Trophy. Marley Roofing supplied the roof tiles for the project

4. Red Location Museum
   The Red Location Museum project in Port Elizabeth was the recipient of the Cathay Industries Concrete Masonry Trophy. The concrete blocks used in its construction were supplied by Deranco Blocks

5. Waterfall Equestrian Estate
   The Waterfall Equestrian Estate, a concrete block paving project in Gauteng, won the Cathay Industries Concrete Block Paving Trophy. SmartStone’s Huguenot concrete Cobbles were used on the project
Harnessing the spirit of our people

WHEN IT COMES TO corporate awards, global engineering company Golder Associates is no stranger. Having recently scooped the highest accolade in the prestigious CESA Glenrand MIB Engineering Excellence Awards 2008, as well as having been named the winner of the Deloitte Best Company to Work for 2008, this innovative and aspirational concern is setting the industry benchmark in a highly competitive local and international market.

And what is their secret ingredient or magic potion you may ask? It’s nothing exotic or unusual. In fact it is quite simple – a genuine respect and understanding of their employees and their needs, as well as a phenomenal product service offering.

“Winning these two awards can be attributed to the Golder Way of Doing Business,” says Fred Sutherland, managing director of Golder Associates Africa (Pty) Ltd. “The Golder Way is essentially a combination of a few fundamental factors – the health and safety of our staff, the satisfaction of our clients, strong well-tested business systems, as well as the delivery of quality innovative products. These factors have been perfected and replicated in Golder Associates operations across the globe, wherever feasible and possible.”

However, Sutherland is convinced that the primary reason for the company winning the 2008 Glenrand MIB Engineering Excellence Award is because of the people employed by Golder. “There is no doubt that Golder Associates has superlative systems and products, but to deny the effect of our staff on our successes would be to overlook our most precious and important attribute. We hire the best people in the business and we endeavour to treat them as best we can. As a result they deliver to the best of their ability. Our successes in the areas of staff recruitment, training and mentorship, have ultimately led to the achievement of this award.”

The Golder win in the Engineering Excellence Awards saw the company clinch the Business Excellence category. A distinguished level of business acumen was noted in the following areas:
- Overall management and leadership of the firm
- Technical excellence and innovation
- Financial integrity
- Mobilisation and optimisation of human resources
- Marketing image of the firm
- Social impact assessments
- Extent to which the firm represents and upholds world class industry standards

It is no surprise then that Golder Associates Africa (GAA) also went on to be named the winner of the Deloitte Best Company to Work For in the Building, Construction and Engineering category, a few months later. In the nine years that the event has been staged, GAA has finished in number one position in the Building, Construction and Engineering category, a total of four times. In addition, GAA was also placed fifth in the Top Ten Small Companies category.

“We make it our business to understand and recognize what motivates and engages our employees,” says Sutherland. “And on the flip side we take time to recognize what hampers their success and progress. Extensive time and money is spent on staff training as well as on constantly improving our working environment. In addition, being a global company with offices around the world, we are able to offer our people exciting posts in other countries. This keeps them motivated and challenged and also eliminates the boredom factor.”

Although the employee-orientated focus at Golder permeates through all corporate divisions, one business sector that has enjoyed particular direct success from this policy is the mining team. Eighty percent of the entire company works in the field of mining and can be accommodated in one of the following areas – source planning, mine engineering, infrastructure (civil), risk analysis, waste management (tailings dam design and solid waste), closure planning, and environmental and social group assessments.

Sutherland does not consider the Best Company to Work for Award as merely a feather in the organisation’s cap, but rather as an opportunity to work on areas of the business that are still lacking. He plans to study the Deloitte report and findings and further improve the employees’ outlook on the organisation in the categories in which it was assessed, namely environmental services, environmental technology, engineering, mining, project services and corporate.

