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BUSINESS, LIKE WATER, is lazy and cowardly. Both gravitate via paths of least resistance, finding gaps and loopholes, weaknesses and fissures, to achieve their ends. But one to acquire its moksha, and the other to acquire socio-economic benefit – economic nirvana.

However, like water, despite its lazy and cowardly status, if business is not closely monitored and managed, it could incur devastating social and economic impacts.

On a related tack, over the past weeks, I have travelled extensively for both work and vacation. I have gathered two observations. The first is the endorsement of Paul McCartney’s Ebony and Ivory – that people are the same wherever you go. The second is that South Africa is the most desirable destination to enjoy salubrious climate, rich cultural heritage, diversity, fair cost of living and great value for money. South Africa possesses a most conducive agricultural climate, as well as fertile commercial and trade conditions where entrepreneurial activity and innovative creativity are promoted.

Notwithstanding peaceful possession of this fair south portion of the earth, we find ourselves charmed to expand our territories and circles of influence, as far as business is concerned. In recent months, there have been excellent mergers and acquisitions (M&As) of some of our best and brightest infrastructure engineering service providers with larger international outfits – service providers that have their foundations firmly planted in South African history and that are connected to its people and government, doing sterling work for the development of South Africa, showcasing South African engineering innovation on infrastructure platforms in Africa and around the globe.

With the depreciation of our local currency and the lack of financial depth of South Africa’s new individual economic role players, the cyclical nature of the engineering business and the lack of government project roll-out, acquisitions and mergers with outside companies are obviously highly attractive for longstanding shareholders. Further to this, an array of opportunities have now been opened to our local engineers, particularly younger engineers; this includes opportunities to travel and work on international projects, to participate in diverse and experienced engineering teams from around the world. In line with this, South African engineering project teams, too, have the opportunity to attract international engineers to our shores. Training and development will start to adopt an international flavour that will hopefully inspire local young graduates to international aspirations and standards.

On the other hand, we also need to consider the fine print of good intentions of our offshore partners who wish to partner with us with the view to make South Africa and Africa improved places – bringing in their philosophies of mutual respect, sharing, reverence for and working with the environment for the benefit of earth and man. Just like they did in their western countries.

I am not convinced there will be a fair exchange. I expect the expectation is that the African market is about to experience a boom in infrastructure development, and most M&As are aimed at using South Africa as a springboard into Africa, while they also tackle and reap economic benefit from the local South African market. I wonder how much opportunity there will be for local engineers to work on international projects outside of South Africa, in comparison to opportunities for externally based engineers working on local projects – reaping economic benefit, which was meant for South Africans in the first place.

There have been some companies that have ignored the flattering eyelashes of international business – some even called it ‘economic colonisation’. I haven’t yet made up my mind whether this is good or bad.

I am acutely aware that international confidence and investment improve job creation opportunities at home. But this is Africa, and African infrastructure engineering professionals know and understand the African soil. My view is that South Africa and South Africans ought to be the primary and secondary beneficiaries of the economic climate of the local land – South Africans first, black and white, Africa next, and then the ends of the earth. Our young engineers need training and sustainable jobs – young technicians and technologists are still struggling to find experiential training before they can graduate. Youth unemployment is at an all-time high.

But this draws my attention to the most important matter – due to the challenges associated with training in the work place, price-cutting, tendering pitfalls, the lack of project roll-out, and the incompetent client in South Africa, young South African engineers are practising engineering like an athlete who is running a marathon with a stone in his shoe. To add to the challenge, we are now competing on international frontiers, pitting ourselves against the best of China, India, Japan, and our good friends in the west. There is an urgent need, now more than ever, for young engineers to develop within themselves that intrinsic value that will make them viable and in demand in the local and international market.

To paraphrase Stephen Bantu Biko, “South African young engineer – you are on your own.” Young engineer, arise and take your place in the African sun. Or be swallowed up by an international market – you and your whole country.
ON THE COVER
The low pressure headrace tunnel, 116 stores underground at the Ingula Pumped Storage Scheme (in the Little Drakensberg just outside Ladysmith in KwaZulu-Natal) where Royal HaskoningDHV, as part of the Braamhoek Consultants Joint Venture, is supervising construction (photo credit: Chris Swanepoel)

Ingula – mega project taking shape

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Sleeping lion .................................................. 1

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Delivering sustainable infrastructure that improves our world. “DOING GOOD WHILE DOING BUSINESS”
MESSAGE FROM THE PRESIDENT

Dear Members and SAICE Staff

SAICE IS AN EMINENT organisation and it was a singular honour to serve as president over the past year. What makes SAICE great is its members and the passion and commitment with which they participate in furthering the art of civil engineering. This is enhanced by the hard work of the staff who work long hours to keep the wheels turning. Wherever I went I was always proud to be able to introduce myself as the president, but at the same time it was humbling to realise that in doing so I was representing a dedicated, highly professional membership. This is the membership whom I met during my visits to the Branches and Divisions. And what a pleasant experience it was to meet so many colleagues, some for the first time, and some from my shady past as a student. There truly exists a fellowship amongst SAICE members.

There was also a more sobering aspect to these visits around the country. It is clear that many local authorities are in trouble and not able to deliver the services that a modern society takes for granted. The reason for this lies in a lack of professional people employed at local authorities, which came about because the responsibility of running a town was taken away from engineering practitioners. Water supply, sanitation, roads, waste disposal and power supply should be left to the people who are qualified and experienced to do it. It is a sad fact that many of the bright-eyed students who are about to graduate and who look forward to a rewarding career, might have trouble finding employment. How can it be that on the one hand we have a shortage, and on the other hand a surplus? The answer lies in the availability of sufficiently experienced professionals to mentor and guide the young graduates.

It has been my mission to do something about this, fully realising that there is no magic bullet that will save the day, but also accepting that if we do not start, it will never happen. That is what we have done this year. We have started. There were opportunities to engage with a number of highly placed officials and politicians, and at every such opportunity we communicated the message that there is a problem, but that there is also a solution and that SAICE’s members are ready and willing to help. What we conveyed was a hard truth, and in all cases it was accepted as such. It may take some time for the message to take hold, but lately there have been some very encouraging signs that realism is returning. Of course, 11 000 protests linked to a lack of service delivery in one year must also have an impact. Maybe this is where “Civilution” has a strong ally?

SAICE has come a long way since 20 people sat in a bar (some things never change – in vino veritas) in Cape Town and started something that now has around 9 000 members. And SAICE is now ready to take the next step and expand into a regional body. This does not mean that we want to take over our friends in the neighbouring countries, but that we start to support them, and in so doing grow the capacity of engineering in the region. There is also a new vibrancy in SAICE, brought about by our CEO who certainly does not fear to stomp where angels do not even tip-toe. This has caused some ripples, but I believe that it will all be to SAICE’s benefit. Being static is the beginning of going down, but SAICE is going UP. This has been the most rewarding aspect of the past year – being part of a new exciting beginning.

This is the time of year when we find time to stand still and reflect. I believe that the future of South Africa lies in the hands of our members. We cannot any longer wait for the politicians to make the right decisions. We will have to get involved and positively start making a difference. This we should do by reaching out, and not by standing by and watching what is happening, or even worse, wondering what had happened.

I wish all our members and staff a restful and peaceful festive time with their families and loved ones, and may the new year bring us all that we are hoping for.

Martin van Veelen
martin@iliso.com
The world needs fewer engineering companies.

Rebranded as Royal HaskoningDHV, SSI Engineers & Environmental Consultants believes in being more than an engineering company.

Our rebranding to Royal HaskoningDHV ushers in a new class of engineers and consultants, offering solutions for the sustainable interaction between people and their environment, ultimately enhancing society together.
In the Little Drakensberg, just outside Ladysmith in KwaZulu-Natal, the Ingula Pumped Storage Scheme (IPSS) is under construction for power utility ESKOM – 116 storeys underground!

Under the supervision of Royal HaskoningDHV (formerly SSI Engineers & Environmental Consultants in joint venture) construction is progressing on this R30 billion project which will increase South Africa’s energy generating capacity during peak demand periods.

IPSS HAS SEEN the formation of several joint ventures, including the Braamhoek Consultants Joint Venture (BCJV) comprising three of the country’s major consulting firms, namely SSI, Arcus Gibb and Knight Piésold, who have been involved with project design and construction supervision since inception.

The BCJV appointment included the project’s tender design, construction design, and the construction supervision of four contracts within the bigger project, namely the dams’ contract, the main underground works, turbines and generators, and various surface buildings.

The IPSS consists of the upper Bedford Dam and the lower Bramhoek Dam, each with a capacity of approximately 26 million m³ of water. The dams, which
are located 4.6 km apart, are connected by underground waterways through a power house complex which will house 4 \times 333 MW Francis-type turbines with a total generating capacity of 1332 MW. During times of peak energy consumption water will be released from the upper dam through the turbines to the lower dam in order to generate electricity. When the energy demand is lower than the base load supply, the pump turbines drive water 441 m from the lower to the upper dam where it is then stored in readiness for the next peak event.

Construction of the Bedford and Bramhoek Dams commenced in April 2008 and was completed by August 2011. The design of the Bedford Dam, being situated inside a wetland, incorporated a number of environmental mitigating measures of which wetland protection, landscape aesthetics and artificial bird cliffs are but a few. Another interesting fact was the discovery of approximately 255-million year old animal and plant fossils during dam excavation works.

The Bedford Dam is a 49 m high concrete-faced rockfill dam with a crest length of 810 m. Its complex design has won a number of awards for the BCJV – the 2011 CESA AON Engineering Excellence Award, the 2011 Construction World Best Projects award, and most recently, the 2012 SAICE Outstanding Civil Engineering Achievement award for the best project identified by the SAICE Water Engineering Division.

Construction of the underground power house complex and access/link tunnels was started in September 2008 and is currently entering a new phase with the completion of the excavation and rock support activities, and commencement of civil works together with the installation of turbines and other mechanical items.

The nature of the geological conditions encountered underground presented the designers and contractors with some unique challenges, as the power house complex is the largest yet constructed in mudrock, making environmental and safety issues of paramount importance.

The use of a three-phase rock support system and extensive instrumentation made possible the construction of the power house cavern. The excavation of the very steep headrace tunnels (45.5°) involved specialised equipment and techniques by the contractor, and close cooperation among all parties. The deep excavation in soft ground, required for the fresh air intake shaft, was successfully completed in a relatively short time by micro-piling the first 24 m.

Ultimately five contractors (civil, mechanical, cranes, transformers and electrical/earthing) will be working inside the power house simultaneously, which will necessitate very close cooperation to maintain project momentum.

The first of the four generating units is scheduled to come online during 2014.

INFO

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INGULA FACT BOX

- Energy storage: 21 000 MWh (15.8 generating hours)
- One of the biggest construction projects currently in South Africa
- The machine hall at 180 m long x 25 m wide and 40 m high is the largest excavation cavern in mudrock in the world
- Nine kilometres of tunnels
- The power station is 116 storeys underground
- Three million cubic metres of rock excavated
- A dolerite quarry produced 2.4 million tons of aggregate
- Imported from Germany: 15 000 tons of steel lining for the waterways
Density leads to durability

Our fly ash provides lasting strength for sustainable and durable structures.

AshResources
Fly ash products

Green engineering with fly ash
CIVIL ENGINEERING SOFTWARE
For the latest in true integrated design for civil engineering, surveying and mining/geology.

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AutoTurn
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RoadMate
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AeroTurn
Aircraft Movement/Space Analysis

SurfMate
Survey/Digital Terrain Modelling

ParkCAD
Automated Parking Area Layouts

PipeMate
Sewer & Stormwater Design and Analysis

AutoCAD Civil 3D
DTM, Site Development and Transportation

RebarMate
Reinforced Concrete Detailing and Scheduling

TECHNoCAD TRAINING
TECHNoCAD provides professional training and support for both TECHNoCAD civil engineering application software and Autodesk products. Our new state-of-the-art training facility provides courses varying in duration from one day to four days. For our course schedule, visit our website or email us at admin@technocad.co.za.

NEW! Now available for AutoCAD 2013
Worthy winners!

A FESTIVE EVENT
At a festive dinner on 11 October SAICE presented the finalists of this year’s excellent project entries and announced the winners in the various categories. Individual awards were also made on the evening, much to the delight of the recipients and the audience alike!

The theme of the evening was a newly coined SAICE word, “Civilution”, which can be defined as the culmination of civil engineering and evolution, of serving civilisation through social, economic and political changes, and in so doing revolutionising civilisation. This new term has already become ingrained in SAICE’s vocabulary and philosophy.

AWARD CATEGORIES
Pages 12 to 73 cover the finalists and the winners in the following categories:
- Technical Excellence Category
- Community-based Category
- International Projects Category
- Individual Awards

PROJECT ADJUDICATORS
We thank our adjudicators for their time and effort. Their following constructive comments on this year’s entries will undoubtedly assist future entrants:

Technical Excellence Category
The three projects that were recognised for their technical excellence demonstrated complementary faces of civil engineering. The Koeberg interchange provides an iconic example of a complex and well-executed civil engineering structure, which will serve the general public on a daily basis in a most visible way for years to come. The Kraaifontein waste management facility gives expression to the public desire to reduce the impact of waste in our urban space, by extracting the useful fractions of the waste and reducing the volume to be landfilled. Civil engineering, with special emphasis on green engineering, played a key role in making such a large-scale waste recycling and processing project possible. The repair of the Brakspruit Bridge, in rapid response to an unforeseen derailment, utilised a novel sideways deck-jacking method under difficult site conditions and stringent time constraints.

Community-based Category
Out of the four community-based projects nominated for this year’s award, the judges were particularly impressed by the Ethekwini Zibambele Poverty Alleviation Programme and the Cape Town Community Residential Unit Refurbishment Project, so much so that they decided that these two projects should be joint winners. Both demonstrate that civil engineering can assist in addressing socio-economic problems by applying innovative and appropriate design and project management skills. These projects are outstanding examples of the provision of meaningful employment to destitute and impoverished families, skills transfer, out-of-the-box thinking and careful handling of community and social issues. The on-going benefits of the Zibambele Programme and the successful completion of the Cape Town CRU Project should encourage civil engineers and government institutions to implement similar projects in the future to enrich the lives of those in need, to the benefit of the whole nation.

International Projects Category
The St Regis Saadiyat Island Resort is a remarkable project. Its construction faced many challenges – environmental, geotechnical, structural and, most of all, project management. Aurecon and the rest of the team did well to meet all these challenges and to complete the project in time for the Abu Dhabi Formula 1 Grand Prix. The submission highlights the demanding project management requirements and the impressive architecture of this prestigious building project. However, one needs to dig a little deeper to uncover the engineering challenges. Some of these were problem finding conditions combined with the seismicity of the region, the need for protection of all buried concrete and, not least, translating the architect’s visions into solid reality. The latter included aspects of the project like the impressive spiral staircases and the 50 m span of the beams over the banquet hall. The judges’ main reason for not voting this project the winner of the International Category was the omission of details of the engineering aspects of the work. This made it difficult to assess the civil engineering achievements involved. Nevertheless, the judges all agreed that this project richly deserves its “Highly Commended” status.

A word of advice from our adjudicators
The adjudicators have to review each project according to the submission in front of them. Projects of obviously winning standard are, however, often presented from a public relations perspective only, omitting the essential in-depth civil engineering information on which the adjudicators’ evaluation has to be based. When preparing project submissions for adjudication, entrants should always keep this requirement in mind.
OVERVIEW
This unique project required the construction of new directional ramps threaded through the maze of the old interchange while maintaining the existing traffic flow of 200,000 vehicles per day.

Innovative design, approval and tender processes were adapted to achieve the very tight time constraints imposed by the need to open Ramp A before the 2010 World Cup event.

The design was aimed at the most effective use of precast concrete beams so as to reduce interference with the heavy daily traffic through the interchange. Innovative construction techniques reduced traffic deviations to a minimum, allowing the major part of the construction to proceed quickly by maximising off-site production. Not only were the enormous 40 m beams precast off-site and transported to site using a purpose-built beam carrier, they were also launched in the quickest and most efficient way using huge cranes.

The contractor interacted with the dedicated design team and introduced several clever and time-saving innovations. Underground piling layouts were adjusted to ensure that piling rigs did not obstruct traffic flow unnecessarily. Permanent formwork was tested to speed up the construction of the concrete deck on top of precast beams, and the contractor and designers worked in conjunction to develop and test precast concrete balustrades, all of which made the timely completion of the project a reality. The construction of the enormous 68 m cast in situ spans across the eight-rail line reserve required intricate temporary support trusses and formwork to ensure that rail traffic, 12 m below, was not impeded at any stage.

The project provided much-needed traffic relief, contributed significantly to employment opportunities for local communities, and offered empowerment opportunities for sub-contractors. In addition, the environment was greatly improved by cleaning the canal and providing indigenous water-wise landscaping.

DESCRIPTION OF THE PROJECT
The upgrade and commissioning of Ramp A formed part of the 2010 World Cup Transport Infrastructure Plan. This improved the traffic flow from the N1 to the M3 southbound before the World Cup event, thereby avoiding backup obstruction to the N1 inbound traffic. Ramp B for northbound traffic from the M3 to the N1 was completed...
ahead of schedule just over a year later, dramatically improving the level of service rendered by the interchange.

The works consisted of the two flyover ramps, which required realignment of the Salt River canal and widening of the M5 northbound from Berkley Road to the Koeberg Interchange. Included were two additional outgoing lanes and one additional incoming lane on the N1, street lighting and landscaping. The upgrade complements the upgrading of Table Bay Boulevard between Marine Drive and the Koeberg Interchange.

**PLANNING AND DESIGN: FAST-TRACKED AND UNIQUE**

To achieve the construction deadlines, the project time lines required preliminary design, environmental impact assessment and client design review to proceed in parallel.

Monthly design review and approval meetings were held during the preliminary design phase to advance the design and approval at breakneck speed. Much of the detailed design of the project was done on a just-in-time basis in parallel with construction. This allowed for useful interaction, leading to innovative cost and time-saving improvements.

To enable contractors to assess if they had the capacity for this major project, a pre-tender meeting was held with all major contractors. The feedback received was invaluable in assembling the tender documents.

