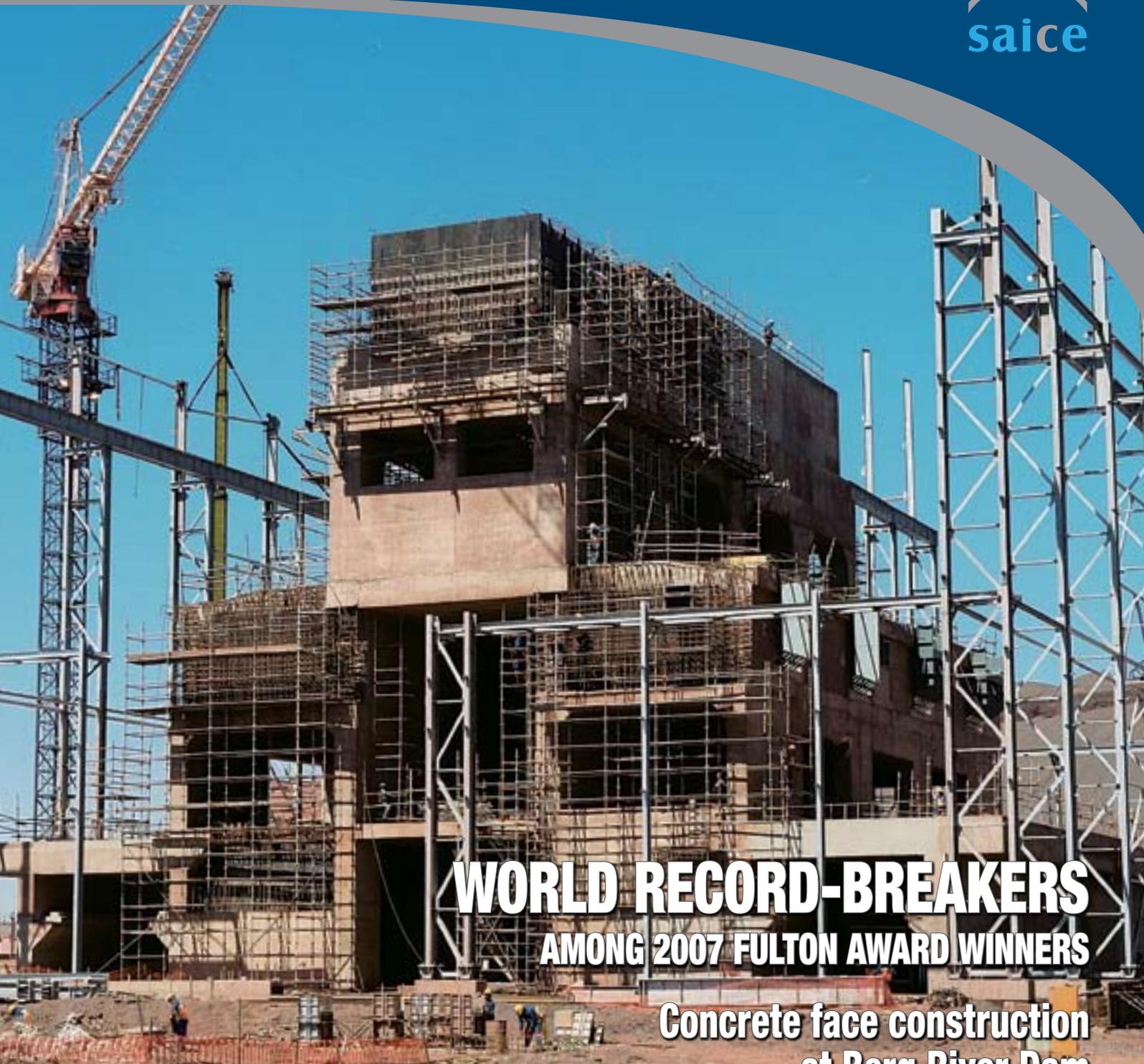


Civil Engineering

Siviele Ingenieurswese

July 2007 Vol 15 No 7



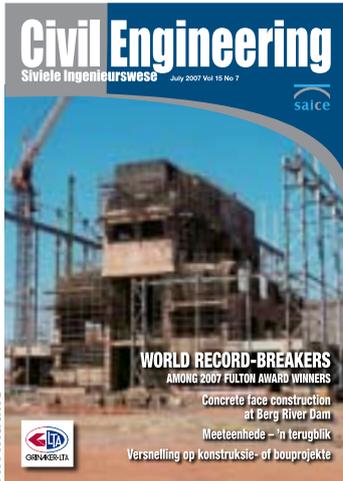
WORLD RECORD-BREAKERS
AMONG 2007 FULTON AWARD WINNERS

Concrete face construction
at Berg River Dam

Meeteenhede – 'n terugblik

Versnelling op konstruksie- of bouprojekte





Afrikaans

ON THE COVER

The tertiary crusher under construction at the Sishen Iron Ore Company's R344-million expansion project near Kathu in the Northern Cape, with the civil works undertaken by Grinaker-LTA Civil Engineering and Murray & Roberts Construction



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PUBLISHED BY SAICE/SAISI Block 19, Thornhill Office Park, Bekker Street, Vorna Valley, Midrand Private Bag X200, Halfway House, 1685 Tel 011-805-5947/48, Fax 011-805-5971 http://www.civils.org.za civilinfo@saice.org.za

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ANNUAL SUBSCRIPTION RATE SA R550,00 (VAT included), International US\$115,00

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DESIGN AND REPRODUCTION Marketing Support Services, Menlo Park, Pretoria

PRINTING Ultra Litho, Johannesburg

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ISSN 1021-2000



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World record-breakers

among 2007 Fulton Award winners

THE TALLEST MINING HEADGEAR in the world, a 515 m long tunnel under the sea, two innovative pedestrian bridges (one equal to the longest in the world), an upgraded soccer stadium stand, and a 'world first' in railway sleepers are among the impressive concrete construction projects and concepts that have won 2007 Fulton Awards.

The prestigious Fulton Awards are presented every two years by the Concrete Society of Southern Africa (CSSA) for excellence in the use of concrete in five categories: Civil Engineering Projects, Building Projects, Design Aspects, Construction Techniques, and Aesthetic Appeal. This year's awards – which included a Fulton Award in a special category – were made on 9 June at a gala banquet at the Champagne Sports resort in the Drakensberg. The Cement & Concrete Institute (C&CI) is the anchor sponsor of the awards.