With future prospects geared towards expansion in Africa, as well as growth of the regional offices in Pretoria, Randburg, Cape Town and Durban, an enormous staff increase is expected over the next year. “We envisage that the staff complement of GAA will almost double between now and 2010. There’s no resting on our laurels. We will continue to strive to uphold the principles that we have passionately championed since our inception,” says Sutherland.
WHILE HIGH-LEVEL TALKS have been proposed between Transnet group chief executive Maria Ramos, the new Minister of Public Enterprises, Brigitte Mabandla, and city officials to discuss congestion within the Port of Durban, local port authorities have also recently begun a process of engagement with maritime freight representatives in an effort to tackle congestion along the much-maligned Bayhead Road.

A forum was established comprising representatives of the South African Association of Freight Forwarders (SAAFF) and its harbour carriers division, the Transnet National Ports Authority (TNPA), Transnet Port Terminals (TPT), local freight carriers, the South African Police Services (SAPS) and the Durban Metro Police. The forum met for the first time in mid-October to map out joint actions that would help provide temporary relief from the problem. At the time the Bayhead area had experienced serious gridlock on two or three occasions, caused by trucks queuing along the road.

The majority of trucks queuing on Bayhead Road are bulk carriers destined for the Cutler Complex, a facility located in the Island View / Fynnland area of the Bluff. It covers an area of 116 hectares and acts as a major bulk storage and handling facility, housing fuel depots, bulk terminals and grain handlers. However, the complex is unable to handle large volumes of trucks arriving outside of their allocated time slots. This has led to trucks parking along Bayhead Road and surrounding areas while waiting to enter the facility.

TPT and Cutler Complex tenants made a concerted effort to instruct customers to adhere to allocated arrival times and to avoid parking along the roads when they arrived too early. These efforts have improved the situation somewhat within recent weeks.

TPT Business Unit Executive at Pier 1, Michelle Phillips, says the terminal’s security staff had also stationed themselves along the road to ensure that only trucks destined for Pier 1 and the neighbouring Greystones Container Freight Station could pass a certain point.

This in turn highlighted the need for greater traffic enforcement within the area. Anand Maharaj of the Durban Metro Police confirmed that ten Metro personnel would be on duty within the area on a daily basis from Friday 7 November onwards. TPT made facilities available at the Durban Container Terminal (DCT) to temporarily house the Metro personnel.

According to Kevin Martin, vice-chairman of the Harbour Carriers Association, the Metro police need to adopt a more visible, vigorous approach to policing and enforcement of traffic laws in the area.
Trucks parking along Bayhead Road, while waiting to enter the Cutler Complex, cause major traffic disruption.

The newly established forum also called for greater cooperation between port authorities and the SAPS. Currently, the National Ports Act allows the SAPS to carry out random searches on containers and trucks outside the terminal. However, the management of Pier 1 and the DCT emphasize that police checks need to be carried out responsibly and without compromising operations or becoming a hindrance to the business and the economy. It was pointed out that SAPS officers sometimes carried out police checks at the entrance to the terminal, leading to bottle necks. Trucks would then be released into the terminal in batches, creating further congestion inside the terminal.

The DCT’s management team offered to make one lane available at its A-check for SAPS checks to be carried out on trucks in a controlled area away from the terminal entrance and busy roads. TPT also requested that the SAPS keep terminal management informed of intended checking sessions that would potentially slow down the flow of traffic into the terminals.

According to Martin the area has seen an improvement in traffic flow since the forum had been established. He urged TPT to consider a colour-coded electronic system to manage traffic flow into the terminal.

To address ways of efficiently transferring more freight volumes from road to rail, it was agreed that Transnet Freight Rail (TFR) would be present at future meetings of the forum.

Plans are currently in place to widen Bayhead Road, but engineers are still awaiting EIA (Environmental Impact Assessment) approval. The TNPA is planning a phased construction process that would not interfere with traffic flow and operations.

It was also proposed that the Bayhead Road lanes be demarcated, reserving the left lane for use by container trucks only, and the right lane for other traffic. This issue is still under discussion.