**COMPUTER SIMULATIONS IMPROVED UNDERSTANDING OF THE CONTRACT**

At both design and tender stage, computer simulations enabled the design team to visualise the completed structure and view it in both daylight and streetlit conditions.

**DESIGN, CONSTRUCTION AND ERECTION OF U-BEAMS**

Central to the planning, design and construction of the two new ramps was the use of precast, pre-stressed U-beams. This would be the most effective way to construct the ramps through the historic maze of the old Koeberg Interchange over the numerous intersecting heavily trafficked roadways. The design also ensured that the same beam profile could be used repetitively.

The U-beam chosen was suitable for spans up to 40 m in length, and
was designed to be linked over alternate supports to reduce the number of roadway joints and improve structural efficiency. The beams were evaluated aesthetically using computer simulations. They proved to be practical to place and laterally stable, while allowing quick and cost-effective completion of the top deck – a definite advantage when bearing in mind that construction frequently crossed busy roadways. The end product certainly dispels the belief that precast beams cannot yield an attractive result.

The length of the U-beams varied between 22 m and 39.5 m. The longest beam, nearly 40 m long, required a second stage of pre-stressing. A purpose-built beam carrier – a unique piece of engineering in its own right with sophisticated steering mechanisms – transported the beams on public roads to their placement positions. Placement of beams was done mostly at night to minimise traffic disruption.

Gaps between beams and webs were spanned with permanent in situ formwork which blended in perfectly with the adjacent concrete and ensured the safety of construction workers and motorists.

**RAILWAY SPAN**

One of the most challenging sections of work was the construction of two 68 m post-tensioned box decks over the eight-track rail reserve. The erection of the temporary support structure necessary to build this 3.5 m deep post-tensioned box girder required extensive liaison with rail authorities.

In order to construct this span, temporary structural steel girders were installed to span the rail reserve and support the in situ post-tensioned concrete box section of the bridge without interrupting rail traffic into Cape Town.

**IN SITU DECKS**

Cost-effective arched three-span box girder sections cross the M5 and the N1 diagonally with 65 m central spans over the extremely busy roads underneath. Each 137 m structure was constructed in situ and stressed in stages in a very restricted environment. Particular attention was paid to safety monitoring, especially when working at height above moving traffic.

**PRECAST BALUSTRADES**

The extremely tight time lines for completion of Ramp A in time for the 2010 World Cup could only be met using precast balustrades. Following full-scale load testing of sample precast balustrades, a system of overlapping galvanised U-bars, laced together by 25 mm diameter galvanised steel reinforcing bars and filled with non-shrink grout, was developed. This has resulted in accurately aligned and aesthetically pleasing balustrades.
SUBSTRUCTURE
Computer simulation was invaluable in deciding on the best combination of attractive and cost-effective pier and capping beam designs. The repetition of piers allowed the contractor to invest in high-quality formwork which provided a superior finish.

SERVICES
The multitude of existing, abandoned and new services required very careful design, planning, construction and traffic accommodation. Uncharted services that ran through the interchange required regular liaison with service authorities and re-evaluation of the sequencing of the programme in order to minimise delays.

REALIGNMENT OF THE SALT RIVER CANAL
The Salt River Canal was shifted 15 m to accommodate Ramp B, and the canal capacity had to be maintained during winter to avoid flooding. The canal and the surrounding area were cleaned, which led to a significant increase in fish and bird life after construction.

M5 WIDENING
The widening of the M5 was yet another technically challenging component of the project, with all the T-beams used being of varying lengths. The structural integrity of the old bridge was improved by gluing plates to the outside beams and adding post-tensioned internal cross beams to the structure.

BBBEE TARGETS
The target of R125 m to be spent on local subcontractors, suppliers and labour was exceeded. In addition to the skills development programme of R2.6 m, 20 school leavers were put though an extensive training programme to prepare them for work in the construction industry.

Two projects in which J&G played a significant role were judged the joint winner of the Technical Excellence Award in SAICE’s “Most Outstanding Civil Engineering Project Achievements for 2011/2012”. J&G was the leader of the professional team for the Kraaifontein Waste Management Facility, and a member of the professional team for the upgrading of the Koeberg Interchange.
Revolutionary design and inventive construction at new Alexander Forbes headquarters

Zenprop Property Holdings’ completes its most innovative development on time.

Construction of the R840 million development at 115 West Street in Sandton commenced in February 2010 and Alexander Forbes took occupation in October 2012.

The eight storey, 36 950 m² building accommodates Alexander Forbes’ 2 800 Johannesburg staff and, for the first time since 1994, most of the firm’s major divisions are in the same building. This is Zenprop’s largest commercial property development in Sandton, and in terms of its scale and environmental innovation, is their flagship South African commercial property.

MASSIVE SCALE CONSTRUCTION

Given the extent of the project and the timeline for completion, the construction of 115 West Street was a mammoth task undertaken by the WBHO/Tiber JV.

In order to meet the deadline, workers were on site 24 hours a day, seven days a week. For their formwork needs, WBHO/Tiber JV contracted PERI Formwork Scaffolding Engineering, one of the largest manufacturers and suppliers of formwork and scaffolding systems in the world.

Strydom Groenewald, Regional Director for PERI, explains the scope of the project: “The basement parking lot of 50 000 m² took about four months to complete. That translates as a production rate of 2 825 m² per week, using 5 000 m² of PERI SKYDECK aluminium panel slab formwork. There was a total of 8 000 m² of SKYDECK on site, which were used for all the horizontal areas.

The timeline for the superstructure was eight months. In this time a horizontal concrete area of 101 000 m² and a total amount of 43 000 m³ of concrete was poured.

GROUND-BREAKING DESIGN

The new Alexander Forbes head office is an architecturally ground-breaking space designed by Paragon Architects. Environmental sustainability is crucial to the design and the building is registered to be accredited by the GBCSA as a five-star “Green Star” rated building.”

Since the health and well-being of staff is one of the central design mandates, it combines plant-filled outdoor areas, natural light, and energy efficient lighting. The circulation of fresh air and temperature control were also key considerations. As such, numerous pause or break areas are incorporated into the design. In addition the latest available technology is deployed in high speed lifts and state of the art auditoriums.

Other benefits for staff include a state of the art in-house gym, coffee bar and staff restaurant. The property is also across the road from the Gautrain station and in close proximity to the BRT route, allowing staff and clients easy access to public transport, thus reducing vehicle dependence.

FORMWORK SOLUTIONS

The structure is unique in its architecture and comprises many complex vertical aspects. Strydom Groenewald of PERI explains that over and above the supply of formwork, they were involved from the planning stages on-
wards. “We worked closely with the WBHO/Tiber JV in resolving the design challenges on this project” he says. “For example, due to its obvious advantages, self-compacting concrete was used on all the vertical walls. This raised concerns due to high pressure on the formwork at the window box-outs. In cooperation with the contractors, our engineers at PERI designed and manufactured special high-tolerance box-outs for the entire project.”

“The special architectural features of the S-shaped scallop walls on the west and east facades of the south building also posed some difficulty. The accuracy and finish required would normally call for highly specialised formwork at a high cost to the contractor. However, we were able to utilise PERI VARIO GT 24 Girder Wall Formwork, made up in 10 m-long units with special radius whalers, ensuring the same quality and tolerance but at a much lower cost.”

“In addition, the south facade wall and the north gable-end walls posed a challenge since they required a special texture on the walls. After considering a specialised, and expensive, rubber form-lining, Paragon consulted with PERI for a custom solution. We produced a sample wall using VARIO and a special timber plank finish which was extremely effective and not as costly.” Trevor Dillon, the Contract Manager for Tiber has been duly impressed by the quality and commitment shown by PERI. “The trusted PERI formwork systems and their dynamic support teams have been integral to the success of the project”, he says.

AN AWARD–WINNING PROJECT
The WBHO/Tiber Joint Venture has won the 2011 National GMBA Super League safety award as well as the 2012 Regional GMBA Super League safety award, Construction World’s Best Projects 2012 “Building Contractors” award and was runners up in the AfriSam “Innovation Award for Sustainable Construction”. In addition, the JV received the FEM Super League Trophy for projects valued at over R500 million for its site safety and health achievements on the 115 West Street office block. The building is 4 Star Green Star Office Design v1 and will be confirmed as As-Built in February 2013.
The Kraaifontein Waste Management Facility in Cape Town, showing new containers on the apron

OVERVIEW
The R230 million multi-purpose Kraaifontein Waste Management Facility (KWMF) is the first large-scale ‘green-fields’ refuse transfer station (1 000 tonnes/day) in South Africa that is integrated with a mechanised materials recovery facility (100 tonnes/day), receiving co-mingled recyclables separated and collected at source. As a fully integrated waste management facility it also encompasses a public drop-off, a greens management facility, offices, a workshop, wash-bays and provision for future ‘energy-from-waste’ technologies.

A key focus for this facility was to move waste management towards a more sustainable municipal service – one that meets new national waste regulatory requirements, reduces waste transportation costs, provides meaningful employment, effectively diverts waste from landfill and enhances the beneficial use of waste.

The facility was designed to allow waste to become a resource, and incorporated green initiatives. The success of the facility is attributed to excellent teamwork and foresight by the City of Cape Town’s Solid Waste Management Department, and the high degree of civil engineering quality and excellence of the design, construction and project management.

BACKGROUND TO THE FACILITY
Arising from a study conducted by USA Consultants, Wright-Pearce (1999), it was recommended that the City develops a single regional waste disposal (landfill) facility, and as the existing landfills reach their capacity, they would be replaced by satellite refuse transfer stations, with waste being compacted into containers and transported by road or rail to the proposed regional landfill. Typical waste collection (compactor) vehicles are not suitable or cost-effective for transporting waste over long-haul distances. In developing its Integrated Waste Management Policy (IWMP) and Plans in 2005/2006, the philosophy of a regional landfill and associated transfer stations was endorsed by the City.

In April 2007 the City of Cape Town’s Solid Waste Management Department commissioned Jeffares & Green (Pty) Ltd, in joint venture with GJA Consulting Engineers, to undertake the civil, mechanical and electrical design
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and construction management of the proposed Kraaifontein Refuse Transfer Station and Materials Recovery Facility.

DESCRIPTION OF THE FACILITY
The KWMF is located in Kraaifontein, in the Cape Metropole, and covers approximately 15 ha. The facility involves the integration of a range of various operations, such as the refuse transfer station (RTS), a compaction hall, container handling operations, chipping operation, material recovery facility (MRF), workshop, wash bays, diesel storage, drop-off centre for recyclables and a public drop-off, security building, entrance building, weighbridges, etc.

The facility reduces the impact of waste in our society by directing waste away from landfill and facilitating economically viable recycling operations. The layout has been planned for a containerised bi-modal transport system (i.e. road and/or rail), although initially the transfer of containers will be by road only.

Jeffares & Green, as the lead consultant, undertook the project management, civil, structural, rail, roads and transportation designs, as well as construction monitoring and contract management duties. GJA (project joint-venture partners) were responsible for the electrical and mechanical duties. There were many other multi-professional consultants involved, including surveyors, architects, quantity surveyors, a landscape architect, mechanical plant consultants, etc. The civil and building construction was undertaken by Haw & Inglis Projects (Pty) Ltd, with Amandla Construction providing a main civil engineering sub-contractor role. The Akura/Petrel Engineering JV designed and installed the mechanical plant.

EXCELLENCE, INGENUITY AND INNOVATION IN ENGINEERING
The need for this facility arose as a result of changes to environmental regulatory requirements which led to the City having to close four of its seven operating landfills, with the Bellville South landfill required to close in 2013. The Kraaifontein facility will allow a substantial reduction in the cost of transporting waste to a planned regional/central landfill, and will allow enhanced waste diversion from landfill for the purposes of recycling and re-use. This in turn increases the lifespan of the City’s remaining landfill sites.

**Built to enhance sustainability**
The layout and design were developed to promote sustainability and versatility to allow the operations to adapt to change, as legislation and social awareness are forcing a re-think of waste handling and waste disposal. The project was further developed in response to the City’s decision to introduce a separate kerbside co-mingled recyclables collection service, which has now been implemented in many residential areas.

**Integration of operations**
The innovation of providing a variety of facilities at one location, centralising the integrated management of the solid waste, is a first such large-scale greenfields development for South Africa.

A new type of loading magazine that handles the closed roll-on, roll-off reinforced steel containers, not previously used in South Africa, was designed and constructed to allow three containers to be loaded simultaneously per compactor line. These magazines also allow live-weighing so that the operator of the facility can see immediately (before the containers are taken away) whether the containers have been optimally filled for transporting.

The facility allows the integration of activities, to avoid unnecessary (costly) transportation and handling of waste, and to divert waste from landfill, thereby indirectly supporting the growth and employment opportunities in a growing and sustainable recycling industry.

**Green engineering**
Over and above the extensive engineering input into the design of this facility, the design team focused attention on ‘green engineering’, such as:

- Supplementary supply of water harvesting
- Low-energy lighting and ventilation
- Water-wise, indigenous greening of the area
- Specially designed oil traps for pollution prevention
- Special litter and silt traps (a design that will be used by the City of Cape Town for research and future use)
- Special bio-swale designed to control and treat polluted stormwater.

**Reduced greenhouse gas emissions and carbon footprint**
The purpose of the facility is to reduce the impact of transportation of waste and to optimise transportation operations, thus directly reducing carbon emissions.

This facility allows (and promotes) the diversion of waste landfilling and allows waste to become a usable material, returned to industry for re-use.
Recycling material also uses less energy than making products from raw materials, which in turn reduces the carbon footprint of the products, as well as the demand for raw natural materials. In addition, diverting waste from landfill also reduces the volume of methane gas emissions from landfill sites, further reducing greenhouse gas emissions.

**Bi-modal transport design**

Extensive transportation economic modelling was undertaken to confirm the location and size of the facility in the context of the City’s waste collection and management areas. The facility was designed to transport waste either by road or rail. Hence, the levels and layout of the facility needed to be designed to respond to either or both modes of transport, which required a rail siding design to be undertaken, whilst ensuring that the current road transfer of compacted waste in containers is optimised. This is a key versatility requirement of the facility.

A study was furthermore undertaken of waste handling systems employed nationally and internationally, including visiting appropriate facilities overseas.

**Magnitude of the various components in constructing such a facility**

A focal point and challenge was the design of the 148 m x 122 m x 18 m (length x width x height) refuse transfer station structure, integrated with the similarly-sized materials recovery structure, both founded on piles, designed by the Jeffares & Green Structures section.

The design and construction of the facility required the incorporation of specialised mechanical components, including odour control systems, air curtains, the supply and installation of waste compactors, impact conveyors, container-loading magazines; and for the Materials Recovery Facility, bag splitters, multiple-deck-star screens, balers, magnetic separators, etc.

**MANAGERIAL COMPETENCE, TIMEOUS COMPLETION AND MEETING BUDGET CONSTRAINTS**

The project, which commenced in April 2007, has straddled a period of five years, including an initial period of intensive research (nationally and internationally), planning and analysis to optimise such a facility, developing the
detailed design involving a wide range of expertise, including mechanical, electrical, civil, structural, industrial architecture, process design, greening initiatives, etc, all of which required close coordination.

Construction was completed within the required timeframes and allowed extensions of time. The main civil works (and related structural, mechanical equipment etc), the mechanical infrastructure (compactors etc) and bulk electrical works were completed early in 2011, with the finishing works, and commissioning of the plant undertaken during 2011 to mid-2012.

The financial management of the project led to a significant final cost saving to the tendered civil and mechanical components of the works.

Considerable attention to detail and interaction/communication between the civil/structural engineering designers and contractors were key to the successful outcome of the project. The design needed to accommodate a complex arrangement of mechanised waste-handling systems and the site layout had to ensure that the containerised handling and the turning movements for long-haul truck-and-trailer combinations functioned seamlessly and efficiently, with containers loaded to optimal waste payloads. High quality of workmanship and construction was
essential to overcome the geotechnical constraints of the site and the specific technical demands of the waste facility.

CONCLUSION
The facility is a licenced/ permitted facility. The process for obtaining such a licence/ permit involved a comprehensive EIA process including public involvement. The KWMF facilitates a more sustainable approach to waste management by directing waste from landfill and making large-scale source separation and material recycling financially more feasible.

Another benefit of this facility is employment creation. Approximately 150 new jobs will be directly generated once all the facilities are fully operational.

Aesthetics
Careful consideration was given to the aesthetics of the building. Architects were engaged to create a pleasing ‘green’ aspect to the buildings to meet the City’s aesthetic requirements to “lift the quality of the area”. A landscaped access roadway and vegetated green berms were developed, combined with extensive planting. An auditorium and viewing platforms within the facility were developed to accommodate visiting students, scholars and other groups. The public waste drop-off facility was designed to facilitate and attract residents.

ACKNOWLEDGEMENT
Jeffares & Green hereby acknowledge the client, City of Cape Town: Solid Waste Department, for their vision, valued input and support.

BMK Engineering Consultants, a multi-disciplinary civil engineering consulting company providing engineering solutions which stem from the advanced management and technical skills offered by each and every staff member. BMK is known for their service excellence and quality of work which is due to the continued communication between staff and client on every stage of the project cycle, to achieve optimal work success. BMK Engineering Consultants currently a Level 1 BBBEE company, and is proudly ISO 9001:2008 certified.

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SUMMARY
A train derailment in September 2010 caused part of the original Brakspruit Bridge between Hoedspruit and Phalaborwa to collapse. Through the application of sound engineering principles, teamwork and sheer determination a temporary structure was designed and built in just five weeks, returning the line to service. During the preliminary design stage for the replacement structure, the option of constructing a new bridge adjacent to the existing one was considered, but discounted due to the scarcity of fill material for the new approach embankments. An innovative new structural system was then designed using established technology that eliminated any further disruption to the train service. The permanent structure was completed safely, and in an environmentally sensitive manner within budget and programme despite challenging circumstances.