CIVIL ENGINEERING PROJECTS

The Fulton Award in the Civil Engineering Projects category went to Impala Platinum Mine's Number 16 Shaft – a project that called for a towering headgear, the tallest in the world. The judges found that the quality of concrete that the construction team, headed by Murray & Roberts Construction, achieved was outstanding. 'This was even more emphasised by the scale of the project. Innovative shuttering methods were used to construct 6 m deep beams, 92 m above ground level, to house the Koepe winders. Due to the overall height of the structure – and the volume of concrete required for the continuous slide – all the concrete had to be pumped to a height of 108 m, which makes it the tallest headgear in the world with an overall height from the foundation of 132 m. Construction was further complicated by the fact that the mine shaft was being sunk at the same time as construction took place,' the judges added in their citation. Chryso SA, suppliers of the concrete admixtures for the project, submitted this entry.

BUILDING PROJECTS

Athlone Soccer Stadium's East Stand won the Fulton Award in the Building Projects



category. 'The quality of the concrete finishes achieved was very high. Even more impressive is that the contractor sourced all his labour from the vicinity – a notorious area for drugs and gangsters in Cape Town,' the judges commented. They were further impressed by the fact that the contractor was prepared to rebuild sections of the structure to ensure that his own quality standards were met and, at the same time, trained the local community. This was the first building contract of this scale that the contractors and Fulton entrants, Vusela Construction, had undertaken.