The forum has since met for a second time on Friday 31 October as part of the agreed series of monthly meetings to address the issue of congestion. The meetings will take place on the last Friday of every month and any major developments and resolutions will be communicated publicly.

INFO

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Infrastructure design in the heart of KwaZulu-Natal

THE BEHIND-THE-SCENES work in the surveying office is where it all comes together, according to Imraan Mohammed, a CAD draughtsman at MHP Geomatics in Durban.

The organization’s staff are experts in the areas of Cadastral, Sectional Title, Engineering Topographical, Photogrammetric, Hydrographic and Industrial Surveys, and the organization has become fully standardized on local infrastructure design software, AllyCAD.

“I like the fact that you can import aerial photography into AllyCAD as this helps with Sheet File creation. We also design urban development roads by making use of aerial and road photography which makes our lives as designers a lot easier,” explains Imraan.

Imraan’s role at MHP Geomatics provides regular interaction with civil engineers, architects, surveyors and also clients. A multidisciplinary project requiring interaction with all the aforementioned stakeholders, is the Royal Palm Estate which had been requested about five years ago. Once complete, the development will span a total of around 1 500 hectares, with the first phase consisting of three separate elements. Future phases of the project will also include a broad range of residential, commercial, retail and hospitality options. “We received the tender to do the surveying work for the project and found the detailed design to be extremely challenging. The numerous changes to the application plan meant that the design was tweaked several times. It is likely that the project will keep our office busy for at least another five years.”

According to Imraan no day is like the next in the design office. “And no two projects are ever the same. Each task differs from the next in terms of scope and complexity. A zero margin of error is maintained, as the quality and design standards are exceptionally high. Even challenging projects like the Bushman’s Nek initiative was surveyed with complete accuracy. Bushman’s Nek marks the end of the Giant’s Cup Hiking Trail, a 68 km path that passes through indigenous forest and mountain grassland with steep slopes that became a nightmare for the surveyors. Fortunately the team could make use of aerial photography to design the road. This project needed constant interaction between the design office and the surveying team.

The varied nature of the work, and the element of creativity involved, keep these designers rooted. “Although the surveyors are our eyes, we take the rough data and provide the visual result in an accurate format. This is a challenge, but to me as a surveyor draughts-person this is an extremely rewarding experience,” says Imraan in closing.

Charles Scott
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Aerial photo of Royal Palm Estate
Zukiswa Mvoko: My career journey

As a young girl growing up in the small town of Matatiele in the Eastern Cape I dreamt of one day returning there to construct roads and buildings. The lack of infrastructure in my home town inspired me to study civil engineering as I saw it as a way I could make a difference.

After completing the National Diploma in Civil Engineering at Technikon Mangosuthu in Durban, I started working at Eskom as a civil technician supervisor. From there I moved to an engineering firm in Sandton, and completed a B Tech degree in Construction Management at the then Technikon Witwatersrand (now part of the University of Johannesburg) before joining Murray and Roberts.

As a young black woman I continually have to prove myself in a field dominated by men, but since registering as a Professional Civil Engineering Technologist with the Engineering Council of South Africa (ECSA) I have never looked back.

Civil engineering is certainly not a job for the faint-hearted. It is, however, very rewarding to see projects come to life and to be involved with these projects from start to finish. There is a special thrill attached to being able to point out places that one has helped build.

I still fully intend realizing my dream of one day building roads and other structures in my home town of Matatiele.
HANDWRITTEN DIGITAL NOTES BECOME A REALITY

IN MOST JOBS TODAY employees take notes and draw diagrams and graphs which eventually need to be transferred to computer, saved and distributed in digital format. For convenience, notes are also taken on paper during many planning meetings and briefings, and these also need to be transferred onto a computer at a later date.

Using paper to capture data and then recapture it onto computer is a waste of time and energy, especially when the technology exists to combine the two processes. Simple Solutions offers its clients a new product that allows people in almost any industry to capture information on paper and then automatically translate it into digital format.