BACKGROUND
The original Brakspruit Bridge was constructed in 1962, and consisted of three 100-foot span steel trusses supported on reinforced concrete wall-type piers and abutments. On 20 September 2010 a freight train, consisting of 80 wagons, derailed whilst travelling over the bridge. The last 18 wagons crashed into the truss structure, demolishing two spans and damaging the third. Transnet faced serious financial losses whilst the line was out of operation and it was therefore imperative for them to restore the train service as a matter of extreme urgency. Goba was appointed to design a temporary structure to restore the line as soon as possible and to then proceed with design, documentation and construction supervision of a permanent replacement structure.

TEMPORARY STRUCTURE
Transnet Freight Rail (TFR) mobilised their in-house construction team to clear the site and erect the temporary support structure. The truss at the southern end of the structure was salvaged and pulled back into position. The two remaining spans had to be reconstructed with material that was immediately available to TFR, including 1.27 m deep plate girders.
approximately 16.7 m long and space frame steel cribs fabricated from 50 x 50 angles.

It was necessary to construct two temporary piers to support the plate girders. Existing mass concrete foundations, located midway between the existing piers and abutments, which had been used for the erection of the original trusses, were modified to accommodate the two temporary supports. These supports were up to 15 m high and were constructed from the space frame steel cribs. Nearly 800 cribs, which were 1.83 m long, 0.61 m high and 0.61 m wide, were stacked in an alternating pattern and connected with clamps and stitch welds. Additional bracing angles were welded onto the cribs to increase the rigidity of the towers. A pair of high-strength concrete brick pedestals, braced together with angles, were constructed on top of the existing concrete piers and abutment to support the temporary deck.

The temporary deck was constructed from the available plate girders and spanned from the existing concrete piers and abutment to the new support towers. Transverse steel beams connected the girders together and supported the sleepers and track.

The temporary structure was completed in just five weeks and the line was then returned to service. Speed restrictions were put in place to limit the dynamic forces on the structure. It was also considered prudent to monitor the performance of the
temporary structure. A remote monitoring system consisting of GSM modems, a data logger and multiplexer, together with eight high-gain tilt meters were installed. The tilt meters had a measuring resolution of 0.005 arc degrees and a repeatability of 0.01 arc degrees, and were positioned on top of the temporary towers, concrete pedestals and plate girders. The monitoring system provided results that correlated closely with the anticipated deflections.

Whilst completion of the temporary structure was an important milestone the structure was by nature not that robust and was susceptible to flood damage. To mitigate the risks it was necessary to construct a permanent replacement as soon as possible. The floods in Hoedspruit in January 2012 proved that this was indeed a prudent decision.

**REPLACEMENT STRUCTURE**

Initially a new bridge was proposed on a new alignment adjacent to the existing structure. This bridge would be a continuous three-span cast in-situ beam and slab deck. The substructure would consist of wall-type piers and spill through abutments. A benefit of this scheme would be that the major part of the work could be carried out while the line remained operational, with a short period required to carry out the tie-ins at either end. However, the extensive rail realignment work and the scarcity of suitable fill material for the new approach embankments meant that this scheme was relatively expensive and would require a long construction period.

Goba, using their extensive experience in bridge launching, then developed an alternate scheme which had numerous advantages. This scheme had two sequential construction periods. During the first construction period the existing bridge substructure would be modified and strengthened whilst still in use. At the same time a new prestressed concrete deck would be cast on staging adjacent to the temporary bridge. During the second construction period (a scheduled three-week maintenance shut of the line), the temporary structure could be removed and the new deck could be launched sideways into position. With only minor rail tie-in work required the scheme offered both cost and programme advantages and was approved by Transnet.

Stefanutti Stocks were awarded the contract for the new bridge, and work commenced on site in April 2011. The most unusual part of the site establishment was the construction of an electrified game fence, as the Brakspruit site is located within a ‘Big 5’ game reserve area which forms part of the greater Kruger National Park.
The new structural arrangement required the support points on the substructure to be lowered to maintain the track geometry. This imposed eccentric loading on the piers and abutments, and strengthening measures were therefore necessary. It was also found that the existing structure had insufficient resistance to the full traction load specified in the SATS Bridge Code. Strengthening measures to the abutments comprised a 1 m thickening of the wall, together with the installation of six no 350 kN permanent ground anchors to each abutment. A temporary shotcrete and soil nail wall, up to 6 m high, was required to provide working space whilst working on the abutment wall. The surface of the existing wall was sandblasted before the installation of dowel bars to provide composite action between the existing and the new concrete.

The existing piers had a dumbbell shape in cross section. To carry the new loads it was necessary to increase the thickness of the narrow part of the pier and to construct corbels near the top of the pier to support the new deck. Work was carried out on the piers in a similar manner to the abutments, with sandblasting followed by the installation of dowel bars and then casting of the concrete thickenings. High-strength prestressing bars were used to prestress the corbels. All the modification and strengthening of the substructure was done whilst the temporary structure was open to normal rail traffic.

In section the deck was 6 m wide and comprised 2.2 m deep edge beams connected by a 0.3 m thick slab. The deck was designed as simply-supported for the three spans, with link slabs over the piers to eliminate the need for expansion joints. Due to the limitations of concrete supply the deck was cast in three stages. After the concrete had attained a strength of 35 MPa each span of the deck was prestressed with 108 strands to a force of 21 MN.

A major part of the work required on site was the temporary work necessary to support the new prestressed concrete deck and to form a slide path onto the strengthened substructure. Temporary foundations comprised large quantities of soilcrete fill within the river channel, together with the installation of micro piles through boulder formations near the abutments. A system of high-load props and steel girders was preferred to a conventional staging layout, as it was less susceptible to damage from floods. The slide path was formed from a 35 mm thick polished steel plate on top of a pair of large steel beams.

At the start of the occupation period the rail infrastructure was removed from the temporary bridge before the plate girders and cribs were dismantled. The single remaining span of the original truss bridge was also removed. This required the establishment of a 650 t crawler crane which was the largest single cost to the project. Once the temporary structure had been removed the new deck could be moved into position. The deck was supported on elastomeric bearing pads with a PTFE sliding surface which slid over the polished steel plate. The entire 100 m long and 6 m wide deck weighing nearly 1 700 tons, was moved by synchronising six 95 t hollow plunger cylinder jacks which pulled on 36 mm diameter high-strength steel bars. The maximum force required to move the bridge was 135 tons. After the deck had been moved into position, it was raised slightly to remove the slide beams and install the permanent pot bearings. The ballast, sleepers, track and electrical infrastructure were installed by TFR as soon as the deck was in place.

**CONCLUSION**

Difficulties during construction, including the remoteness of the site, the steel industry strike at the time and the complexity of the temporary work, hampered progress. These obstacles were, however, overcome through a combination of teamwork and dedication to the task. Particular emphasis was paid to health, safety and environmental issues during construction and the team successfully completed more than 130 000 hours without any lost time injuries. The successful completion of the project within budget and by the required completion date was due to the team’s ability to overcome the challenges involved in an unusual and technically challenging project.

Highly Commended: the Brakspruit Bridge team seen here with SAICE president Martin van Veelen at the awards function.
Stefanutti Stocks Geotechnical
a division of the multidisciplinary Stefanutti Stocks group, offers a comprehensive range of services.

- Construction of various pile types
- Lateral support, rock anchoring and shotcrete
- Geotechnical investigation (including diamond core drilling, reverse circulation drilling, DPHS testing and Auger Trial Holes)
- Geo-thermal installation
- Specialist compaction and other types of grouting

We offer innovative and cost effective design and construct solutions. We are committed to the highest standards of safety and delivery of the best quality and value to our clients.
**SUMMARY**

Paarl, the largest town within the Drakenstein Municipality area, purchases approximately 95% of its water supply from the City of Cape Town, which is relatively expensive.

An existing water supply scheme included the Nantes and Bethel bulk storage dams on Paarl Mountain, as well as the infrastructure to supplement the natural run-off to the dams with the municipality’s allocation of water from the Berg River.

In addition, reservoirs and pipelines existed to feed the water into the town’s distribution network. This scheme could provide up to 25% of the town’s annual water requirements, substantially reducing water supply costs. However, apart from basic disinfection, no treatment facilities existed and the infrastructure was largely wasted.

The need for a treatment works was identified in a 2001 feasibility investigation by Ninham Shand (now part of Aurecon). The Drakenstein Municipality subsequently commissioned the construction of an 8 Mℓ/d water treatment works (WTW) on Paarl Mountain.

The new WTW treats water from the two dams on the mountain, and is located on the boundary of the beautiful Paarl Mountain Nature Reserve. Due to its location, the plant was designed with careful attention to environmental considerations.

An innovative treatment process was designed to use direct filtration and minimise the plant footprint. The filters are equipped with a dual-parallel lateral under-drainage system, the first plant in South Africa to incorporate this design. This system is part of an overall design to enhance the filter performance through the incorporation of optimised collapse-pulsing backwashing.

Other special design features include the architectural style of the WTW to minimise its visual impact. Granite sourced from excavations for the plant was used to clad structures, giving them a texture closely approximating that of their surroundings. Buildings incorporate ‘green’ roofs and the site was re-vegetated with indigenous seeds and plants from the mountain reserve.

Exceptional attention to plant design, construction and finishing, together with innovative solutions to environmental protection needs, has resulted in a unique and aesthetically pleasing plant.
DESIGN APPROACH AND AESTHETICS

Plant design
The design team included professional staff specialising in process design; civil, geotechnical, structural, mechanical, electrical and electronic engineering; as well as an architect, a landscape architect and botanists.

This diverse team incorporated the advice of heritage specialists and various environmental specialists, to produce an integrated design that paid careful attention to the various constraints and design objectives.

From the basic engineering and the innovative treatment process design, through to the architecture and the landscaping, careful attention was given to ensuring that the plant was well-constructed in accordance with appropriate specifications. Finishing details such as screeding, tiling and painting received particular attention, so that with minimal cost, substantial value could be added.

Treatment process design
The water treatment process consists of coagulation and flocculation, direct filtration through four deep sand-bed rapid gravity filters, equipped with a dual parallel lateral under-drainage system, disinfection with chlorine, and stabilisation with lime.

Flexibility was built into the plant design to accommodate the future possibility of the municipality increasing the annual volume of Berg River water that is pumped into the Nantes Dam to supplement the natural inflow.

Aesthetics
As opposed to a more conventional single large structure, the plant is made up of several smaller structures and designed to mimic the large granite boulder outcrops that characterise Paarl Mountain. Other features are:

- The height of the WTW above natural ground level was minimised.
Sitting the plant up to 5.5 m deep into the ground displaced approximately 1 500 tons of granite, almost half of which was used as granite cladding, or as stone pitching around the site.

Flora species sourced from the Paarl Mountain Reserve were planted on the roofs of the buildings and in the general vicinity of the WTW.

The site was landscaped to effectively reduce its visibility.

Lighting was designed to prevent ‘light pollution’.

**INNOVATIVE TREATMENT PROCESSES**

Innovative treatment processes were implemented in the construction of this plant. For example, direct filtration, which is not common in South Africa, was selected to reduce the plant’s footprint. This achieved a compact and effective treatment process which is also environmentally sustainable. A substantial capital cost saving over conventional treatment options was achieved – in the order of 15% of the construction costs.

**Process design**

The design of the water treatment works is unusual: the filter media bed in a rapid gravity sand filter system must be supported by an under-drainage system, which is important to achieve uniform filtration and backwash.

When a combined air scour and backwash process is used to create the collapse-pulsing mechanism, a false floor is often used. However, in view of the risk of false floor failures, the project team installed a dual-parallel lateral system, the first plant in South Africa to incorporate this design.

In line with the international trend, Meulwater has coarse filter beds designed to achieve longer filter cycles. Also, the coarser beds allow a higher nominal design filtration rate of 8.5 m/hour, with concomitant savings in construction costs.

Another novel aspect is the design of the filters with declining rate hydraulic control. This is again an uncommon feature in South African plants, but is able to produce a better filtered water quality and capital cost savings. This system is part of an overall design to enhance the filter performance through the incorporation of optimised collapse-pulsing backwashing.

**CONCLUSION**

The optimised design, with a smaller footprint than for conventional treatment processes, allowed for a cost-effective construction cost (excluding professional services) of approximately R34.7 million, translating into R4.34 million per megalitre of water treatment capacity. This cost is considered reasonable for a relatively small plant, particularly in view of the onerous environmental sensitivity constraints.

The project team worked closely with the client to match the funding requirements of the Meulwater project with the municipality’s annual budget allocation derived from external and internal sources. This procedure worked well and accommodated the delays in obtaining approvals from the Department of Environmental Affairs and Tourism.

The Meulwater WTW was designed to blend in with the pristine natural surroundings.
Mvoti River Pipe Bridge Crossing Project

**KEY PLAYERS**

Client
Umgeni Water

Main consultant
Bosch Stemele (Pty) Ltd

Main sub-consultant
BKS (Pty) Ltd

Main contractor
Icon Construction (Pty) Ltd

Main sub-contractor
Impact Engineering

**OVERVIEW**

The Mvoti River Pipe Bridge Crossing is an important component of the Umgeni Water North Coast Bulk Water Supply Project. The strategic bulk conveyance system between Ballito and KwaDukuza, comprising large diameter steel pipelines, is necessary to ensure security of supply by meeting the present and projected future water demand requirements in the North Coast area of KwaZulu-Natal.

The North Coast Bulk Water Pipeline starts from the Avondale Reservoir in Ballito, traverses through and along several housing developments, farms and major roads, and crosses the Umhlali, Etete and Mvoti Rivers until it terminates at the Mvoti Balancing Reservoir in KwaDukuza.

The Pipe Bridge crossing is located over the Mvoti River in Groutville, alongside the existing R103 road bridge between Umhlali and Stanger.

**DESCRIPTION OF THE PROJECT**

The Mvoti River Pipe Bridge Crossing Project comprises a 280 m long, 800 mm diameter steel pipe supported by a 220 m long steel lattice-type bridge, in turn supported on existing abandoned concrete abutments and an existing unreinforced concrete central pier which were extended using reinforced concrete.

It includes below-ground reinforced concrete anchor walls which contain the forces generated as a result of the transition from the buried to the above-ground pipe installation, pipe thrust walls, and a system of pipe bearings and bridge bearings.

Other salient features of the project include a maintenance walkway along the bridge, and allowance for the installation of a second 800 mm diameter pipeline at a later stage.

**SPECIAL DESIGN AND CONSTRUCTION CONSIDERATIONS**

One of the key decisions during the preliminary design stage was to consider the various options for the piped river crossing, which included a sub-surface river bed installation, installing on the existing R103 road bridge, and on a steel...
pipe bridge supported on the old abandoned road bridge pier and abutments. The latter was determined to be the most feasible option taking into consideration various criteria such as costs, operations and maintenance, future demands and environmental impacts.

The Mvoti River Pipe Bridge consists of two main spans fabricated from tubular steel sections in a trapezoidal arch configuration. Each girder spans a distance of 79.46 m, is 3.5 m wide and 4 m high. A lower bridge deck, which supports the bulk water pipeline, is suspended from the main bridge girders with tubular hangers at 6 m centres. All loads are taken to ground through the existing concrete abutments and central pier which previously supported a steel road bridge that was decommissioned. The existing abutments and pier were modified to suit the new bridge steelwork.

Both main spans were fully pre-assembled, surveyed and welded in the contractor’s workshops to ensure fitment on site. The girders were then dismantled in approximately 20 m segments and shot-blasted and painted in the contractor’s in-house painting facility.

Transporting the girder segments to site was undertaken with eight abnormal loads, the longest being 24 m.

The truss segments were then spliced together on the flood plain before being lifted in two lifts per span, into their final position over the river. The various segments were held and lifted into position using one 90-ton and two 200-ton mobile cranes. The two bridge sections were then finally bolted together in the air and secured on bearings at the abutment. Connections at the central pier were site-welded onto cast-in plates.

As each bridge span was erected on separate days, the first bridge span needed to be supported by a temporary erection tower in the river bed to minimise any eccentric loads on the central pier while waiting for the other span to be erected.

Close cooperation between engineering and construction teams was crucial for the successful completion of this complicated construction project.

Unseasonable winter and well above average spring rains resulted in high river levels, which created huge challenges for access of materials and equipment during construction.

The old existing concrete abutments and piers date back to 1921 and, following
investigations, were found to be completely unreinforced. The central pier and abutments were modified and extended in height using an elaborate layout of dowels and reinforced concrete.

Detailing of the steelwork and the profiling of the ends of the circular hollow sections and connections were complex. The steelwork was detailed using the contractor’s in-house StuCad 3D Modelling Software and shop drawings produced to facilitate fabrication.

The above-ground section of the steel pipeline is subjected to variations in pipeline and temperature and the significant effects thereof were taken into account in the design. Stainless steel bellows (pipe movement joints) were installed on the pipe at each of the abutments. The supports located on the bridge were positioned approximately six metres apart. These are subjected to movement of both the pipeline and the steel structure, and as such the final installation thereof had to take this into account, as well as the “Poisson” effects when the pipeline would be pressurised with water. Movement bearings and an uplift bearing are located at each pipe support.

**PROJECT SCOPE**

The scope of the project comprised the following:

- Supply, fabrication and erection of the double-arched steel bridge structure spanning 220 m across the Mvoti River, supported on the existing old road bridge central pier and abutments
- Extension of the existing central concrete pier and end abutments by 13.5 m vertically
- Construction of temporary works, including access roads and working platforms, river diversion and a temporary support for erection of the first bridge span
- Installation of 220 m of above-ground and 60 m of buried steel pipeline (800 mm nominal diameter)
- Supply and installation of expansion and contraction pipe bellows
- Construction of concrete in-situ plinths, anchor walls and thrust blocks on the north and south banks
- Supply and installation of the bridge bearings, pipe support bearings
- Sheet piling, dowelling and anchor bolts
- Air valve installations
- Cathodic protection requirements
- Environmental management and rehabilitation.

**ENVIRONMENTAL CONSIDERATIONS**

The Mvoti Pipe Bridge Crossing project traverses an environmentally sensitive river and wetland area.

Based on the Environmental Impact Assessment and the Environmental Record of Decision, Umgeni Water’s Scientific Services Division prepared a comprehensive Environmental Management Plan specifically for the implementation of this project.