DESIGN ASPECTS

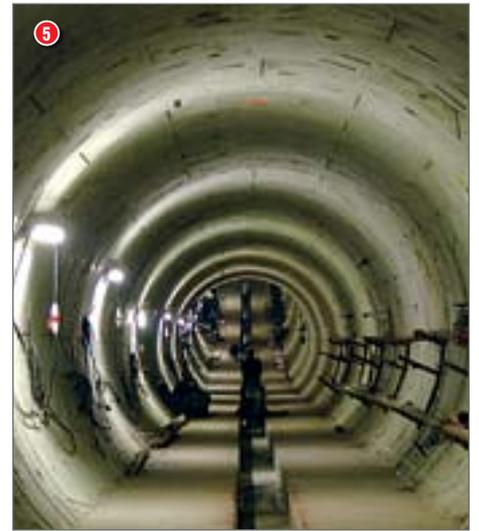
The Fulton Award for Design Aspects went to the Mkomaas Pedestrian Bridge,

► **Figure 1** Mkomaas River Pedestrian Bridge

Figure 2 Impala Platinum Shaft No 16

Figure 3 Bosmansdam Road Pedestrian Bridge

submitted by consulting engineers Jeffares & Green. The judges commented: 'Located in a remote area of KwaZulu-Natal, the context required a solution which was aesthetically pleasing, robust, economical and constructed with unskilled labour. The location of the project and nature of the river mitigated against a traditional solution. This project was not only a bridge between two points, it united two communities. The bridge equals the longest of its type in the world and the chosen construction method can be used for similar projects in the future.'



► **Figure 4** Spoonet Universal/Infrabolt concrete sleepers
Figure 5 Durban Harbour Services Tunnel
Figure 6 Athlone Soccer Stadium

AESTHETIC APPEAL

Another pedestrian structure designed and submitted by Jeffares & Green, Bosmansdam Road Pedestrian Bridge, won the Aesthetic Appeal category award. The judges said the combination of functionality and aesthetics was complemented

by high quality off-shutter concrete and a design that had to take the concerns of the neighbours into account. 'The confined space available to the team made it challenging to achieve an appropriate structure. It is felt that this could not have been achieved with any other building material than concrete. The versatility of concrete was demonstrated to its maximum through the use of form and structure. The form of the structure was unusual and in context it

has achieved the aims of the whole professional team.'

CONSTRUCTION TECHNIQUES

The 2007 Fulton Award for Construction Techniques went to the 515 m long Durban Harbour Services Tunnel, 35 m under the ocean between Durban Point and the Bluff – an entry submitted by consulting engineers Goba (Pty) Ltd. The judges were extremely impressed



with the quality of the concrete and the intricate nature of the construction. 'Just under 2 600 precast concrete segments were cast for the tunnel lining with no quality variations. The fact that none of the panels were grouted, and no leaks are present, is a testament to the quality of the construction. The construction of the tunnel required certain sections to be cast under water. Special mix designs and good relationships between the contractor, pro-

fessional team and ready mixed concrete supplier ensured that this phase was successfully completed,' the citation reads.

SPECIAL CATEGORY

Finally, a Fulton Award was this year also presented in the Special Category. The winner was the Spoornet Universal/Infrabolt Concrete Sleeper Project featuring a new design and construction methodology which makes it possible for concrete sleepers to be

cut to length and drilled to any size or configuration. The judges' citation states: 'Although concrete sleepers have been available for many years, it has not been possible to use them for turnouts or more complex track configurations. These sleepers have overcome these constraints and offer a more economical and durable alternative to the wooden version. To further exhibit their versatility, these sleepers have been used in lengths of up to 6 m; and the design is gaining world interest.'

COMMENDATIONS

Commendations in the various categories went to Maguga Dam regulating weir and power station foundation and superstructure (Civil Engineering), Walter Sisulu Square of Dedication (Building), Mondi secondary effluent treatment plant (Design), Red Location Museum of the People's Struggle and L'Ormarins exposed aggregate roads (Aesthetics), and Impala Platinum No 16 Shaft and Cradock to Tarka Bridge road rehabilitation (Construction Techniques).

The judges for the Fulton Awards 2007 were Hassan Asmal, president of the SA Institute of Architects; Neil Macleod, president of the SA Institution of Civil Engineering; and Dave Miles, president of the Concrete Society of Southern Africa. □



Text Sarel van der Walt
Grinaker-LTA
Berg River Project



Concrete face construction at Berg River Dam

THE BERG WATER PROJECT is being implemented and funded by TCTA on behalf of the Department of Water Affairs and Forestry. The project will augment the yield of the Western Cape Water System by 81 million cubic metres per year at a forecasted cost of R1,6 billion.