Called DigiMemo, the solution consists of a digital memo pad (clipboard) and a pen. Users write on normal paper attached to the clipboard in their natural handwriting and the system saves everything on the page in digital format. With a 1 GB memory card, the system can save up to 999 pages of text and diagrams.

“The productivity-boosting benefits of DigiMemo are apparent when wanting to save, alter or redistribute one’s notes,” says Cathy Campbell, Managing Member of Simple Solutions. Attaching the clipboard to a PC or laptop via a USB cable transfers all the pages to the computer for easy reference or printing. In addition, with a single click, one or more pages can be e-mailed or pasted into a Word document. The DigiMemo is sensitive enough to copy handwriting through 140 A4 pages, ensuring that users can take notes as they normally would without worrying about technicalities.

Of course, simply converting handwritten notes to digital format is a limited solution if further work or input is required. The DigiMemo caters for this with the addition of one of the most advanced handwriting recognition applications, MyScript Notes, which can be easily ’trained’ to interpret anyone’s handwriting to more than 99% accuracy in a matter of minutes. Once this has been done, users can translate a handwritten page or pages in a matter of seconds, or even simply select a portion of the page to convert into text, which can then be imported directly into e-mail or a Word document at the click of a button.

Multiple handwriting recognition profiles can be stored on a laptop or PC for fast and accurate translation into digital text. Moreover, if shapes or tables are drawn, these can also be easily converted to digital shapes or tables ready to be edited or distributed as required.

Because the DigiMemo runs off batteries, the clipboard can be used in any location, for days if necessary, without the need for a recharge or for transferring the data to a computer. For medical practices or hospitals or, for that matter, any organisation that needs to keep information on clients, all notes on a patient or patient can be archived in a proprietary file format on a unique memory card for later reference.

The DigiMemo package solution is modestly priced and includes the digital memo pad, the pen and two refills, the USB connection, a 1 GB SD card, an A4 carry bag, as well as the ACECAD DigiMemo Manager Software and full version of MyScript Notes Handwriting Recognition Software. It also includes a two-year replacement guarantee.

GLOBAL DIGITAL LIBRARY ON ETHICS

A NEW GLOBAL DIGITAL library on ethics was launched on 9 October 2008. This library will provide users with free access to full text versions of about 200 journals and more than a million documents in the field of applied ethics.

The digital library on ethics was developed by Globethics.net, a global network organisation with the objective of empowering people in all regions of the world to reflect and act on ethical issues. They developed the Globethics.net Library to ensure that persons and institutions - especially in Africa, Asia and Latin-America - have access to good quality and up to date knowledge resources. There is no cost involved in using the library. Individuals only need to register, free of charge, as participants on the library’s website to gain access to all the full text journals, encyclopaedias, e-books and other resources in the library.

The library does not only offer free access to knowledge sources, but also offers participants the opportunity to submit their own documents on applied ethics (articles, journals, books, dissertations and newsletters) to the Globethics.net Library, thereby ensuring that their publications receive global exposure.

More information on how to access the library, as well as on how to submit documents to the library, is available on the globethics.net website (www.globethics.net).

The DigiMemo is sensitive enough to automatically translate it into digital format.

Called DigiMemo, the solution consists of a digital memo pad (clipboard) and a pen. Users write on normal paper attached to the clipboard in their natural handwriting and the system saves everything on the page in digital format. With a 1 GB memory card, the system can save up to 999 pages of text and diagrams.
increased from 634 000 in 2001 to 1.2 million in 2007, with some 44% employed on a permanent basis. In 2006 the sector experienced 15.1% growth and in 2007 topped that at 21.3%. Employment in the infrastructure sector has doubled from 4% to 8% of total employment.

The Survey researched 82 companies with just over 214 268 employees, representing 40% of permanent employment in the infrastructure sector, as well as consulting engineers, major construction companies able to deliver projects of over R30 m, large JSE-listed construction companies, and large suppliers to the construction industry, such as cement producers.