The contracts were closely monitored during construction for compliance with the requirements of the Environmental Management Plan. Specific emphasis was placed on the rehabilitation of areas along the pipeline route affected by construction activities.

The use of the existing concrete supports of an abandoned road bridge...
reduced the impact on the environment, whilst also minimising costs.

Steel’s ability to be recycled also provided good motivation in terms of environmental sustainability. Steelwork could also be pre-fabricated off-site, which minimised the impact on the environmentally sensitive area.

**SOCIO-ECONOMIC BENEFITS AND OPPORTUNITIES**

Construction of the Mvoti River crossing will result in several short- and long-term benefits for the region, including:
- that it is of strategic importance in significantly increasing the capacity and improving the security and reliability of water supply in the upper North Coast supply area, extending from Ballito in the south to Groutville and KwaDukuza in the north,
- that the implementation of the project has made allowance for much needed future developments in the supply area, and has unblocked one of the key infrastructure constraints for new developments, and
- that the pipe was designed to accommodate a future bulk pipeline and to operate bi-directionally, from the Hazelmere Dam in the south in the short term, and from the future Tugela River supply in the north in the medium to long term.

**COMPLETION AND COST**

The project was completed within budget at a cost of R 22.3 million, although later than originally programmed, mainly due to inclement weather conditions and associated high river levels during construction.
INTRODUCTION

With Pietermaritzburg being the capital of the KwaZulu-Natal Province, it had become necessary to upgrade the city’s airport. The airport had lost popularity over time due to growing dissatisfaction with the level of aircraft comfort, perceptions of unreliability, diversions to Durban and some fears about safety. The ailing airport experienced a 25% decline in passenger numbers from 2006 to 2009.

The upgrade (to the value of R40 million) of this Category 4 airport took place over a three-year period and was funded by the KZN Provincial Treasury. One of the major elements in this project was the rehabilitation of the airport’s runway.

THE EXISTING RUNWAY

The existing runway was built more than 20 years ago and is 1780 m long and 30 m wide. For approximately ten years the runway had undergone continuous and costly maintenance, using crack sealing and major patch repairs. It was eventually decided, as part of the upgrade, to consider resurfacing the runway.

In August 2009 the runway pavement was assessed using visual assessment, Dynamic Cone Penetrometer (DCP) survey and a Falling Weight Deflectometer (FWD) analysis. The runway presented structural weaknesses in the landing zone, probably due to the infiltration of water in the base course, caused by serious cracking on the existing asphalt layer. Continued loads along the centre line of the runway affected the cross falls on the runway and created further problems of water ponding on the surface. This was compounded by a blocked 900 mm diameter pipe culvert which carried stormwater under the runway. The ponding water posed a safety hazard for aeroplanes on take-off and landing.

The main problem was related to the ageing asphalt surface layer which no longer correctly functioned as an impermeable layer, due to extensive longitudinal and transverse crocodile cracking. Water was therefore seeping into the underlying layers causing major failures to the base course layers.

FINALEIST –
Technical Excellence Category

KEY PLAYERS

Client
Msunduzi Municipality

Professional team
Brava Engineers, Maccari South Africa

Main contractor
Elco Asphalters cc

Main sub-contractors
Phambili Road Surfacing, Cozzi Road Markings, SIA Solutions, Megaphase Roadmarking and Signage
REHABILITATION

A two-stage rehabilitation process was proposed. The first stage commenced on 1 November 2010 and entailed crack sealing and extensivepatching and base repairs. The second stage commenced on 16 February 2011 and comprised a rehabilitation exercise using fibreglass geogrids of 100 kN x 100 kN strength, overlaid by 50 mm of asphalt wearing course, followed by a 20 mm ultrathin latex modified (ULM) layer.

The design of the works was undertaken by Pietermaritzburg-based Brava Engineers, with design support from Maccaferri Southern Africa and their MacGrid AR grids. All work was undertaken at night, as the airport had to continue operating during the day.

Approximately 9 000 m of crack sealing was undertaken, and approximately 300 tonnes of bitumen-treated black-base course were used to correct the cross falls on the pavement. The repair work was followed by a tack coat upon which the 66 000 m² of 100 kN x 100 kN fibreglass grids were laid. The cold night temperatures prevented the adhesive from the fibreglass grid to become activated, resulting in the grid lifting up during placement. A 15 mm asphalt blinding layer was therefore placed over the glass grid immediately after placement to prevent movement and to activate the glue admixture, thereby allowing it to adhere to the existing surface. A 50 mm asphalt layer was thereafter placed at a cross fall of between 0.5% and 1%. The asphalt was topped with a 20 mm latex-modified ultra-thin surface which met the design requirements for friction and skid resistance.

The runway markings were painted with reflective paint containing glass beads to enhance visibility in all weather conditions. The drainage on either side of the runway was improved by constructing a system of open drains and gabion structures, and by clearing the blocked pipe culvert to allow stormwater to flow from one side of the runway to the other.

A NEW SOLUTION IN ASPHALT OVERLAY

As far as could be ascertained, the runway at the Pietermaritzburg Airport is probably the first runway in South Africa where this type of overlay solution has been adopted, i.e. the use of a geosynthetic asphalt reinforcement layer inserted in the pavement layer to increase the structural performance of the runway. Geosynthetics for reinforced asphalt must possess the following properties to comply with the requirement of a runway:

■ High-tensile strength and tensile modulus, in order to provide consistent tensile forces with minimum elongation.
■ Very low viscous elongation (creep), to resist the formation of incremental plastic deformation of asphalt over a long time.
■ Capacity of lateral confinement of aggregates for limiting the lateral deformations, hence open-grid structure and not plain solid surface.
■ High flexibility and drape-ability, in order to lie flat on the asphalt surface without generating waves and without creating voids; sheets must lie flat on the supporting layer, without requiring nailing or pre-tensioning. Moreover, sheets must not be resilient, in order to avoid the spring effect, which would produce undesirable stresses in the asphalt.
■ Resistance to high temperatures so as to avoid the formation of waving and shrinkage, which would produce further cracks in the asphalt.
■ Capacity to keep the bond between the upper and lower asphalt layers, granted by the tack coat, without creating a separation between the two layers.
CONSTRUCTION
The rehabilitation works were undertaken by Pietermaritzburg-based Elco Asphalters. The work commenced in November 2010 and was completed in June 2011. The fact that the airport could not be closed during the construction period posed a major challenge to the construction team.

Work on the runway therefore had to be undertaken at night. A stretch of runway 100 m x 30 m was resurfaced daily, including the placement of the MacGrid. The newly laid surface was feathered down to the old level over a distance of 2 m to allow a smooth transitional surface for landing aircraft. The 2 m section was then milled to the original level before continuing the pavement placement on the following day. The runway was thereafter thoroughly cleaned to remove loose stones which could be picked up by aircraft and could affect their engines. The ultra-thin layer followed in similar fashion.

CONCLUSION
The rehabilitated surface has undoubtedly resulted in a vast improvement to the runway – the new surface has fewer bumps and therefore a much smoother riding surface, resulting in less stress to the aircraft. The reflective beads, which had been incorporated into the painted markings, have markedly improved visibility, even in misty conditions.

The new Pietermaritzburg Airport is indeed putting the town back on the map. The total number of passengers increased from 59 000 in 2010 to 96 000 in 2011, and the 2012 passenger numbers are projected to exceed 100 000.

Runway after placement of MacGrid
THE FUTURE OF ASSET MANAGEMENT

VNA Consulting (VNA), a first generation professional service consulting firm focused on construction and infrastructure delivery for the past 12 years, have invested massively in design and research development to enhance road and bridge interventions.

In doing so, VNA offer services that utilises infrastructure network survey and asset management technologies to ensure that we give our clients the best services, utilising the latest technologies.

Through these technologies, it allows us safe and efficient data collation, analysis and to present scientific accurate assessments with a high level of repeatability enabling capability to assist with effective management of infrastructure assets.

We are the proud affiliated partners of the ARRB Group (Australia) and the Grontmij Group (Europe), by acquiring their leading world class network survey technology.

Some of the technology applications are;
- Network and project level road and asset collection surveys
- Routine pavement monitoring surveys
- Roadside inventory and asset management
- Road geometry and mapping surveys
- Contractor quality control
- Road safety assessment
- Airport runway inspections

During a recent initiative launched by the KwaZulu-Natal Department of Transport (KZN DoT), VNA became the first Professional Built Environment Consulting company to utilise infrastructure network survey and asset management technologies at infrastructure network level and not only at project level.

VNA were engaged to undertake a detailed assessment of the KZN provincial road network. This project entailed capturing images of all road side features, pavement characteristics and pavement strength data, utilising Falling Weight Deflectometers, the Hawkeye 2000 Network Survey Vehicle and RoseyCams.

This initiative by the KZN DoT from a Network level assessment, is a first for South Africa. Previously all surveys were undertaken merely by visual assessments (VCI). The total provincial road network under the jurisdiction of KZN DoT is 7 350 kilometres of blacktop surfaced roads and 23 000 kilometres of gravel roads consisting of both urban and rural roads.
ON THE MOVE IN SOUTH AFRICA

VNA utilised the Hawkeye 2000 system to undertake a detailed assessment of the current condition of the paved roads. In addition, an ARRB Roughometer III device was used on the gravel roads. All provincial roads per district were analysed and the data was captured on an Asset Management System.

The results from the Asset Management System were analysed and a report was presented, which provided the Department with significant information on:

- Maintaining and improving the average road network condition
- Maintaining a stable road network condition
- Maintaining and increasing the road network asset value
- Assessing the lifecycle of the network
- Enabled initiatives to reduce the overall cost for maintaining the network

During a recent visit to the 25th ARRB Conference in Perth, ARRB and VNA agreed to cooperate on building road asset management capability in South Africa.

“We believe this partnership will greatly assist the regional road authorities in South Africa to more effectively manage their road network and we are very happy to be involved with such a progressive and customer focussed organisation”

ARRB’s General Manager  Garry Warren

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The University of the Free State (UFS) needed to enlarge its facilities to cater for the growing number of students, and in particular required new buildings for its Economic and Management Sciences Department. The structural and civil designs were awarded to GIBB and Cas Kempff Raadgewende Ingenieurs as a joint venture. The full project entailed two tower blocks of lecture theatres, consulting rooms and a separate 800-seat auditorium.

It was a requirement that the auditorium had to be soundproof and had to provide a clear span across its full width. The roof also had to be curved and stepped in three levels to suit the architectural specifications, and had to be designed using suspended concrete slabs. These specifications required a complex roof structure design.

The solution was to design two concrete box girders spanning the width of the auditorium, which in turn carried the roof slabs. To suit the architectural details these box girders had to be curved in shape, which meant that they also had to resist the torsional effects caused by their shape. The clear span of the concrete roof had to be 22 metres. Other challenges in the design of the auditorium were the curved walls which had to be partially buried.

An interesting feature in the structure was the integration of steel columns supporting concrete floor slabs. These involved careful detailing at the interface between the concrete floor slabs supported by architectural steel column features.

A rather challenging feature in the design was accommodating a main campus road running underneath the building. Composite beams were used extensively to address this challenge.
In designing these buildings the loading parameters of SANS 0160 were used.

UNUSUAL AND CHALLENGING FEATURES
Not only is the auditorium designed to accommodate acoustic requirements (i.e. a concrete roof), but the structure is also designed to carry a public open area on the stepping roof. The combination of these heavy loads and the shaped geometry of the auditorium resulted in an interesting and unique structure, but offered its fair share of challenges. The various connections between steel and concrete members were, for example, very challenging.

DIMENSIONS AND COSTS

<table>
<thead>
<tr>
<th>Total project cost:</th>
<th>R69.2 million</th>
</tr>
</thead>
<tbody>
<tr>
<td>Areas of buildings:</td>
<td></td>
</tr>
<tr>
<td>Classrooms Building B:</td>
<td>560 m²</td>
</tr>
<tr>
<td>Auditorium Building B:</td>
<td>105 m²</td>
</tr>
<tr>
<td>Total area of buildings:</td>
<td>7 298 m²</td>
</tr>
</tbody>
</table>

The remainder of the total floor area consists of, among others, open areas, a cafeteria, foyers, stairs, bathrooms, kitchens and a computer laboratory.
INTRODUCTION
The Markgraaff Pedestrian Bridge in Bloemfontein is visible confirmation that steel can be used to create a unique and innovative structure that is functional and aesthetically pleasing, despite a limited budget. Combining technical expertise and creative thinking, the project team constructed a slender steel bridge of individual character, which displays standard sections, and complements its surrounding environment. Positioned at the gateway to the Bloemfontein CBD, the unbraced steel network arches of the 31 m long main span have become a point of proud reference for the client and the community alike.

The attractive bridge is an important link for pedestrians walking from public transport nodes towards Bloemfontein’s stadium and commercial centres. The bridge also completes the Selbourne pedestrian route, which in turn forms part of the rejuvenation of the Bloemfontein CBD. The rejuvenation particularly includes making the CBD more user-friendly for pedestrians.

DESIGN DEVELOPMENT
The final developed length of the structure, including the approach ramps and back-spans, was 152 m. On the eastern side the back-spans are 30 m long and consist of a continuous composite steel and concrete section that is supported by steel Y-shaped piers at 7.5 m intervals. On the western side the back-spans are 22.5 m long and supported at similar intervals.

The main span is 31 m long and is a structural steel-tied arch with a 3.5 m wide concrete deck slab. Situated in the...
midst of the 152 m long structure it was important to visually connect the arch to the approaches. A solution where the arch appeared to flow out of the approach spans was developed.

Arch bridges are often dramatic structures. When they spring from steep slopes to span a cutting or gorge, an arch bridge makes immediate sense to an observer. The flow of forces into solid ground is visible and direct. When supported on low abutments an arch can be read as a single elegant entity spanning across a gap. However, an arch placed on high piers in the midst of multiple approach spans can appear somewhat stranded. It was therefore important to the design team to visually connect the arch to the back-spans.

Given the poor founding conditions, a tied arch was considered the most economical structural form, and a way of visually expressing the flow of the arch into the back-spans had to be found. Exploring the opportunities around this concept led to the innovative idea of the bifurcation of the arch.

The bifurcation of the arch as it approaches the deck visually softens the transition between the back-spans and the main span. The concept also has structural advantages, as the bifurcating section helps reduce the effective length of the arch. This is important when considering the lateral buckling of the element. An added visual benefit of extending the arch below the deck is that the arch appears shallower in elevation.

The conceptual design also developed the idea of connecting the various sections of the bridge with a single visual thread. A composite structure was chosen on the back-spans, because it allows a 150 mm concrete deck slab to run the total length of the bridge. On the approach spans the slab acts compositely with steel I-beams to achieve the required stiffness. Across the main span the slab spans the short distances between the steel I-beams supported by the arch hangers.

The concrete deck slab therefore becomes the connecting thread that creates visual continuity across the differing sections of the bridge. Following this language, the deck edge section is also expressed in the abutments. This is considered a positive feature of the bridge, as the changing sections of the bridge appear related and in harmony. The bifurcating sections of the arch and back-span columns also follow this theme.

**DETAILED DESIGN AND TECHNICAL CHALLENGES**

With a conventional tied arch, the arches typically lean towards each other and are braced against lateral buckling by transverse elements. In this case the arches lean outward and are un-braced. The main work of the arch is done via a set of in-plane high-tensile steel hangers. These hangers are not vertical, but run diagonally in a truss arrangement. This is the typical configuration of a network arch and helps to reduce the bending moments in the arch. This fact helped limit the diameter of the arch to 273 mm, which was the maximum size of circular hollow section (CHS) that could be rolled locally.

Out-of-plane stainless steel cables connect the arch to the deck’s CHS curving edge member. When stressed, these cables provide the necessary stability to the arch and restrain it from buckling laterally. The variation in materials between the in-plane and out-of-plane hangers visually differentiates the different roles of each hanger.

The detailing of the connection points for the out-of-plane hangers presented a geometric challenge. This was because all the cables intersected the main arch and the curving deck beam at different angles. The simple answer came from the stainless steel connectors used to stay the mast of a yacht. These connectors can pivot transversely, accommodating the small out-of-plane angles. The fabrication of the cleats at deck level was therefore simplified, as no complicated setting out was needed. The cleat plates were just sized to accommodate the bending stresses and fatigue actions that resulted.

The connection of the in-plane hangers to the main arch is achieved using a connection plate that runs parallel to the arch section. This arrangement was preferred for aesthetic reasons. In the end the plate was made continuous to simplify the appearance of the structure.

A further technical challenge was the client requirement that pedestrians should be able to access the bridge via staircases on either side of Markgraaff Street. Integrating these staircases onto the limited sidewalk area caused unwanted visual clutter. The dramatic solution where they cantilever over the canal retained the sidewalk functionality and preserved the view of the main elevation of the bridge.

**CONNECTIONS AND MATERIALS**

In the detailed design, the CHS connections were designed using EN 1993-1-8:2005 Eurocode 3: Design of Steel Structures Part 1-8: Design of Joints. This code provides a comprehensive approach for the design of T and K joints.

Although the use of castings was investigated for the bifurcating section, a fabricated solution was preferred. Castings are not commonly used in South Africa and their procurement presented problems in terms of the project delivery. Robust detailing was seen as a pragmatic alternative. The section was designed with full penetration welds and detailed in such a way that the welders could access both sides of the plate using stick welding.
The final product shows that, with careful sequencing and detailing, innovative structural connections are possible using welded structural steel.

CONSTRUCTION
To keep the costs down the bridge was built from standard CHS and I-beams. The only exception was the transverse element that connects the arch and the deck ties. Here a 20 mm thick, 275 mm diameter steel pipe was sourced from the mining industry. This inexpensive product resisted the in-plane shear forces without the need of additional stiffening plates. Although there were elements with double curvature, all elements were bent to a single radius that was fitted to the 3D geometry.

The bridge itself was fabricated in a yard 180 km from Bloemfontein and the components transported to site. The arch was constructed in its entirety before being split at its midpoint and transported as an abnormal load. It was then erected onto temporary supports and reconnected. In adopting this approach the dimensional accuracy of the structure was assured and the support points aligned perfectly onto the concrete piers.