The Berg River Dam with a gross storage capacity of 130 million cubic metres is the main component of the project. Construction of the dam by the Berg River Project JV consisting of Grinaker-LTA, Group Five, WBHO and Western Cape Empowerment Contractors commenced on 1 June 2004. Construction is now in the completion phases with impoundment imminent, in time for the 2007 rainy season in the Western Cape.

The dam is a concrete faced rock fill dam (CFRFD) and is 65 m high with a 980 m crest length. One of the main advantages of this type of dam is that the consolidation and curtain grouting is done from the upstream plinth and not under the main fill. This has major programme advantages.

Whereas the construction of the whole dam may be considered a feat of civil engineering, the focus of this article is on the reinforced concrete upstream face.

The construction of the upstream face slab commenced in May 2006 and was completed in May 2007.

The concrete face was constructed in 63 panels, each 15 m wide and the longest 105 m long. Some 27 000 m³ of concrete was poured to construct the face slab. Two identical slip forms complete with a concrete placing platform as well as a finishing platform were manufactured. One was used to construct the leader slabs, while the remaining slide was used mainly to construct the infill panels. A transverse concrete feed conveyor was shared between the two slip form platforms. The slip forms were moved up the face using 15T hydraulic jacks and steel jacking teeth. The jacking teeth were connected to IPE120 beams. The system was designed for a production rate of 3 m per hour.

One of the main challenges was safety, the main risks being people or material falling down the face. Access steps were installed on the joints for access by the workforce. Mostly ropes were used to lower items down the face. The larger items were transported using the winches and the relevant trolleys. Risk assessments were done for all the activities on the face and the assessments discussed with employees at regular intervals.

Risk assessments were done for all the activities on the face and the assessments discussed with employees at regular intervals

► *Left: Face slab sliding operation*

SURVEY AND SETTING OUT

The area of the upstream face that had to be surveyed was 65 000 m². A 3 m by 3 m grid was installed on the upstream face of the dam. The survey was used to ensure that the minimum specified slab thickness was achieved at all times.

MORTAR PAD CONSTRUCTION AND COPPER WATER STOP INSTALLATION

Mortar pads, 400 mm wide, were constructed to provide an even bedding surface for the copper water stops that were installed on the joints between the panels. The mortar pad thickness, in conjunction with the surface survey, controlled the resulting slab thickness.

The w-shaped copper water stop was installed on the joints between all the panels using a copper-extruding machine. Before the copper installation, a double layer of five-ply malthoid was lowered on top of the mortar pad. These layers serve as further protection to the copper water stop to prevent piercing by sharp objects in the mortar pad, especially when the slip form travels on the side forms during concreting. The copper-extruding machine was positioned at the top of the embankment from where the copper was extruded.

Reinforcing installation

Y20 reinforcing mats, 14,8 m by 7 m, were prefixed on the crest of the wall. The mats were manufactured in a jig to ensure accuracy. They were transported down to their final position using the rebar trolley operated by an 8 t winch. The mats were supported in their final position by pins, at a 3 m grid, driven into the substrate and vertical bars welded to these pins. All the reinforcing supports, the pins as well as the welding of the vertical bars, were done using rope access.

SIDE FORM AND RAIL INSTALLATION

Leader panels

The slab design is such that it decreases in thickness with an increase in elevation, the thickest part being 440 mm at the bottom of the dam decreasing to 320 mm at the crest. The 2 m sections of side forms were designed to follow the slab thickness, in essence this means that the first section at the bottom of the longest panel will be 440 mm high with an even decrease in height to 320 mm for the last section of 2 m side form at the top. The side forms were plumbed and clamped to the reinforcing of the adjacent panel. The side forms were built from the bottom. The IPE120 rails were installed from the top, first installing the anchorage then the rails. The rails were manufactured in 6 m sections with fish plates and three M16 high tensile bolts as connection between the rails. Great care and proper supervision had to be exercised with the connection of the rails, bearing in mind that the jacks propelling the slip form will jam on any significant irregularity in the rails or on the joints between the rails. The rails were kept in position on top of the side form with a T and wedge system.

Infill panels

When casting the infill panels, the side forms are no longer required. The rails are installed on the existing concrete. In this case the rails are fixed to the concrete by coach screws with fish

plates – similar system to that used by the Railways to fix the rail to the sleeper.