Employment equity and gender
The number of blacks in top management in the infrastructure sector has increased from 16.2% in 2005 to 28.8% in 2007. Blacks in senior management increased from 12% to 32.4% and black professionals from 20.6% to 41.3%.

The number of women in top management in the infrastructure sector has increased over the past two years, from 4.3% in 2005 to 12.9% in 2007. Female senior management increased from 6.4% in 2005 to 19.5% in 2007, and female professionals from 10.1% to 22%.

Throughout the sector, these positive trends have no doubt been brought about by black economic empowerment legislation and tender criteria for government spend on infrastructure.

Skills development: Professionals and graduates
In South Africa, between 1998 and 2006, a total of 35 511 engineers (including technicians and technologists – Ed.) graduated across all disciplines. There is a total of 14 234 professional engineers registered across all disciplines in SA – 1 100 fewer than there were ten years ago.

Civil engineering graduates have increased from 507 in 2003 to 1 199 in 2006, with the proportion of blacks remaining fairly constant at around 70% to 75%, and women remaining an increasing but small minority. “Efforts by the infrastructure sector to attract students are clearly paying off,” says Burmeister.

Skills development: Artisans
South Africa is experiencing a severe shortage of well-qualified, competent and experienced artisans. The Joint Initiative for Priority Skills Acquisition (Jipsa) suggests that at least 12 500 artisans should be produced each year over the next four years to meet demand, i.e. a total of 50 000 over four years.

The number of artisans tested across all trades increased from 15 000 in 1970 to 26 500 in 1986, while those who passed trade tests increased from 6 000 to 13 500. From 1986, however, the numbers tested dropped to 9 041, and those who passed dropped to a low 3 222, or 42%.

“This has far-reaching cost implications,” says Burmeister. “The average cost of artisan training is R120 000 over three years. At a 42% pass rate, 120 000 candidates need to be trained over three years to generate the required 50 000 qualified artisans. The cost of training 120 000 artisans at R120 000 each comes to a total of R14,4 billion. This must be seen against the current 1% training levy which generates a mere R6 billion a year.”

Skills development
According to Burmeister the skills challenge will continue for at least the next 10 years. The demand for skills in the infrastructure sector therefore calls for a more innovative approach when recruiting.

Employers can benefit from the transferability of skills; it is less costly to induct into the sector than to train from scratch. The return of retired and offshore contractors or foreign nationals to run infrastructure projects or act as coaches and mentors to up-and-coming young recruits should be pursued, although this is a short-term solution for the development of critical projects. “We need to guard against short-term delivery at the expense of long-term skills development.”

Remuneration
Remuneration packages have tripled and quadrupled over the past two years. Contractors who are paid for expertise on a project-by-project basis are earning as much as 40% to 140% more than their permanently employed counterparts.

Scarce skills incentives, shares, long-term incentives, performance bonuses and retention incentives may well continue to be the norm in the infrastructure sector. Despite the economic slowdown, skills premiums for specific core business activities may continue to rise.

“The only way to drive down the remuneration spiral is to invest now in the development of graduates and young and mid-tier professionals so as to help balance supply and demand in the longer term. To achieve this, executive incentives should be geared to increasing skills across the business, not just to advancing the bottom line,” says Burmeister.

Career management
Key staff and executive committees are younger than before, and their growth pace needs to be consistent. Accelerated development programmes are needed at every level of the organisation, with international exposure and skills exchanges.

The infrastructure and construction sectors are ideally positioned to accelerate skills development on projects across the globe. International exposure and skills exchanges should be part of a broader exposure and retention strategy for managers and skilled professionals such as engineers and artisans.

“Given the spread of infrastructure investment, global resourcing strategies are crucial to the future of infrastructural development, allowing companies to share scarce resources across a multitude of projects.”