As the steel construction of the bridge took place separately from the concrete abutments and piers, quality and accuracy of construction had to be managed very carefully by the engineers. This implied regular surveys and on-site inspections. The non-negotiable 2010 FIFA deadline at the time, combined with the import of critical structural members from Australia, posed a managerial challenge for the engineers.

CONCLUSION
During the 2010 World Cup, the Markgraaff Pedestrian Bridge successfully provided access for thousands of spectators commuting to and from the soccer matches.

Through the use of technology and material from the civil engineering industry, as well as from other industries (shipping and mining), it was possible to adopt a design process where the structural requirements of the bridge were balanced with the aesthetic opportunities. This allowed the project team to create a bridge of individual character that is materially efficient and uses standard sections. The final product, completed within budget (R11 700 000), showcases the versatility of structural steel and the innovative structural connection details that can be developed.
BUILDING CONSTRUCTION WORK:

- A section of the Kimberley Prison for Grinaker-LTA/Karen Kula JV
- New Library in Richmond
- Carpark at the Diamond Pavilion Mall in KBY
- Huis in Kathu on the Kalahari Golf en Jag Landgoed
- Current projects for BHP Billiton in Hotazel
- Renovations to Barkley West Police Station
- many more.

CIVIL CONSTRUCTION WORK:

- Markgraaff Pedestrian bridge
- Ulco STP Facility and Douglas Civil services
- Sewer and Water Reticulation of Breipaal Township.
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eThekweni Zibambele
Poverty Alleviation Programme

BACKGROUND TO THE ZIBAMBELE PROGRAMME
The Zibambele Poverty Alleviation Programme is run by eThekweni’s Roads and Stormwater Maintenance (RSM) Department. Zibambele is a poverty alleviation programme which targets destitute women-headed households, mainly in the rural areas. The purpose of the programme is to provide essential road maintenance and other labour-intensive activities, in return for a monthly payment. Over time the programme has matured into a very significant employer of mainly unskilled and otherwise unemployable labour, reaching into every corner of the municipality.

Households, rather than individuals, are engaged to carry out the maintenance activities. Each contractor is assigned a length of road, varying from 0.3 km to 0.5 km, depending on the difficulty of the terrain. Currently there are approximately 6 000 beneficiaries in this programme. This equates to an estimated 2 500 km of eThekweni’s road network maintained under the banner of the Zibambele Programme.

Whilst poverty alleviation is the primary outcome of the programme, it is implemented on suitable sections of the road network resulting in the improved maintenance of eThekweni’s road infrastructure. The project team is involved in the daily management and operation of the programme, and performs regular monitoring of the maintenance activities.

DESCRIPTION OF ZIBAMBELE PROJECT PROCESSES
The Zibambele Programme provides contractors with two days per week to perform their road maintenance tasks. The remainder of the time is free for them to carry on with any other activities, such as planting crops and seeing to their private affairs. Work undertaken typically includes:

- Maintenance of the road drainage system
- Ensuring good roadside visibility
- Maintenance of the road surface in good condition
- Clearing the road verges of litter and noxious weeds
- Other labour-intensive activities as determined from time to time.

In addition to the social benefits of providing a financial ‘safety net’ for the poorest of the poor, eThekweni Municipality’s RSM Department is fulfilling a core function, which is the maintenance of its road network and other assets. In doing so, it has saved the municipality and the travelling public millions of rands, through:

- Reduced wear-and-tear to vehicles, thanks to regular maintenance and improved fault reporting.
- Improved road safety, as a result of regular pothole patching and grass cutting, especially at intersections and dangerous curves. Contractors are not
issued with tools to carry out pothole patching; potholes are filled instead. ■ Protection of state assets, through the regular clearing of waterways and the construction of rock bolsters. ■ Reduced maintenance costs, through the targeting of persons living within walking distance from their places of work. The programme has now been expanded to include other maintenance activities and participation in Savings Clubs and Cooperatives, which enables the contractors to purchase agricultural materials, school their children, and attend to their health and other basic needs. However, the main thrust of these organisations is to be the guardians of life skills and other training programmes. The key objectives of the Zibambele Programme are as follows:

■ To provide on-going and sustainable work opportunities for destitute households in an effort to break the poverty cycle.
■ To provide cost effective, labour intensive, methods of routine maintenance of the municipality’s road network, or other duties as determined from time to time by the RSM Department.
■ To increase the potential for skills-based and knowledge-based development of all the beneficiaries on the programme, through targeted accredited training programmes.
■ To provide exit strategies in an endeavour to create other sustainable work opportunities inside or outside the programme for beneficiaries who complete the training programmes.
■ To ensure that the programme is administered in an effective and uniform manner throughout the municipality, thus providing compassionate and sustained support for all of the programme’s beneficiaries.

The Naidu Consulting / Vela VKE Joint Venture plays an active role with regard to the monitoring and reporting of the Zibambele Poverty Alleviation Programme. The team comprises thirty passionate staff members who are involved in the project on a daily basis. BENEFITS WHICH CIVIL ENGINEERING BRINGS TO SOCIETY THROUGH THIS PROGRAMME

Community work
What makes the Zibambele Programme different to normal poverty relief programmes is that it creates meaningful work, thus giving contractors a sense of dignity associated with being gainfully employed. The contractors, mainly women, are selected by the community and they in turn decide who the neediest are. This creates an enormous sense of community ownership of the programme and of partnership with government. At any one time there are over 6 000 beneficiaries employed in the programme. Each beneficiary is employed on a one-year fixed term contract, and upon expiry the community opts to either renew or replace the beneficiary.

Innovations
The project team developed the Zibambele Information Management System (ZIMS), which is web-based and provides a simple, effective and user-friendly interface to both manage and A contractor performing essential rural road maintenance; at any one time there are 6 000 beneficiaries employed in the programme

The effective project management of this extensive maintenance scheme empowers the poor

A contractor performing essential rural road maintenance; at any one time there are 6 000 beneficiaries employed in the programme
People and Projects. Winning Awards.

Vela VKE is proud to have been involved in award winning projects across the many sectors we serve from multi-disciplinary International Projects to Transport, Bridges and Programme and Project Management. As part of the SMEC Group, Vela VKE is also part of a global professional services organisation with over 5,000 employees and more than 70 offices in Africa, Australia, Asia, the Middle East, North and South America.

The Baia de Luanda project won the prestigious Best International Project at the 2012 CESA Aon Engineering Excellence Awards. The Hangar Street Pedestrian Bridge was awarded SAISC’s Bridge Category Award for showcasing how structural steel can be used to create a unique and innovative link for an intermodal public transport facility. The Durban Office received the SAICE Branch and National award for Community Based Projects.

Capacity building and empowerment

The programme relies on Zibambele coordinators to support the contractors and overseers. They are the vital link between the programme management team and the programme beneficiaries. The coordinators are individuals studying towards a National Diploma in Civil Engineering, and who are employed on the programme.

monitor the programme. The field team retrieves information using technology such as GPS Trimble Devices. This information is then imported into ZIMS.

The result is a live database which manages the details of each beneficiary, such as ID number, days worked per month and payment information. The website is accessible to the client and other key stakeholders, which ensures that they can view the live status of the project at any time and from anywhere.

In addition to this, ZIMS generates the number of full-time equivalents (FTEs) produced through the programme each month. The accurate and timeous reporting of FTEs enables the eThekwini Municipality to gain access to EPWP incentive grant funding.

The operations team also assists the eThekwini Municipality with incident reporting in these rural areas by reporting, for example, bad roads or illegal dumping. This helps the municipality to ensure rapid incident response with significant associated savings in terms of maintenance and property damage.

Joint Winner: the team from the Zibambele Poverty Alleviation Programme with SAICE president Martin van Veenen (left) at the awards function.
as part of their experiential training. Currently the programme is able to provide 28 students per year with experiential training.

As part of their experiential training, students learn technical skills such as conducting visual condition indexes, and are provided with an opportunity to also improve their driving skills. The students undergo intensive training when they commence work to ensure that they obtain knowledge of basic road maintenance techniques. Throughout their involvement in the programme they continue to benefit from working under experienced professionals, and are exposed to on-going research and development into new technologies.

The health and safety of the beneficiaries, as well as of field staff, are of critical importance. Each beneficiary undergoes an induction to the programme, at which time the Health and Safety Officer explains the risks that they could face whilst undertaking road maintenance. As an added measure to ensure that beneficiaries are well informed, a safety booklet was compiled which clearly illustrates potential health and safety problems and promotes a safe working environment.

Addressing government mandates

The Zibambele Programme is in line with the S’hamba Sonke Programme, which was launched in April 2011 and is dedicated to the maintenance of roads in South Africa. The S’hamba Sonke Programme was developed to guide the implementation of grant funding which targets the development of roads and maintenance in general. The core focus is to create a sustainable programme that will maximise the use of limited funding for road maintenance whilst also targeting job creation.

Through the use of ZIMS, as discussed above, job opportunities created (FTEs) are efficiently and accurately reflected on the Expanded Public Works Programme (EPWP) website.

The system is fully compliant in terms of the EPWP and therefore ensures auditability and accountability of the programme. Accurate reporting of FTEs enables the eThekwini Municipality to access grant funding, thereby ensuring the sustainability of the programme.

Environmental sustainability

Sustainability is very much a part of the ethos of the Zibambele Programme. Environmental control, particularly with regard to erosion and pollution, is carefully monitored. Contractors are trained to manage grass verges in a manner that would prevent erosion. Refuse collected on site is no longer burned, but is collected and transported to central depots where it can be separated and recycled where feasible.

CONCLUSION

The eThekwini Zibambele Poverty Alleviation Programme is a splendid demonstration of how civil engineering can benefit the community at large, whilst also addressing fundamental government objectives.
INTRODUCTION
The City of Cape Town realised that unsatisfactory maintenance conditions prevailed in their housing stock of 43 500 units, which provides accommodation to approximately 340 000 people in the Cape metropolis. The buildings were dilapidated, had structural problems, were poorly maintained, had no security and the communal areas between the flats were not conducive to recreation and social interaction. Overall, the appalling state of the living environments of thousands of people was contributing to serious social ills such as gangsterism, drug usage and the total lack of community pride.

In order to address these issues the City of Cape Town launched its Community Residential Unit (CRU) Refurbishment Programme as part of the nationally subsidised CRU Refurbishment Programme (this subsidy is available to all municipalities).

Some 7 775 rental units (housing around 62 000 people) were identified in 11 areas across the Cape metropolis. These units were to become part of a pilot programme for basic upgrade refurbishment. Funded through the City of Cape Town, the focus was on ensuring that the available budget was utilised in the most advantageous manner for residents, as well as for the

JOINT WINNER – Community-based Projects Category

KEY PLAYERS
Client
City of Cape Town
Professional team
Aurecon, Architects Associated, MLC
Main contractors
Filcon, Vusela
City, which has to maintain these assets. To this end, Aurecon was appointed in August 2008 as the implementing agent for the upgrade of 3 840 units in Region 2, which comprises Kewtown (Athlone); Hanover Park, Heideveld, Ottery and The Range (Elsies River).

The team believes that the days of regarding the engineering and management of a project as their sole involvement have long passed. Truly successful projects are those that not only achieve their objectives through the application of the highest engineering and project management standards, but that also add value by delivering sustainable benefits and effective skills development to communities.

The Cape Town Council’s CRU refurbishment intervention indeed ensures the enhancement of the lives of tenants who have become accustomed to unsafe and poorly maintained rental accommodation. The dramatic upliftment of their standard of living resulted in a sense of place, and community pride. Not only does the programme facilitate community upliftment, it also acts as a catalyst to provide new development opportunities for these downtrodden communities.

Other important aspects of this project include the following:
- It is the first time in South Africa where a CRU programme has been implemented and used for renovations and upgrade work of this magnitude.
- It led to the empowerment of the communities via tenant training, technical training, job creation and Project Steering Committees (the latter to structure the participation of the communities).
- The enormity of the project (around R500 m) required precise and detailed project management. It is believed that the social legacy of the project will endure beyond the time frame of the physical upgrades accomplished.

**SCOPE OF THE WORK**

The scope of the work included general renovations to buildings, roofs, electrical and plumbing systems; the installation of new ceilings, floor coverings, cupboards, geyser s, fencing, refuse management and area lighting; as well as the greening of surrounding areas and provision of recreational facilities.

All the design work involved in this refurbishment project was completed within the framework of the relevant SABS and ISO codes.

**CONSTRUCTION OVERVIEW AND TECHNIQUES**

**Status quo**

To put the innovations applied and the influence of this project into perspective, one first needs to appreciate the tenants’ appalling living conditions.

The lack of maintenance was allowing spalling of the buildings’ concrete structure, making them unsafe. Broken staircases contributed to this unsafe environment. Water ingress through walls into buildings was contributing to the coldness in the flats, causing illness and making it impossible for residents with tuberculosis to recover. Toilets had no seats, flush mechanisms were broken and cisterns were generally in a poor state. The enamel of the baths was disappearing after years of use. Leaking roofs were causing ceilings to come loose, as well as the growth of fungi and mould on walls and ceilings. Many windows were missing and their frames in a dilapidated condition.
Brick skin
Some of the blocks of flats (in Ottery) were built with precast concrete walls, resulting in serious damp and water ingress problems, especially during winter. Although not part of the original refurbishment plans, a new brick skin was attached to these concrete walls, and this has greatly improved the quality of life for the tenants concerned.

Aesthetics
The absence of proper refuse collection areas and attractive safe places for children to play contributed to the run-down appearance of the housing estates. Creative intervention was urgently required, which included painting (using attractive colours, instead of the previous dull colours) and developing parks and open spaces. However, the funding regime of the CRU programme did not provide for refurbishment of the external environment. In order to develop attractive public spaces, additional funding was therefore sourced from the Social and Economic Facilities Programme (SEFP).

Ensuring community buy-in
At the start of the project, door-to-door surveys were conducted to determine the condition of the flats. The buy-in from the community had to be obtained to ensure their cooperation, and also their assistance with identifying items that had to be included on the final Bill of Quantities.
Temporary villages
Tenants had to be relocated temporarily, as not only would their presence hamper the progress of the work required for the upgrade of the buildings, but they would be at great risk of injury.

A temporary village was designed that met stringent standards set by the City. The housing was based on converted 12-metre storage/shipping containers. It was a huge turning point in the project when the fears expressed by the tenants were addressed and they moved into the temporary accommodation.

Locating the temporary village was extremely complicated because of the many factors that had to be considered, such as:
- Appropriate zoning in order to obtain a temporary land use departure for the construction
- Services had to be close to the site
- Minimising moving costs and keeping close to schools, creches, etc.
- Buy-in from the community had to be obtained
- Rival gangs’ territories had to be considered to prevent violence from erupting.

A weighting was given to each of these factors and the potential sites were ranked accordingly. In this way, the most practical and objective decision could be made to the benefit of the community.

Backyarders
Many buildings had families residing in informal structures at the back of the buildings. These were often in the way of the scaffolding that needed to be erected for renovation work.

When addressing the main tenants’ concerns, it was evident that the backyarders could not be overlooked, although funds had not been allocated to accommodate them in temporary villages, too.

Innovative measures were therefore introduced to specifically address the safety of the backyarders. Scaffolding was erected through roofs and anchored on open spaces between the shacks. The part of the shack which was under the scaffolding was partitioned-off and not accessible to anyone. Additionally, cantilevered netting was used to protect the occupied shacks next to the scaffolding.

Concern about the circumstances in which the backyarders reside has not gone unnoticed, but has led to the City commissioning a Backyarder Programme to provide services for these people. The CRU programme was the catalyst for this intervention, which led to communities being upgraded in totality and not only certain sections of the community.

Community dynamics
All of the areas in which the projects are located are gang-dominated territories, and gang fights occur regularly. The tenants in the temporary villages were exposed to this violence, as the villages were used by the gangs as places to seek cover during shootouts.

The team approached the South African Police Service (SAPS), the City of Cape Town’s Metro Police, the City Law Enforcement and community crime prevention bodies to coordinate their patrols, in order to obtain 24/7 surveillance and occasional patrols in the temporary villages.

Community interests and safety were made the number one priority. The refurbishment work was therefore scheduled specifically to ensure that no rival gang members were residing in a temporary village at the same time. Any community mistrust was allayed by being completely transparent when addressing their safety concerns about rival gangs.

ENVIRONMENTAL IMPACT: CHALLENGES AND CONCERNS
The following specific interventions were actioned to minimise environmental impact:
- Ceilings were installed and insulated with thermal insulation.
- Lights were all changed from filament light bulbs to compact fluorescent bulbs.
- Low-flow efficient shower heads were installed where showers are used.
Geysers were installed but limited to 100 litres and the thermostat was set to 50°C (solar-heated geysers were considered but installation would not be practical under these particular circumstances).

Bulk water meters for each block were replaced with individual water-demand management devices which will be set to 350 ℓ/day. Substantial community participation was required to understand and accept the new method of billing for water. In the end, all understood that it would be to the benefit of everyone.

Provision for vegetable gardens was made in the courtyards and tenants are encouraged to start growing their own vegetables.

PUBLIC INTERESTS AND BENEFITS
The sustainability of the CRU project is mostly a combination of future maintenance and the respect tenants have for the newly renovated properties. To enable this, some of the processes rolled out include the appointment of caretakers who reside in the communities, regulation of legitimate occupation, and education of tenants regarding their lease responsibilities. In addition, the tender document was structured to allocate approximately 50% of the labour bill to the local community.

CONCLUSION
The real complexity and sophistication of this project did not so much lie in the technical challenges, but rather in the community challenges and dynamics. Satisfied tenants are proof that these challenges were indeed successfully addressed.

Joint Winner: the CRU representatives at the awards evening, seen here with SAICE president Dr Martin van Veenen

The Intelligent Choice

With a solid track record spanning over half a century, GIBB has established itself as a partner of choice. Backed by a Level 2 BBBEE rating, GIBB provides engineering solutions to a diverse range of markets across the African continent.
KwaMsane Community Access Roads and Pedestrian Facilities – Phase 2

BACKGROUND

Goba (Pty) Ltd were appointed by the South African National Roads Agency Limited (SANRAL) as consulting engineers for Phase 2 of the construction of the KwaMsane community access roads and pedestrian facilities. The roads, which are in the Mtubatuba Local Municipality in KwaZulu-Natal, are situated adjacent to National Route 2 Section 30 near Mtubatuba. The project included the upgrading of three access roads, namely the western collector, the eastern collector and the N2 underpass (which connects the western and eastern collectors) from an existing heavily fatigued gravel-surfaced road to a continuously reinforced concrete (CRC) pavement.