CONCRETE CASTING

Two methods of concrete placing were used, the first being three lines of 250 mm uPVC pipes to transport the concrete from the crest to the slip form. This method was used on the shorter panels. The second comprised a single line of half-round chutes installed outside the panel to transport the concrete to the discharge hopper of the conveyor platform.

The concrete team comprising four concrete hands vibrating the concrete in front of the slip form, three concrete hands floating the final product to the required finish, one slip form operator, one conveyor operator (if being used), four general labour assisting in the disassembly of the pipes or chutes depending on the system used, a section leader supervising the labour and a foreman supervising all the activities and enforcing safe working procedures. The fresh concrete was covered by a drag sheet extending 10 m behind the slip form. This serves as protection against the elements such as rain scouring the surface of the concrete or direct sunlight drying the surface of the concrete.

Curing of the concrete commenced as soon as the placed concrete had achieved initial set. Continuous water curing was used by connecting a 15 m perforated waterline to the slip form, following it up the wall at a distance of about 20 m behind the platform. Another method used was two pivoting sprayers following the platform at the same distance. Once the panel was finished, a

The fresh concrete was covered by a drag sheet extending 10 m behind the slip form. This serves as protection against the elements such as rain scouring the surface of the concrete or direct sunlight drying the surface of the concrete

permanent perforated waterline was installed at the top to cure the slab for the remainder of the specified 21 days.

CHALLENGES, ADVANTAGES AND DISADVANTAGES

One of the major disadvantages of this system is that it is extremely sensitive to the slump of the concrete being used. A concrete slump that is too low would cause delays due to a higher intensity of required vibration. A slump that is too high would cause delays due to sagging and slumping of the skin which can only be countered by drastically slowing the upwards progress.

Panels had to be constructed in one continuous operation, therefore requiring detailed planning regarding concrete supply, equipment performance, weather forecasts, access requirements, etc. The Cape winter and high wind velocities created big challenges and sometimes frustration.

A major advantage of using the conveyor platform is the ease with which concrete is distributed over the 15 m wide panel. The conveyor makes it possible to pour the concrete where it is needed, thereby increasing the pace at which the slip form progresses up the face. The pipes provide limited variation in placing position.

Safe access to the work area created a big challenge. Works were executed over a span of 12 slabs at any given time. Access ropes had to be inspected on a regular basis to ensure the safety of all involved. The access steps had to be moved on a regular basis to ensure quick and efficient access to the workplace. The steps were inspected on a weekly basis and signed off by the responsible person on site.

Safety on the face was taken extremely seriously. A lot of time and effort went into the risk assessments and the toolbox talks that were held every morning to stress the risks involved and to keep everybody involved in the face construction focused and alert at all times.

The construction of the concrete face of the Berg River Dam played a critical role in the dam's integrity and posted challenges to the construction team. Challenges such as these make being a civil engineer on a construction site an exiting and gratifying experience. □

► Bottom: Dam concrete face nearing completion





Water provision in rural KwaZulu-Natal

AS AN ONGOING DRIVE towards achieving the commitments set in 2000 by the Heads of State at the United Nations – to halve the number of people lacking safe water by 2015 – one of the most widely consulted policy programmes in the world, the Reconstruction and Development Programme (RDP), was implemented by the South African government.

Government's intention was clear from the outset – to provide to the poorest of the poor in rural areas.

uMzinyathi District Municipality (situated in northern KwaZulu-Natal), through two of its local municipalities, Umvoti and Msinga, identified one such an area. Ilifa Africa Engineers (known at the time as VGC Consulting Engineers) were commissioned in 2004 to conduct a preliminary survey of the area and to prepare a technical report for submission to the Department of Water Affairs and Forestry (DWAf). Application for funding through a municipal infrastructure grant (MIG) was done through a detailed business plan.

AIMS AND OBJECTIVES

The area that was identified is approximately 230 km² in size. At that stage, water was supplied primarily from streams, irrigation canals, isolated boreholes and the Mooi River, which runs through the southern section of the supply area. The sources were shared with domestic animals

(cattle and goats), which presented a huge health risk.

The aim was to provide the households with a clean, safe water supply of 20–30 litres per capita per day. This was to be achieved by constructing standpipes within 200 m of people's homes (the RDP level of service).