C&CI APPOINTS NEW SENIOR LECTURER
PETRUS JOOSTE HAS joined the Cement & Concrete Institute’s School of Concrete
Petrus started his career in a structural drawing office in 1982, and while working at Eskom as technician, obtained the ND Civil Eng in 1985. After being employed as draughtsman and model-maker at various firms, he lectured at the Technical College of Johannesburg for five years on construction, and spent some time with a firm of consulting engineers.

In 1997 Petrus joined the University of Johannesburg where for the next ten years he lectured on technical drawing, concrete technology, applied mechanics and theory of structures. During this time he obtained an MSc Eng degree from the University of the Witwatersrand for his thesis Approaches to mix design and measurement of workability for self-compacting concrete. He also undertook research on rheology of concrete.

"His wide academic and practical career, together with his experience as a lecturer in concrete technology and other built environment-related subjects, makes Petrus ideally suited for his new position," states John Sheath, C&CI’s marketing manager.

"His wide academic and practical career, together with his experience as a lecturer in concrete technology and other built environment-related subjects, makes Petrus ideally suited for his new position," states John Sheath, C&CI’s marketing manager.

**SA SLOW TO APPRECIATE THE BENEFITS OF HYBRID CONCRETE CONSTRUCTION**

SOUTH AFRICA HAS BEEN slow to realise the many benefits of hybrid concrete construction (HCC), according to John Sheath, Marketing Manager of the Cement & Concrete Institute (C&CI).

HCC combines the advantages of precast and in situ construction.

For example, the use of an HCC frame instead of a composite steel frame on a shell-and-core office project in London resulted in construction savings of 29% and a 13% increase in net lettable area.

With regard to costs, in situ reinforced concrete is commonly regarded as the most economical framing option, while precast concrete promotes speed and factory quality. Combining the two methods as a hybrid frame results in even faster construction, better quality and greater overall economy.

The formwork required for in situ concrete usually accounts for about 40% of the frame costs, but this can be substantially reduced by increasing the precast concrete component, which will cut construction time. Some HCC techniques can remove the need for follow-on trades, such as ceilings and finishes, allowing an even faster construction programme.

Furthermore, exposure of the hybrid construction frame can exploit concrete’s thermal properties in naturally ventilated, low-energy buildings. The finish and shape of the exposed units can also assist with even distribution of lighting levels and reduce noise. Long spans can be easily achieved by using large units, or by pre-stressing or post-tensioning.

C&CI believes that HCC should be considered during the design process to achieve the full potential of economy, safety, speed, constructability and performance.
Visits to SAICE Branches

**SOUTHERN CAPE**

George was where we were heartily welcomed earlier this year by Alistair Fraser and his team from the SAICE Southern Cape Branch.

The evening meeting turned out to be a meeting of the minds, and, to quote our president Johan de Koker, also of “growing together as an Institution”. A lively discussion on the proposed changes to the professional legislation was an obvious choice by the members, who were all feeling decidedly uneasy about the issue.

The next morning it was all about hard engineering in the gentle coastal zone of Groot Brakrivier and Glentana where serious property damage had been done by a 1 in 20 year storm followed by another one a year later. Of course, now one has to re-write the tables which rely on statistics. An interesting fact is that the 1:20 year deluge caused extreme damage due to a weather event that had saturated the ground a month or so before the 1:20 struck for the first time.

The restoration options were very limited – mostly hard engineering with direction change and energy dissipating chambers, culverts and slightly softer structures in the form of gabions as part of the solution.

This experience was an expensive lesson, indeed. Nature will be nature and if we human beings interfere by building on flood plains or on flattened dunes it is only a question of time before the punishment comes.

In this case punishment came in the form of HUGE expenses, lost land, lost houses, lost insurance cover, and obviously trauma and heartbreak.