In addition to the 2.8 km long upgrade of the roads, pedestrian facilities were constructed along the eastern collector and N2 underpass to ensure safe passage for scholars from two nearby schools.

The project was undertaken to alleviate congestion on the N2 passing through KwaMsane where pedestrian and taxi congestion resulted in unsafe road conditions. The project was undertaken as a community upliftment project, with contract requirements stipulating that the community had to benefit fully from the project. The first requirement was that a minimum of 8% of the allocated funding had to be spent on local labour. The second stipulation required that at least 35% of the total project expenditure had to be retained within the community, within the bounds of the Umkhanyakude District Municipality.

High volumes of heavy vehicles from the nearby quarry, poor quality highly weathered in-situ basalt subgrades, low maintenance requirements, and a high labour usage prompted the use of a continuously reinforced concrete pavement (CRCP). In order to maximise labour usage on this project...
it was stipulated that concrete would be batched on site by means of mechanical mixers.

Due to the nature of the topography and the alignment of existing infrastructure in the area, drainage on the eastern collector was identified as a crucial element in the design, requiring particular attention. Stormwater outlets in certain areas were located on steep gradients and, due to the high concentration of stormwater, compounded by the addition of outlets from the adjacent N2, resulted in severe erosion and damage to the properties of local residents. This necessitated the design and construction of gabion stormwater attenuating structures to curb existing erosion in these areas and to control future erosion.

Mazcon Civil and Building Contractors were awarded the contract worth R17 049 388, and construction commenced on 28 June 2010. Mazcon is a black-owned construction company based in Vryheid. The company, which was established in 2001, has a 7CEPE CIDB rating, and is a level 6 BEE contributor.

COMMUNITY INVOLVEMENT
As part of the community upliftment programme, funds were allocated for training within KwaMsane. The Cement and Concrete Institute (C&CI) were approached by Goba to conduct an engineering training course for forty local labourers on the batching of concrete and the construction of a CRC pavement. The training course involved a six-hour lecture on concrete theory and its applications, and a two-day practical workshop on the construction of a CRC pavement. The trained locals were subsequently hired by the main contractor for the full duration of the project.

To increase the delegates’ skills, Goba and Mazcon facilitated training on steel fixing, formwork erection and concrete batching within the site camp, followed by a mandatory trial run. Delegates were taught the correct methods of steel fixing and placement of reinforcing for the pavement, as specified by the drawings, the correct methods of formwork erection to ensure that correct levels were achieved, and correct batching methods to ensure that the concrete met strength and consistency requirements throughout the project.

In addition to the engineering training, thirty local community members were trained by Tholowethu Trading Enterprise in home-based care as part of a generic training initiative. Delegates were taught various methods of communication, community empowerment, community mobilisation and basic nursing care with specific reference to rural, elderly and HIV-positive people.

As part of the entrepreneurial training, Goba recommended that Mazcon be assisted in attaining a recognised quality management system. Wynleigh International (Pty) Limited were contracted to assist Mazcon in compiling an in-house quality assurance plan.

Furthermore, two students received in-service training under the supervision of Goba and Mazcon during the construction phase. A total of nearly R400 000 was spent on training as part of this contract.

As part of the project SANRAL had allocated funds for the construction of a community facility. Four such projects were identified within the KwaMsane community, namely the installation of refuse bins, the installation of three bus shelters, the re-grading of an existing access road to allow correct drainage, and planting fruit trees within the community.

The first project was to procure and install eight refuse bins around the KwaMsane community to combat litter
pollution. This project was undertaken with the assistance of the Mtubatuba Municipality to ensure that the refuse would be removed and correctly disposed of. The second project was to design and construct three bus shelters for the bus lay-bys along the new roadway. Two bus lay-bys and shelters were constructed at identified locations along the western collector and one was constructed along the eastern collector. Goba, together with the Mtubatuba Municipality and local taxi association, coordinated the placement of the lay-bys and shelters to ensure their correct usage.

The third project involved the re-grade of an internal access road within the community. The existing road did have sufficient drainage, but due to poor town planning, stormwater outlets at critical locations had been blocked by residents, as the runoff was damaging their properties. Various alternate drainage options were considered, with the final decision being to re-grade the existing road and construct proper drainage along the road.

The fourth project, still under way, involves the planting of fruit trees in the properties of local residents. Various local fruit-bearing trees are placed in selected areas to both enhance the general appearance of KwaMsane and provide an alternative food source for local inhabitants.

On completion, the expenditure for these community projects will amount to R780 000.
CONCLUSION

This R17 million project is in the final stages of completion, with less than 5% of the outstanding works requiring completion. The construction of the KwaMsane access roads and pedestrian facilities has benefited the KwaMsane community immensely through utilising labour-intensive construction techniques and providing much-needed training for local residents. The project is an excellent example of how cooperation between all the parties involved leads to the successful completion of a project – in this case between the client (SANRAL), the engineer (Goba), the contractor (Mazcon), the Mtubatuba Municipality, amaKhosi, local residents and local labour.

In addition to this, the entire funding allocated to training and community facilities was expended during the project through effective interaction with the various parties and buy-in from the local amaKhosi. To date a total of nearly R5.3 million has been spent within the Umkhanyakude district, of which R2.1 million went towards local labour, and a further R1.4 million was spent within the local community.

Although the project ran over the allocated construction period, the major goal of maximising community participation was achieved, resulting in a high-quality product that was completed within the allocated budget.
**INTRODUCTION**

This roads project in Cornelia was part of the second phase of the Township Revitalisation Programme, which is an initiative of the Free State Department of Public Works. The town of Cornelia is situated in the north-eastern Free State and is part of the Mafube Local Municipality, which in turn is situated in the Fezile Dabi District Municipality.

The project commenced on 15 September 2011 and was completed, within time and budget, on 30 March 2012 at a cost of R 9 million. The project was designed and constructed to satisfy the requirements of the EPWP (Extended Public Works Programme) guidelines in terms of job creation and training. Labour-intensive methods were in other words given preference where it was technically and economically feasible without compromising quality.

In order to maximise the empowerment of workers they were trained in all the tasks by rotating them between jobs. The contractor provided ‘on the job’ practical training of all the workers on site, and spent the first four months of the project familiarising them with the tasks, while maintaining productivity standards. The contractor created 94 jobs for workers from the local community of whom 87 were labourers. The project produced 11 019 person-days of employment for unskilled labourers, and a total of R822 070 was paid out as wages to local labourers, accounting for 10.5% of the construction cost. In total 5 042 person-days of employment were created for women and 8 244 person-days for the youth.

**LOCATION AND NUMBERS**

The Mafube Local Municipality includes the towns of Frankfort, Tweeling, Cornelia and Villiers. Mafube, with 12.5% of the population of the District Municipality, covers 21.5% of its area.
Only 16.6% of the population of Mafube are employed. Currently 30.4% of the population in the District Municipality are economically active, while 26.8% of households have no income. Within this bigger picture Cornelia has the highest percentage of households with no income (38.2%). It is estimated that 77% of Mafube’s population are living in poverty.

**DESIGN**

The engineer considered two labour-intensive options for the surfacing – an 80 mm interlocking bricks option, and a Cape Seal option. The pavement design of the Cape Seal alternative required a C3 base layer on top of a G6 selected layer and G6 sub-base layer. Of the two options, the interlocking bricks were found to be the most cost-effective solution. The job creation potential of the Cape Seal was also found to be lower than that of the interlocking bricks option.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Summary of CETA-accredited unit standards used in training</th>
</tr>
</thead>
<tbody>
<tr>
<td>NR</td>
<td>UNIT NO</td>
</tr>
<tr>
<td>1</td>
<td>12916</td>
</tr>
<tr>
<td>2</td>
<td>13973</td>
</tr>
<tr>
<td>3</td>
<td>9974</td>
</tr>
<tr>
<td>4</td>
<td>14575</td>
</tr>
<tr>
<td>5</td>
<td>12877</td>
</tr>
<tr>
<td>6</td>
<td>12875</td>
</tr>
</tbody>
</table>

One of the completed 2.67 km of streets in Cornelia constructed by hand according to EPWP guidelines
of the interlocking bricks. The earth and layer works were done machine intensively because of the requirement of the EPWP that the construction method employed also has to be the most economically efficient method. It was not required of the project to be labour-extensive.

The drainage infrastructure for the area was totally inadequate, with stormwater running down the streets and sidewalks, damaging infrastructure. The existing drainage system had to be integrated with the new drainage infrastructure where possible. It was therefore decided that drains would be mainly surface drains and that they had to be constructed in situ.

**TRAINING PROVIDED**

As mentioned above, as part of the project the contractor transferred practical skills regarding earth works, concrete works and the laying of pavements to all the unskilled workers on the project by rotating them between the various tasks. The contractor had his own programme of skills transfer and did 870 days of ‘on the job’ training in order to be able to produce at the required level to complete the work in time. Ten weeks before the end of the project, CETA-accredited training (in six unit standards) was provided to all the workers (CETA: Construction Education and Training Authority). Every worker received practical training in all six of these unit standards, and the 16 best performing candidates were selected to complete the theoretical part of the training as well. In total 1 434 person-days of accredited training were provided to local workers, and all 16 candidates that had completed the full course were found to be competent. Table 1 summarises the unit standards that were presented.

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 mm gravel sub-base</td>
<td>compacted to 97% Mod AASHTO density</td>
<td></td>
</tr>
<tr>
<td>150 mm gravel selected layer</td>
<td>compacted to 95% Mod AASHTO density</td>
<td></td>
</tr>
<tr>
<td>80 mm interlocking bricks</td>
<td>25 MPa</td>
<td></td>
</tr>
<tr>
<td>25 mm bedding sand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>150 mm in situ roadbed</td>
<td>compacted to 95% Mod AASHTO density</td>
<td></td>
</tr>
</tbody>
</table>
Although the workers did not receive the full training for a qualification, they now definitely have a better chance to be employed on future projects where they can build further on the six unit standards already completed.

COMMUNITY LIAISON
The positive involvement of the community through the Project Steering Committee, as well as through the provision of work, cultivated a better understanding of the technical issues involved in construction. Through this project it was proved once again that a well-informed community will actively support a project and the execution of the work it entails.

CONSTRUCTION
Construction covered a total of 2.67 km of streets. The surfaced width of the streets was generally 6.0 m, except for a stretch of 306 m in Street No 5, which was 8.0 m wide. The roadbed and layer works were constructed on a width of 8.0 m where the surface was 6.0 m, and 10.0 m where the surface was 8.0 m. The pavement structure is illustrated in Figure 1.

The quality of the work was excellent right through the execution of the project, and the budget was wisely spent. Tables 2 and 3 summarise the numbers involved.

CONCLUSION
The project was completed within budget and within less than six months. In total 2.67 km of streets were planned and constructed. The project not only provided road infrastructure, but also provided technical skills to local labour in the form of practical ‘on the job’ training, as well as accredited technical training. In total 2 304 person-days of training were provided. The project also succeeded in creating employment to the amount of 11 019 person-days with 10.5% of the construction cost going towards wages for local labour.

Members of the government’s Portfolio Committee on Infrastructure visited the project on 25 January 2012 and were very impressed with the work that had been done in Cornelia.

Table 2 Summary of the volumes involved in the Cornelia project

<table>
<thead>
<tr>
<th>Description</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laying of kerbs</td>
<td>295 m</td>
</tr>
<tr>
<td>Placing of concrete</td>
<td>562 m³</td>
</tr>
<tr>
<td>Earth works</td>
<td>7 334 m³</td>
</tr>
<tr>
<td>Layer works</td>
<td>6 198 m³</td>
</tr>
<tr>
<td>Placing of paving</td>
<td>16 251 m²</td>
</tr>
</tbody>
</table>

Table 3 Summary of how the project budget was spent

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction cost</td>
<td>R7 850 745.66</td>
</tr>
<tr>
<td>Occupational health and safety compliance</td>
<td>R12 100.00</td>
</tr>
<tr>
<td>Technical training of local labour</td>
<td>R90 138.98</td>
</tr>
<tr>
<td>Reimbursable cost</td>
<td>R231 315.79</td>
</tr>
<tr>
<td>Professional fees</td>
<td>R815 699.57</td>
</tr>
<tr>
<td>Total expenditure</td>
<td>R9 000 000.00</td>
</tr>
</tbody>
</table>
SAICE 2012 AWARDS CATEGORY: INTERNATIONAL PROJECTS

HIGHLY COMMENDED International Projects Category

KEY PLAYERS
Client
Tourism Development & Investment Company of Abu Dhabi
Professional team
Aurecon, Mirage Mills Leisure Development Inc, Woods Bagot
Main contractors
Al Habtoor / Murray & Roberts JV

OVERVIEW
The St Regis Saadiyat Island Resort is a prestigious development on Saadiyat Island, 500 m off the coast of the capital city of Abu Dhabi. Abu Dhabi’s Tourism Development & Investment Company (TDIC) is in the process of transforming the 27 km² island into a signature tourist, leisure, residential and cultural destination. Ideally located on Saadiyat Beach, the St Regis Resort and precinct form part of a master plan, which will eventually see the island become home to the Guggenheim Abu Dhabi and the Louvre Abu Dhabi museums.

The engineering and management challenges that confronted the team began with assessing and developing a solution to the unstable engineering properties of the natural ground profile of the project site. This stabilisation process was critical to ensure proper founding conditions, mitigating the risk of seismic-induced liquefaction and ensuring the stability of platform side slopes and other excavations envisaged for the proposed developments.

The sheer size of the project meant that the team had to maintain meticulous focus in terms of producing a very large number of design drawings, as well as reviewing shop drawings produced by the contractor. The design programme was extremely challenging, and drawings frequently had to be fast-tracked to construction within hours of being needed.

A year into construction, a significant design variation was announced in the form of a banquet hall to seat 3 000 people. The contract deadline was extended by only three months, with completion of the hotel and banquet hall scheduled to coincide with the Formula 1 Grand Prix event in Abu Dhabi in November 2011.

The banquet hall consists of a three-storey concrete structure inclusive of a single level of basement parking. To
ensure that the strict design and timeline criteria were met, innovative resourcing was necessary. For example, Aurecon resourced the project from the onset by splitting it up and effectively coordinating the work between dedicated teams of engineers across South Africa and the Middle East. This strategy helped the teams to maintain tight control on the different aspects of the project and their accompanying construction programmes.

**DESIGN APPROACH AND AESTHETICS**

The ambitious design included 373 rooms with en suite bathrooms, a spa treatment facility, beach club and beach-facing restaurant, banquet hall seating 3 000 people, seven apartment blocks (256 apartments) with a 6 000 m³ retail component, a three-storey basement parking structure, 33 luxury exclusive villas and extensive landscaping and water features.

Every component of the structural and civil engineering works was required to contribute to the overall objective of a demanding aesthetic standard, which included detail finishes such as water features, swimming pools, palm tree boxes, a large number of retaining walls, pedestrian ramps, staircases, sidewalks, etc.

Some of the project team’s major contributions to the transformation of the Saadiyat Beach site can be summarised as follows:

- Concept design reports provided the basis of the project budget and feasibility.
- Sophisticated geotechnical engineering enabled the site to be raised with dredged material to a level significantly higher than the surrounding land. This was a major and expensive requirement by the owner.
- The construction of a service tunnel to allow delivery/service vehicles to enter the site without interfering with guests or residents.
- An innovative solution for the roof of the banquet hall created a highly successful structure that blended aesthetically with surrounding buildings.

**CONSTRUCTION CHALLENGES**

Initiated before the global financial crisis, the project was delayed until August 2009 when the construction team was informed that the project had to be fast-tracked and completed within 24 months, which led to concerted efforts on all sides to make this a reality. Many construction challenges presented themselves and needed innovative solutions.

A crucial challenge was the fact that the environment of the United Arab Emirates is exceptionally aggressive to any type of construction, requiring sophisticated design and unusual construction methods, such as:

- All structures, together with most of the 3 m retaining walls, were piled. This involved approximately 3 600 piles.
- The entire site was filled with approximately 10 m of marine-dredged fill material.
- All concrete in contact with the ground has a waterproofing membrane to protect it against aggressive chlorides and sulphides.
High-durability concrete mixes were employed.

Due to the high water table, all basements had to be constructed with de-watering pumps that run continuously.

Five of the seven apartment buildings were built over transfer slabs.

Seismic loading was an important design criterion. The analysis carried out was based on Seismic Zone 3.

Construction was made more complicated by a number of other issues as well:

Large volumes of drawings had to be processed and transferred between offices. This included 1 600 drawings issued by Aurecon for construction and 8 500 shop drawings and contractor submittals that had to be reviewed.

The scale of activity in general. During peak construction there were over 10 000 people on site, made up of widely diverse nationalities.

Communication difficulties. Two specific challenges had to do with the site’s underlying geological structure, and with unexpected design changes, requiring innovative solutions to be developed under considerable time pressure:

Stabilising the site’s underlying geological structure

Saadiyat Island is founded on natural land. To develop the resort a dry platform had to be established above sea level. The geotechnical team conducted a thorough assessment of the engineering properties of the natural ground profile underlying the future settlement-sensitive development, and developed a solution to this challenge, which included falling-weight dynamic compaction and roller technologies.

**Accommodating significant design changes**

As had been mentioned above, a year into construction, a significant design variation was announced in the form of a banquet hall to seat 3 000 people, but the contract deadline was extended by only three months.

The main structure is formed in reinforced concrete around the banquet hall space, free of any supporting columns measuring 50.5 m x 63.0 m in plan. Challenging features of the design for the roof structure included the main span of 50.35 m, the high loadings to be catered for, and the limitation on deflection to ensure trouble-free operation of mobile acoustic partitions. These factors resulted in structural steel tonnage per square metre that cannot be compared with that of a normal steel roof structure.

**ENVIRONMENTAL PRECAUTIONS**

TDIC has introduced extensive measures to protect the marine environment surrounding Saadiyat Island. For example, wastewater has to be tested and a quality permit obtained before it can be discharged into the ocean. In addition, the building line is 500 m from the beach to protect the highly sensitive breeding areas of the endangered Hawksbill turtle.

**CONCLUSION**

Innovative, well-coordinated resourcing and the application of international best engineering practices enabled the team to successfully meet the client’s budget, timing and aesthetic requirements for the complex St Regis Saadiyat Island Resort development.

Quality control of this challenging project required highly skilled management in view of the large volume of design documentation. Aurecon successfully accomplished this through meticulous attention to detail and putting in place stringent quality check procedures. This exemplary team effort met the challenging contract deadline in time for the official opening in February 2012 of this flagship Saadiyat Island project.
OVERVIEW
The East African Community (EAC) Secretariat contracted Aurecon in association with Cape Consult to prepare a regional Transport Strategy and a regional Road Sector Development Programme. The objective was to identify regional priorities for transport sector development for the medium-term in line with EAC development goals.

The five EAC member states (Kenya, Uganda, Tanzania, Burundi and Rwanda) are served by an extensive road, rail, lake and pipeline transportation network, as well as by two major sea ports (Mombasa in Kenya and Dar es Salaam in Tanzania) and several international airports.

The EAC Transport Strategy is the EAC’s key planning document for guiding regional policies and investments. The strategy assessed operational needs in the medium-term (over ten years), and provides a detailed assessment of all modes of transport in the regional dimensions.

The EAC Regional Road Sector Development Programme is a comprehensive, multi-year work programme based on the regional demand model, combined with the goals and objectives defined in the EAC Transport Strategy.

An all-embracing model was produced to simulate the movement of people and goods throughout the five countries in the EAC and beyond, focusing especially on the main corridors for regional economic development.

Aurecon applied international best practice and sophisticated modelling, combined with the company’s experience in managing major projects in Africa, to successfully complete a complex exercise on schedule and within budget in December 2011.

DESIGN APPROACH
The project required the delivery of a detailed assessment of all transport infrastructure, modes of transport, and the transport enabling environment within the region. From these assessments a ten-year Transport Strategy and a Roads Development Programme were developed with the distinct purpose of guiding both regional transport policies and sustainable transport investments in the future.

In addition, Aurecon also formulated a comprehensive, multi-year work programme (development plan) which complied with constrained budgets and was based on the goals and objectives as defined in the Strategy.

The Transport Strategy and the Road Sector Development Programme components of the project comprised the following:

The EAC Transport Strategy covers an analytical review of the transport status in the region, the preparation of a regional transport model, and recommendations
on the implementation of the Strategy, including institutional, financial and private sector participation arrangements.

**The EAC Road Sector Development Programme** comprises a road characteristic survey, and assessment of road capacity and road conditions, together with the identification of priority roads projects and funding requirements.

A key objective of the project was to ensure that the Strategy and Programme provided valuable assistance with sound policy formulation and legislation recommendations. This was achieved by building the project around engineering and economic concepts and principles, which properly determined the impact on alternative regional highway investment levels and the resulting regional highway conditions and performance.

Although the study reviewed and made recommendations on transportation, policy and institutional arrangements in the region, the Strategy is biased towards physical, immovable infrastructure.

### 3-Tier modelling approach

Particular attention was placed on the interface between road capacity, road transport demand and road condition by constructing three interrelated road modelling platforms:

- **Transport Demand Model (PTV VISUM)**
- **First Order Network Assessment (FONA) Capacity Model**
- **HDM Road Condition Model**

The Transport Model (PTV VISUM) was utilised across all transport modes to assess the relationship between traffic and infrastructure capacity.

In the case of roads, the high-level assessment carried out by means of the Transport Demand Model is refined by applying the more detailed First Order Network Assessment (FONA) Capacity Model developed by Aurecon, based on the principles of the Highway Capacity Manual (HCM).

Particular attention had to be paid to the transport network integrity and, specifically, the treatment of new road links. FONA only investigates and assesses existing road links based on traffic (demand) flows without traffic assignment.

The Transport Demand Model, however, analyses new road links based on land use and other socio-economic data utilised to generate traffic. Employing both models enabled superior road network analysis.

Ideal Level of Service (LOS) ratings were derived for road links, although the reality within most countries is at a level that is usually exceedingly worse than this ideal situation, especially in and around urban environments.

### Innovative road condition survey techniques

Road condition data for the road network classified as the EAC Corridor was obtained from two sources:

- **Primary source condition data**
  - The primary source for the road condition assessment was undertaken by means of video logging and assessing the road network by means of visual data. The video feed was linked via GPS to a geographic information system (GIS). The data collected during the surveys was used as the primary source of data, describing the current condition of the road network in terms of roughness, rut depths and other road deterioration indicators, such as cracking, ravelling and potholes.

- **Secondary source condition data**
  - All data obtained from the management systems of the five countries was used as the secondary data source to supplement the primary data source. The data set was further enhanced with input from local experts. More than 70% of the data was sourced from the clients’ systems.

The primary and secondary data sources were aligned using GIS in order to create a composite data set for analysis purposes.

### METHODOLOGY

**Project prioritisation**

A multi-step approach, including both quantitative and qualitative criteria, was developed to determine the relative priorities of the various projects included in the project’s ‘long list’. The result was a Strategy made up of various packages of interventions.
Prioritisation context
The study Terms of Reference (TOR) stated that “the objective of the EAC Transport Strategy was to identify regional strategic priorities and resources for transport sector development”. This meant that interventions were to support an overarching plan (a ‘regional strategy’), and those that did so best should receive precedence.

Prioritisation approach
The prioritisation process applied in the study was based on a multi-criteria analysis approach, also referred to as a generalised utility analysis model methodology.

At the project outset, stakeholders emphasised the importance of the economic performance of projects, both in terms of positive transport results and economic impacts beyond the transport sector. At the study review stage, more qualitative criteria in the form of the strategic implications of projects were included.

Strategic projects, in the context of this project, are those that are visionary (they change the structure of the existing regional transport network) and provide alternative access (an ‘insurance policy’ in the event that the preferred transport route becomes unavailable).

Projects were prioritised based on system integrity, as well as strategic, economic and capacity impacts. Projects that did not have the integrity of the transport system as their principal aim were assessed for inclusion in the Strategy, based on economic merit. This was determined with reference to the economic importance of the project area (measured in annual goods trade on the actual or closest transport link) and the cost of the project.

The project was focused around transport corridors that play an important economic and socially stabilising role for both the member countries as well as the EAC as a whole. While highlighting local involvement, it is unclear at this stage how many local jobs would be generated, as the project did not analyse at such a detailed level.

CONCLUSION
The comprehensive model compiled by Aurecon to simulate the movement of people and goods throughout five countries in the EAC and beyond, focused especially on the main corridors for regional economic development. In addition, a comprehensive investment programme, with priorities for the roads sector for the next ten years, was compiled. The benefits of the project will be potentially far-reaching in terms of the development of transport infrastructure in East Africa and the resulting effect on the region’s economy.
At the SAICE awards dinner in October this year individual awards were made in the sub-categories listed alongside, and presented to the recipients by SAICE president Dr Martin van Veelen

- **Project of the Year per SAICE Division.** This is a new category and only two SAICE Divisions entered this year (the Water and Structural Divisions), but it is expected that this category will become hotly contested in years to come.

- **Branch / Division of the Year**

- **Student Chapter of the Year** (the winner was the University of Cape Town, but Chapter members were so busy preparing for exams that no-one could attend the awards function)

- **Engineer / Young Engineer / Technologist of the Year**

- **Most Supportive Advertiser of the Year.** This award is made annually to recognise the continued and loyal support of SAICE’s magazine advertisers.

- **Winning photos in SAICE’s annual Photo Competition**
The SAICE 2012 awards evening was a joyous occasion, indeed. We eagerly await entries for the 2013 event!
SAICE Annual Photo Competition

The Three Winning Photos

Winner: Reach for the sky
Photographer: Charles Stolper
Location: R27 Kenhardt to Kolmards (safety improvement of structures, including the widening of five bridges)

Second: Primary Silo
Photographer: Dalton Dingelstad
Location: Trekkopje (Maxi) Project Civil Works, Namibia
steel leaves a legacy

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Sandton, South Africa • 5 & 6 March 2013

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Hosted by the Southern African Institute of Steel Construction
SteelFuture – a ‘can’t miss’ event

A word from SAISC's
Hennie de Clerq

Arranging a conference about the future of steel in construction felt like a good idea, yet the overwhelming response from speakers around the world still surprised – and encouraged – us. More than 24 of the leading international authorities on various aspects of steel will feature on the programme, together with top South African speakers.

The SteelFuture conference, which will take place in Johannesburg on 5 and 6 March 2013, has already evolved into a ‘can’t miss’ event packed with the promise of insight and information that will be of real value to everybody with any interest in the use of steel in construction (visit www.steelfutureconference.co.za).

Steel construction is in the midst of raging change. Prominent thinkers and leaders will congregate during SteelFuture to help us understand these changes: Edwin Basson (Director General of Worldsteel, the body representing steelmakers worldwide), Reidar Bjørhovde (widely acknowledged as a leading authority on structural steel), Richard Liew (whose status in Singapore, China and further afield makes him a portal to a body of knowledge which is otherwise largely inaccessible to us), John Cross (from America and a specialist regarding construction economics, sustainability, building information modelling, and the early involvement of steel specialty contractors in the design and construction process), and various other brilliant speakers.

SteelFuture is intended to equip companies and the industry to decide on future strategy. Conference topics will therefore be in line with this intention. We believe it will be impossible to leave the conference without thinking deeply about how to build in line with what the future holds in terms of the imminent changing building processes.

SteelFuture will undoubtedly make a difference to the steel construction industry by providing delegates with a new vision. However, and notwithstanding precise planning and the selection of outstanding speakers, the main impact of SteelFuture might in fact not be what comes across in carefully prepared speeches, but rather the interaction between delegates coming together in a climate of exploration and sharing. It is this promise of the unexpected emerging when people of similar interests are thrown together that makes SteelFuture the sort of event one should not miss.

The structural steel industry WILL change dramatically in the next 10 to 20 years. These changes will include:

- an increasing level of technological sophistication tying together the entire steel supply chain, while at the same time exchanging necessary information within the broader design and construction disciplines
- the standardisation of sustainable processes within the structural steel industry
- the collaboration, as a rule, between designers, contractors and specialty contractors such as structural steel fabricators
- a broadening of fabrication activity both in terms of materials and scope to fully embrace the efficiencies of modularisation
- the embracing of new, innovative structural systems, even if those systems are of a proprietary nature.

All of these trends are already coming into play. Software packages that allow the exchange of dissimilar data from building models are becoming commonplace; a growing percentage of projects across the globe are actively pursuing zero net carbon impacts; Design Build and Integrated Project Delivery methods are demonstrating lower costs, accelerated construction and enhanced quality; fabricators are experimenting with providing more than just fabricated steel beams and columns; and innovative systems like SidePlate, ConXtech, Girder-Slab and steel plate shear walls are gaining traction. But the big change will be that all of these trends and opportunities will begin to merge into a single focus where each is recognised as not only bringing value to the project, but enhancing the value that the other trends bring.

To survive, structural engineers will need to embrace these changes, not merely adapt to them. And they will find it necessary to rapidly assess a growing number of design alternatives, not just from a structural perspective, but also taking into account cost opportunities for off-site modularised fabrication, the embodied environmental footprint and the impact that design decisions will have on the operating energy requirements of the completed structure.

I believe that attendees at the SteelFuture conference will not only gain an insight into how these industry-wide changes are playing out in today's global marketplace, but will also gain a future perspective, enabling them to establish a long-term strategy for their organisations.
Construction is not getting simpler. In fact, in many ways it is getting more complex. Some projects are very large (Medupi and Kusile will, for example, be the two largest coal-fired power stations in the world), and size tends to mean more and often bigger elements.

Hence, traceability has become a driving force. Each element in each assembly for important jobs has to be traceable to a particular cast made by the relevant steel mill on a given day, and all the tests performed on the steel, welding, corrosion protection, etc, must be immediately accessible in the file associated with the assembly. No longer is a cursory glance at a bolt sufficient to satisfy the engineer that it is of the right quality, diameter, and so forth. Written proof is required, and, like all the other bits of written proof, this must be retained and kept available.

Computer-aided draughting, especially in 3D format, has brought some complexities in its wake, notably an increase in the amount of information created by the steelwork detailer. On a sizeable project the number of detail drawings submitted to the engineer for approval can therefore be immense. Boredom, loss of concentration and shortcuts are almost inevitable, allowing errors to slip through.

The computer may also lead to complexity in another way: it enables architects and engineers to design more complex structures – “If you can draw it and analyse it, somebody should be able to build it.” In addition, some of the old contractual arrangements and the relationships between the various parties on a project tend not to work too well any more on projects making full use of BIM (building information modelling). At SteelFuture Roger Ferch and David Ratterman will show delegates the way out of this problem.

But if technology takes away, technology can also give. In fact, problems glibly attributed to “technology” are often symptomatic of an immature technological system, or an inadequate or incomplete application of it. Too frequently we merely camp in one corner of the big technology field, complaining that it is not the great place it should be. That’s fine for your cell phone, or for typing with one finger in Microsoft Word, but if you are playing professionally in the steel game you can’t do it on a level where you need an eight-year old to help every time you get stuck. You have to be, well, professional!

That’s where John Moebes comes in (and other great minds on the SteelFuture programme). He was a successful architect when he joined the Crate and Barrel chain (retailers of household ware and furniture), and soon became an internationally recognised authority on integrated project delivery while building new stores for the group. He made technology a close friend in pursuit of better, more economical, faster-built stores, while always reflecting the professionalism of the company brand.

Moebes will be talking to SteelFuture delegates about BIM, web-based project management, performance metrics and workflow standards. He is truly into technology. Maybe one of his phrases, “conference-style review of shop drawing”, says more about his approach – it is the mix of technology and how people interact which determines success. We stand to learn a lot from him. Moebes and his colleagues have considered the whole delivery process – from contractual arrangements to technical specifications to how the various professions and contractors can each make the best contribution. And it is striking how Moebes sees structural steel as key to their success, and the importance he attaches to the contribution that the fabricator can make.

But technology does not stop with software. The manufacturers of the big numerically controlled machines for the fabrication of steelwork will also be at SteelFuture. Engineers and fabricators alike will be able to learn a lot about where this technology stands and what can still be expected in the future.

Also, the steel mills are coming to the party with new products that are greener, lighter, stronger and more imaginative, again giving steel an advantage when it comes to future demands. To this mix the manufacturers of fabrication and other equipment will bring new products to integrate into the process to enable even faster, more accurate steelwork of consistent quality.

The progress being made to integrate robotic welding with CNC (computer numerically controlled) equipment will be of particular interest to SteelFuture delegates.

But a revolution is required on site – the industry will have to develop new approaches to marry the need for faster construction with the demand for ever-increasing safety standards. The latter is sucking any gains in productivity from the process of steelwork erection, and there is a danger of it encouraging alternative forms of construction.
SteelFuture
RESEARCH AND DEVELOPMENT AND DESIGN CODES

Structural steel research and development is carrying on unabated all over the world, and SteelFuture will be an excellent opportunity to catch up with new developments in this regard.

The best research work often greatly influences codes of practice, and the SteelFuture conference will clarify the road ahead with respect to codes in South Africa (considering our tradition of these being based on the Canadian codes), the pressure to move to the Eurocode, and what the Australians, North Americans, Chinese and others are doing.

WHERE ARE WE GOING WITH OUR STEELWORK DESIGN CODES?

Let's admit it: structural engineers are in a bit of a dilemma when it comes to steel design codes.

Eurocode 3 (EN1993, also called EC3) has been in existence for some time and a lot of supporting items – design aids, software, iApps, etc – have been developed. Even the British have adopted EC3, though many engineers have just dug in their heels and stuck to BS5950. Our ‘loading code’ SANS 10160 is based on Eurocode 1, and for the concrete design code we are adopting the Eurocode EC2.

Our structural steel is now made to EN10025 (given a jacket by the SABS and called SANS50025). There is also EN1090, the specification governing the quality of structural steel fabrication and erection, and currently being adopted by ISO. When we review SANS2001-CS1 we will have to decide whether to adopt EN1090 or just use it as source material.

Considering this European ‘onslaught’, there are those who say we should waste no time in adopting Eurocode 3, but that is not so simple. In fact, the code being not so simple has everything to do with the matter. Take, for example, the fact that it consists of 20 parts, all a lot more complex than anything we have seen before; and that is not counting the four parts of Eurocode 4, which deal with composite construction.

Adopting, or at least adapting, somebody else’s code makes a lot of sense for a smaller country. Compiling and maintaining a code is a huge exercise that only the wealthiest countries can afford. There are quite a few codes to choose from, but if we negate the Japanese, Chinese, Russian and other codes on language grounds, we are actually left with two: Eurocode and North America. In 1993 we opted for the latter, entering the scene through Canada, which draws on the same body of knowledge and is characterised by the same approach as the Americans. There is no question as to the North Americans’ commitment to continued code development, or the quality and availability of design aids.

So we have a choice. And we have a dilemma. Do we stay with the Canadian code, or do we adopt EC3? And if we choose the latter, do we go for all the parts, seeing that we have just adopted the Australian code for cold-formed sections, a document which is totally in line with the North American standard?

The SABS committee dealing with standards for metal structures decided at its last meeting to form a study group to advise it on which way to go. This study group will double as a subcommittee of the SAISC Engineering Committee.