The engineers, however, did their best – and hopefully next time will not be as bad.
ALGOA

Geoff Roberts was the perfect host! We were fortunate to visit the harbour of Ngqura which is now getting a vast slab for the stacking of containers, a further quay, and a rail connection. Of course, no commercial ship has docked there yet. And the rumours about smelters or no smelters persist. Hopefully in fifty years’ time there will be many occupied buildings and factories. Then people will forget about the lack of integrated planning and execution that seems to haunt this development.

Our visit to the stadium was a happier story. The satisfactory progress with the stadium will ensure Port Elizabeth’s participation in both the 2009 Confederation Cup and the 2010 FIFA World Cup. Not so many moons ago something like this was considered an impossibility. Delivering in the current deadline-driven boom, however, is taking its toll on our profession and our contractors. Decision-makers are inclined to expect miracles, whereas the reality is that stadiums and the like can only be built so fast and no faster.

At the Nelson Mandela Metropolitan University, Debbie Hogan’s team and their students proved that there is a future for our profession, but once again, at a too high price. Unless our government and lawmakers wake up IMMEDIATELY there will soon be no lecturers left, although there are more than enough enthusiastic students. Classes will ultimately run on empty, causing education and training in engineering to come to a halt.

But while we have the dedicated teaching staff who perform far beyond the call of duty, let us salute them. SAICE is continuously addressing this matter through liaison with the Department of Education, and through efforts to buy into initiatives such as JIPSA (Joint Initiative for Priority Skills Acquisition).

The final part of this visit was an experimental one – talking careers with toddlers aged three to five. One has to keep it brief. One has to sit on the floor with them. One has to keep it basic, referring to everyday things like getting water out of taps, and flushing toilets. Perhaps another task for our retired golden oldies would be to tell stories about engineering – as long as one can still get up from the floor afterwards!

TRANSKEI

Simon Mqamelo always packs branch visits to the brim. This time was no exception. He also arranged that a small group of high school learners accompanied the SAICE team to see what civil engineering is all about.

We headed west towards Ugie where one of our country’s greatest mountain passes is nearing completion. At nearly R700 million this magnificent road captures the imagination. It is opening up an interior with huge potential – Ugie is currently one of the potato baskets of the country, with timber in abundance as well.
A stretch of seven kilometres of the pass is built at an 11° gradient, requiring precise driving with a trusted vehicle! The pass also boasts a 240 m viaduct – at almost 50 m above the forest floor one yellowwood tree that we saw reached to just below the deck.

After a long day, concluding with the presidential speech and a questions and answers session that evening, we all went to bed tired but enriched. The learners that had accompanied us during the day were likewise tired, but felt inspired to think seriously about their future careers – hopefully they will all decide to pursue civil engineering!

**AMATHOLE**

At Amathole the next day Johann du Preez and his team awaited our arrival at the chaotic construction site called the East London Airport.

Engineers, architects, quantity surveyors and other members of the infrastructure team have indeed been handed a difficult task to renovate, expand, upgrade, demolish and build, while passengers, aircraft, cars, trucks, and even water pipes and cables are all over the place! But an attitude of “we will make it work” will ensure that when the sun rises over this airport in 2010 there will be a gleaming new facility.

The pleasant evening function had a serious undertone as talk focused on the radical change that the proposed DPW legislation could have on our professional landscape. It was heartening to note how many SAICE members had rallied around to support the Institution’s actions in this regard. Thank you Amathole for your support!

**SPECIAL VISIT TO PORT ALFRED**

On our way home the next day we made a detour to Port Alfred where we were graciously received by one of SAICE’s retired members, the sprightly 89-year old Arthur van Nierop, who incidentally was the respected and greatly admired boss and mentor in the 1970s of current SAICE president Johan de Koker. Arthur is a history and heritage champion for that part of the country and was in fact instrumental in SAICE sponsoring a plaque at the site of the original Henry Putt Bridge over the Kowie River in Port Alfred. The old bridge had been the first reinforced bridge structure in South Africa, but was sadly demolished years ago to make way for a modern structure. Fortunately Arthur saved the cornerstone for posterity. Thank you Arthur and other senior members of our Institution for continuing to fly the SAICE flag and for keeping civil engineering history and heritage alive! Still being so active and enthusiastic at your age is indeed an inspiration to the rest of us!
# SAICE Training Calendar 2009

Contact SAICE on telephone 011 805-5947/8

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<tr>
<th>TOPIC</th>
<th>CPD No</th>
<th>Days</th>
<th>Jan</th>
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<td><strong>BUSINESS/GENERAL</strong></td>
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<td>Business Finances for Built Environment Professionals</td>
<td>SAICEfn06/00004/08</td>
<td>2</td>
<td>23–24 GAU</td>
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<td>14–15 CT 28–29 PE</td>
<td>11–12 NEL</td>
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<td>Handling Projects in a Consulting Engineer’s Practice</td>
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<td>26–27 GAU</td>
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<td>8–9 NEL</td>
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<td>The Application of the Finite Element Methods in Practice</td>
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<td>2–6 GAU</td>
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<td>Writing Winning Proposals</td>
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<td>12–13 GAU</td>
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<td>Technical Reports with MS EXCEL &amp; MS PROJECTS</td>
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DBN = Durban // GAU = Gauteng // WHK = Windhoek // EL = East London // CT = Cape Town // BFN = Bloemfontein // PMB = Pietermaritzburg //

**PLEASE NOTE THAT COURSE DATES ARE SUBJECT TO CHANGE**
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<td>Wolf Weidemann</td>
<td>Dawn Hermanus</td>
<td><a href="mailto:dhermanus@saice.org.za">dhermanus@saice.org.za</a></td>
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| 19–20 NEL | 22–23 PLK | 23–24 GAU | Sharon Mugeri | cpd.sharon@saice.org.za |

KBY = Kimberley // SCD = Secunda // RUS = Rustenburg // PLK = Polokwane // NEL = Nelspruit // GEO = George // RCB = Richards Bay
Our second PiCA Award!

THE 2008 PiCA Magazine Publishing and Editorial Excellence Awards gala dinner was held on Friday 21 November at the Cape Town International Convention Centre under the auspices of the Magazine Publishers Association of South Africa (MPASA).

At this glittering event, the SAICE magazine, Civil Engineering, scooped the award in the category Construction, Engineering and Related Industries – this year sponsored by Siemens – for the second year in succession. The award was accepted by our previous editor, Sarie Moolman.

The 2008 PiCA Awards boasted 42 categories – seven more than in 2007. The awards also saw a record number of entries – an increase of more than 100 over the previous year.

THE JUDGING PROCESS
To heighten the credibility and prestige of the PiCA Awards, the judging model and process were completely overhauled in 2007. With this year’s awards, the principles of independence, consistency and focus were again tantamount.

Each of the three publishing excellence sectors – Customer, Business-to-Business and Consumer – had a dedicated judging panel made up of experts drawn from the different areas of magazine publishing – including editorial, design, and marketing/sales – to ensure that each area of publishing excellence is judged authoritatively yet independently. The Customer and B2B judging panels included experts in specialised fields such as engineering, finance and retail.

FUTURE PLATFORMS
A common thread running through MPASA chairman John Relihan’s opening speech and Chief Judge Gisele Wertheim Aymes’ comments on the standard of the 2008 submissions was the need for magazines to meet the demands of newly evolving technologies and media consumption trends by extending their brands to other media platforms, particularly digital and mobile.

Celebrating individual creativity, honouring collective endeavour, the PiCA Awards are South Africa’s premier acknowledgements of excellence in the realm of magazine publishing. We are proud to have been part of this initiative once again!

WHAT THE JUDGES HAD TO SAY…
‘Containing a wealth of information, Civil Engineering is a “must-read” for the professional in the built environment. The content is interesting and relevant – with a proven influence on decision-makers in the field. Moreover, this valuable magazine has significantly grown its advertising revenue, volume and market share’