SteelFuture will be the ideal forum to show us the way out of the dilemma. Prof Richard Liew from Singapore, according to our information one of the few countries in the world seriously considering adopting EC3, will speak about their views and the research they did into the topic. Don McDonald from Australia can provide very useful input, as their history and circumstances, at least as far as structural steel is concerned, are similar to ours, except that they tend to lean even more heavily towards the Americans. The Canadians, represented by Ed Whalen, can inform us as to their plans for the future with respect to maintaining their standard, which is the model for ours. Prof Reidar Bjørhovde from the USA has made a study of codes all over the world and is an ideal person to advise us, admittedly with an intimate connection to the USA standard – he actually serves on the committee responsible for the document. And finally, Roger Pope can tell us about the British. Their experience and the availability of software, design aids, textbooks, etc, should clearly have an impact on how we ultimately decide.

One can argue about which of the modern codes that we use will, or will not, greatly influence the amount or distribution of material in the final structure. But what one cannot argue against is that the design code has a huge influence on the design process and on the knowledge the engineer has to acquire to do his/her work.

After SteelFuture we should be able to move towards making up our minds, that is if we don’t make them up then and there.
Statement from the SAICE Executive Board regarding recent ECSA-related articles in the SAICE magazine

July 2012 page 1: You can but you may not
September 2012 page 6: Comment from ECSA CEO

THE SAICE EXECUTIVE BOARD has taken note of the contents of the above-mentioned two articles, to which members and readers had responded in various manners. The issue was subsequently discussed at the 20 November meeting of the Board, and it was resolved to issue a formal statement to ensure that members are made aware of SAICE’s official standpoint.

In the complex world of the engineering profession, differences of opinion will always exist. Such debates should, however, lead to greater understanding of facts, and should not create perceptions that could be interpreted in the wrong way.

The official SAICE policy is that an Opinion, expressed in whatever manner, is the responsibility of the author. As such, “From the CEO’s desk” is classified as an Opinion and does not present the formal SAICE position or standpoint. A formal standpoint or position paper undergoes a rigorous process of evaluating and is mandated by the governing bodies of SAICE.

It is regretted that the July piece seems to have created the wrong impression due to several statements and observations expressed. It is therefore much appreciated that the ECSA CEO provided comment, which should play a valuable role in clearing up possible misunderstandings and incorrect perceptions. This approach is in line with the longstanding relationship and cooperation between SAICE and ECSA, which started about 50 years ago. At that stage the Institution played a leading role in establishing a statutory structure in the formation of the then SA Council of Professional Engineers (SACPE), which was meant to regulate the engineering profession of the time.

Subsequently SAICE has played a substantial role in providing nominations to SACPE, and to ECSA as its successor in 2000. Many prominent members of SAICE have and are serving in the ECSA structures, where their wisdom and expertise contribute towards ensuring that ECSAs mandate in terms of the health and safety of the public is pursued efficiently. The challenges are vast, but as engineering practitioners serving the South African community, we remain solution driven. It is therefore imperative that the finalisation of the policy in terms of which the reservation of engineering work (as required by the Act of 2000) will soon be accomplished. We owe it to the country and we owe it to our members who often have to work in an environment where professional registration is not always valued appropriately.

The SAICE Executive Board therefore confirms its unwavering support for the concept of professionalism, with ECSA as custodian and SAICE as partner and recognised Voluntary Association. It also confirms its endorsement of the ECSA Code of Conduct, underpinned by the SAICE Code of Ethics.

In conclusion the Executive Board invites members to help address the many issues facing the profession by contributing to and participating in the SAICE structures, as well as by making themselves available to be nominated to the ECSA structures.

The road-shows of the SAICE Young Members Panel and Allyson Lawless’s PDAP* seminars and workshops are continually building capacity by providing students and younger members with information about a number of professional issues, including the road to registration with ECSA. Members are encouraged to participate and inform themselves of these opportunities to develop their own capacity.

ECSA has also made numerous presentations about statutory registration and associated matters over the years, and members are encouraged to request ECSA to facilitate such presentations.

It is sincerely hoped that this statement from the SAICE Executive Board will assist members in finding closure on the two articles that necessitated this statement.

Dr Martin van Veelen
SAICE 2012 President
On behalf of the SAICE Executive Board
martin@iliso.com

Note

*PDAP: Professional Development and Projects, i.e. SAICE’s not-for-profit company, managed by Allyson Lawless and trading as Civils Masakheni
SABS launches series of dolomite standards for safer SA communities

STUDIES CONDUCTED by various departments within the engineering sector, in collaboration with the National Department of Public Works and the Association of Engineering Geologists, indicate that 25% of Gauteng is located on dolomite-based land.

The South African Bureau of Standards (SABS) launched six national standards (SANS) dealing broadly with the subject of land development on dolomite during the annual SABS Convention, held at the Indaba Hotel and Conference Centre on 11 October this year. The objective of the SANS 1936 series, with the general title Development on dolomite land, is to set requirements for the development of dolomite land in order to ensure that people live and work in an environment that is seen by society to be acceptably safe, where loss of assets is within tolerable limits, and where cost-effective and sustainable land usage is achieved.

The importance of these standards lies in the fact that between four and five million South Africans currently live on dolomite areas, which makes it impractical and impossible to move these people to other, safer areas. Twenty-five per cent of Gauteng – the commercial, mining and manufacturing centre of South Africa – is located on dolomite land. Development can therefore not be prohibited; the risk can only be mitigated.

“It was therefore deemed necessary to provide a standard solution which will provide guidelines through an integrated risk management approach,” explains Dr Sadhvir Bissoon, Standards Executive at the SABS.

SANS 633:2012 (Soil profiling and rotary percussion borehole logging on dolomite land in southern Africa for engineering purposes) serves to standardise the methods, procedures and nomenclature required to accurately define ground profiles for the purposes of infrastructure development and the repair of subsiding dolomite land.

SANS 634:2012 (Geotechnical investigations for township development) identifies the applicable requirements for a preliminary and two-phase detailed geotechnical site investigation on unoccupied, undeveloped parcels of land for settlement development purposes.

SANS 633 and SANS 634 are complementary to the SANS 1936 series, and all six standards represent a world first in terms of national standards for land development on dolomite.

“South Africa’s growing population and influx of workers from outlying areas require the vast development of land for residential and business purposes. SABS’s series of national standards (SANS) is a safety net for both the government and private sector when developing such land for South Africans,” concludes Bissoon.

Letter

THE EFFECT OF DENSIFICATION ON WATER AND SEWER NETWORKS

I found the article in the October 2012 edition of Civil Engineering (p 31) on the effect of densification very interesting. It would seem that the City of Cape Town’s commission only addressed the water and wastewater networks. A further and potentially more problematic service needs to be considered in a city’s quest for densification, and that is the stormwater network.

In my experience (over the last 40 years or so), many developments have down-played or completely ignored the issue of stormwater management. Returning to a project some time later to remedy the lack, or inadequacy, of that service can be very difficult indeed. The quest for densification (which has both a political and practical thrust) is fully understood, but the impact on the stormwater network can be extremely problematic.

By its very use, the word “densification” means that more is going to be packed into the same area, which generally implies that more roof areas will appear, more driveways will be hardened (or semi-hardened), all leading to an increased impermeability and an increase in run-off. To assume that any existing stormwater system has spare capacity is usually misplaced, as most are only designed to accommodate a 1/3 year or 1/10 year return period flood.

This leads to all sorts of design challenges. Because the area has been densified, there is less opportunity to provide attenuation ponds, leading to the requirement that ‘on site’ attenuation needs to be done. Normally this can only be achieved by rainwater tanks (not cheap – a sizeable one can easily cost as much as the higher figure quoted in the article), surface detention by way of intelligent use of parking areas (limited on residential sites) and, in drastic instances, underground attenuation tanks (where one would be lucky to get any change out of R10 000 in normal circumstances). The alternative, of course, is re-laying an up-sized stormwater network, which is usually prohibitive.

The eThekwini Municipality (Durban) has, for many years, been tackling this problem – sometimes successfully, but mostly under very difficult conditions, because even with the normal passage of time (as town planning regulations change), the impact on the stormwater network becomes more and more drastic. Durban’s stormwater strategy has addressed this problem for years and is being updated at present.

I would strongly urge all municipalities to bear the stormwater disposal issue in mind when considering densification of existing urban areas.

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QUALITY IS OUR FOUNDATION
ALLYSON LAWLESS, SAICE’s president in 2000, was made an International Fellow of the Royal Academy of Engineering, at a glittering function in Drapers Hall, London, on 5 November 2012.

The Royal Academy of Engineering (RAE) was founded by HRH the Duke of Edinburgh in 1976 to promote engineering and technological development, provide independent and impartial advice to government, work to secure the next generation of engineers, and provide a voice for Britain’s engineering community. The RAE scope has since extended to supporting engineering and technology development, and the development of the engineering profession in emerging nations.

Academy Fellows are drawn from the UK’s most eminent engineers and international specialists representing the best of engineering worldwide. Their role is to provide leadership and expertise to address the relationships between engineering, technology, and the quality of life. Academy activities are grounded in a vision that engineers have essential roles to play in addressing the world’s most pressing challenges, including climate change, global poverty and international security.

SAICE is very happy to report that Allyson was one of four international Fellows to be inducted on 5 November. She was honoured for her pioneering skills development work. Most SAICE readers are familiar with Allyson’s ground-breaking Numbers and Needs books and her mentoring programmes.

The other three Fellows who shared the honour with her on the day were:

- Shirley Anne Jackson, the first woman and the first African American to serve as chair of the U.S. Nuclear Regulatory Commission, and who is now a member of President Obama’s Council of Advisers on Science and Technology. She is currently the president of Rensselaer Polytechnic Institute – the institution in the USA that first offered a degree in civil engineering.

- Michel Virlogeux, the talented bridge designer responsible for the construction of the iconic Normandy Bridge, and the Millau Viaduct (the world’s longest bridge at this altitude – 343 metres). Dr Virlogeux has designed over 100 of his native France’s most beloved bridges, and has also designed bridges further afield, including the Vasco de Gama Bridge in Lisbon.

- Tony Gibbs, a pioneer in promoting safe architectural and engineering designs that can withstand natural hazards. He is particularly passionate about designing health care buildings in such a manner that they are not destroyed or made inoperable by earthquakes and hurricanes. He has enjoyed a distinguished career in the West Indies and beyond, and has been recognised by the United Nations for his contribution to disaster risk reduction in the Caribbean and throughout the Americas.

Allyson reports having had a wonderful day, which included attending a briefing at which Fellows showcased their pioneering work. She was particularly thrilled to have met Dr Stephen Myers, the Director of Accelerators and Technology in Geneva, the body which recently announced finding the Higgs boson, which explains why objects in our universe have mass.

She was also impressed with Suranga Chandratillake, an unassuming young man who has created the world’s premier video search company, Blinkx, valued at £500 million, before his 35th birthday! An exceptional engineer, his work is focused on the convergence of the web, television and online advertising. He has also designed a data mining solution to enhance searches – one of the internet’s greatest challenges.

According to Allyson the evening’s event represented a who’s who in engineering. She was inspired by the number of professors, engineers, scientists, Sirs and Lords who had made a significant contribution to engineering over the years, both in the UK and further afield. Her only regret was that the Senior Fellow of the RAE, Prince Philip, was not well enough to attend!

Congratulations Allyson!
Kevin Wall receives esteemed JD Roberts Award

At a sparkling gala event on 15 November, held at Emperor’s Palace in Johannesburg, SAICE’s magazine scooped its fourth PiCA Award in six years for publishing excellence in the category “Construction, Engineering and Related Industries” in the Business-to-Business publication section. We are very grateful for this award which, in the magazine publishing world, is akin to an Oscar. The judges commented as follows:

“Civil Engineering is an informative magazine for engineers by engineers. It has a clear understanding of its target market and speaks authoritatively to its readers. The redesign of the magazine has paid off, resulting in an appealing, slightly conservative new look and feel. A perfect offering for the magazine’s mostly male readers …”

The SA Publication Forum serves the extensive corporate magazine sector. We entered their competition for the second time this year and in September received the following two awards:

Certificate of Merit for Excellence in Communication
The following are a few of the comments from the judges:

“This is a quality magazine with integrity…… Current and fearless…… An admirable achievement given its frequency and number of staff.”

First Runner-up Editor of the Year
The judges commented as follows:

“Verelene is the worthy runner-up in the SA Publication Forum’s prestigious Editor of the Year competition…… Runner-up status is no small achievement. The judges were again impressed with Civil Engineering’s high standard and the magnitude of Verelene’s task. It is obvious that this editor works hard. The highly technical content makes it a difficult publication to produce and Verelene succeeds in communicating the often difficult subjects clearly and accessibly. Coordinating a regular publication of this magnitude is commendable. Well done.”

IN THE SPIRIT of recognising talent and research at the CSIR, the coveted 2012 JD Roberts Award recently went to CSIR Built Environment’s Dr Kevin Wall, for his leading role in developing innovative solutions for alternative housing, infrastructure asset management and the maintenance of sanitation systems. The celebratory event was held at the CSIR Conference Centre on 25 September 2012.

A registered professional engineer and town planner, Dr Wall’s life-long career in urban and regional engineering and planning and city management afforded him substantive experience in civil engineering and town planning in low-income urban areas and forward planning for development at metropolitan and regional scale.

The recognition for his expertise included the development of a franchising model for the routine maintenance of municipal infrastructure. The model has significant job creation potential for small entrepreneurs and workers, and can assist municipalities in meeting service delivery targets. The franchising model has been implemented in 400 schools in the Eastern Cape, with another 1 100 to follow. In addition, 600 households have also benefited, with another 2 400 to follow.

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

Heartiest congratulations to SAICE’s president of 2001!
### SAICE Training Calendar 2013

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<td>Greg Parrott</td>
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<td>Prof Zvi Borowitsch</td>
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Training 2013: suggested supporting books available from the SAICE bookshop

**COASTAL ENGINEERING**
- Marine Outfall Construction – background, techniques and case studies, Robert Grace 2009
  ISBN 9780784409848 R1 200

**RAILWAY ENGINEERING**
- Bridge Engineering – A Global Perspective, LF Troyano 2003
  ISBN 9780727732156 R1 650
- A Short Course in Geology for Civil Engineers, M Matthews, N Simmons, B Menzies ISBN 978072773504 R1 100
- Geosynthetics and their applications, SK Shukla 2003 ISBN 9780727731173 R2 200

**TRANSPORTATION ENGINEERING**

**STRUCTURAL ENGINEERING**
- Concrete Industrial Floors on the Ground, Cement & Concrete Institute R114
- Modern Structural Analysis – Modelling Process and Guidance, I Macleod 2005
  ISBN 9780727732798 R1 150

**BUSINESS / MANAGEMENT**
- FIDC Guidelines for Business Integrity Management in the Consulting Industry, Test Edition 2001 R150
  ISBN 9780727732583 R900
- Risk Analysis and Management for Projects (RAMP), 2nd Edition 2005
  ISBN 9780727733900 R660

**DRAINAGE / WATER ENGINEERING**

**CONCRETE**
- Reinforced Concrete Design to SANS 10100, Greg Parrott R320
  ISBN 9780727741899 R790
- Site Management for Engineers, TM Holroyd 1999 ISBN 9780727734808 R1 300
- Concrete Bridge Strengthening and Repair, Ian Kennedy Reid
  ISBN 9780727732204 R420
- Concrete Industrial Floors on the Ground, Cement & Concrete Institute
  R114
  ISBN 9780727732583 R900

For more information please contact Angelene Aylward
(angelene@saice.org.za)
THE CURRENT process of registration with the Engineering Council of South Africa (ECSA) was implemented in January 1998. The ECSA "Discipline-Specific Guidelines for Civil Engineering" of February 2003, Clause 6.5, indicates that two essays will have to be written by candidates:

- The first essay will be on one of two technical subjects set by the reviewers in the context of the training report and the interview.
- The second essay will be on one of two topics selected by the interviewers from a list published in advance by SAICE. Guidance notes for the assessment of essays are set out in the Guidelines for Professional Registration of Civil Engineers, available from the Institution.

The topics for the second essay for 2012 are listed below, and have been approved by the Professional Advisory Committee on Civil Engineering at ECSA:

1. Discuss the most significant influences, attitudes and strategic issues relevant to the total project cycle.
2. In projects for developing countries emphasis is often placed on the need for transfer of technology. How can this best be achieved in practice?
3. Discuss the importance of environmental regulations on the design, documentation and construction of civil engineering projects. Use your own experience to illustrate your argument.
4. Although failures may be a disaster for the individuals concerned, many have led to advances in theory, design and construction methods. Discuss how failures should be dealt with so as to ensure the maximum benefit to society and the engineering community.
5. Discuss the opportunities and threats inherent in industrial and infrastructure projects which impact on local communities and the role civil engineers can play in delivering value to society through their involvement in such projects. Use your own experience where appropriate.
6. Discuss the difference between ‘Quality Control’ and ‘Quality Assurance’. Discuss the requirements for quality management by clients, designers and contractors, and their respective contributions to the success of a project.
7. Discuss the importance of environmental regulations on the design, documentation and construction of civil engineering projects. Use your own experience to illustrate your argument.
8. Discuss the principle of whole life asset management with specific respect to municipal infrastructure, using a single service to illustrate your argument.
9. Risk is inherent in most civil engineering work. Discuss the ways in which such risks can affect the employer and the contractor, and how they can influence the form of contract and the contract price.
10. "The estimation of costs of schemes and their budgetary control is one of the key functions of the engineer." Discuss how engineers should be trained to fulfil this function in design and construction.
11. Describe how you have implemented health and safety legislation on the projects you have worked on, and detail what opportunities you think there are for improving health and safety performance.
12. Describe the authority of the Engineer to delegate decisions to the Engineer’s Representative under the General Conditions of Contract (GCC) for construction works (the 2004 and 2010 versions have reference). In what circumstances could an Engineer vary the level of delegation during the construction period?
13. Discuss the role that the civil engineering profession has to play with respect to poverty alleviation.
14. Discuss how the principle of whole life asset management with specific respect to municipal infrastructure, using a single service to illustrate your argument.
15. Discuss the impact of the National Environmental Management Act and its regulations have on the planning, design and construction of a civil engineering project.
16. Discuss how the role that the civil engineering profession has to play with respect to poverty alleviation.
17. Why should a Registered Professional Engineer not undertake work of a nature for which their education, training and experience have not rendered them competent to perform? What in your view ought to be the punishment for contravening this competency prescription in the Code of Conduct?
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