PROJECT DESCRIPTION

The design of the system included a number of facilities.

Water treatment plant

The supply area is situated approximately 25 km north of Greytown, which meant that there was no source of treated water to supply the communities.

An irrigation canal operated by the Mudén Irrigation Board was identified as the most suitable source because a section of the canal runs near the small village of Mudén. A privately owned section of property adjacent to the canal was ideally situated for the construction of a water treatment plant. The property was subsequently bought and utilised for this purpose.

The initial capacity of the plant is 3 Mℓ per day (20-hour operating cycle). The design of the plant allowed for a doubling in the capacity, should future demand necessitate it.

The raw water is gravity fed to the plant with a turbidity ranging between 35 and 400 and an average of about 40 NTU. The settled turbidity varies between 1,0 and 2,0 and the filtered turbidity between 0,03 and

0,6 with an average of about 0,4 NTU.

The compact design of the plant enables effective operation by a minimum of staff. This contributes to minimising operating expenses.

Reservoirs

Twenty five reservoirs are to be built, with 15 already completed. Their capacities range between 100 Kℓ and 450 Kℓ each. Reinforced concrete structures were chosen with a view to low maintenance costs.

Bulk lines and reticulation networks

A total of 80 km of bulk supply lines and 118 km of reticulation lines will have been constructed on completion of the total supply area.

A variety of materials were used in the construction of the pipe lines. The bulk supply lines were either uPVC or mPVC pipes with classes ranging between class 9 and class 16. Bulk lines ranged between 110 mm and 250 mm diameter pipes. The difference in elevation in certain areas necessitated the use of steel pipes. Clambon pipes as well as ductile iron pipes were used. A number of river and donga crossings required the use of flanged galvanised steel pipes. uPVC, mPVC and HDPE pipes were utilised for the reticulation networks. Clambon and galvanised steel pipes are protected with PVC rock wrap.

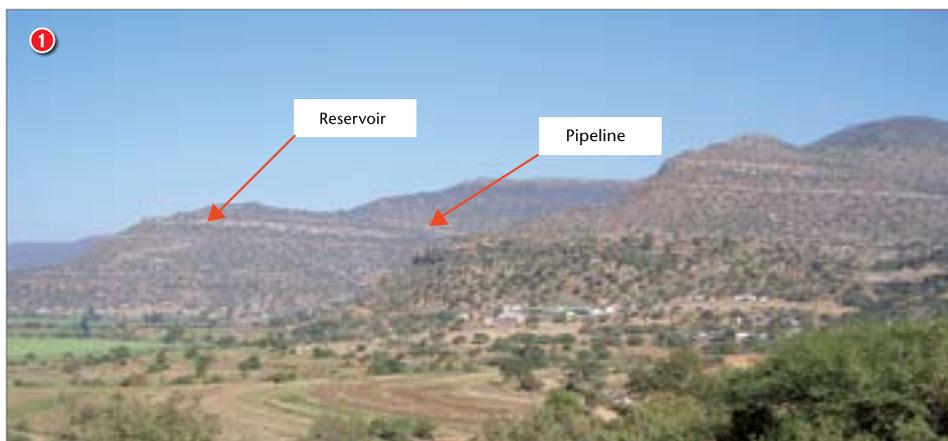
PROBLEMS ENCOUNTERED AND INNOVATIONS

Design challenges

Development within the supply area is scattered without any fixed patterns, which made the provision of a homogeneous supply system in accordance with conventional practices difficult. In addition, the supply system requires optimal design for the low demands in accordance with RDP standards. The volumes are small, the distances long, the elevation variations extreme (± 400 – 450 m) and infrastructure positions remote.

Supply zones of ± 90 m were established. Reservoir draw-off was further provided for at various levels to protect downstream users. This was achieved by

► **Figure 1** Site of the project



dividing reservoirs into distribution and transfer volumes. Intervals of 60 m would have been preferred, but this wasn't practical because of the topography and long supply lines.

The distribution network was designed to provide for the systematic filling of the facilities from the water treatment works outwards simultaneously in all directions or in any specific direction. The average distribution flows are small and the reticulation pipes had been designed for simultaneous draw-off. Larger-diameter main distribution pipes with small-diameter draw-off were provided to ensure even distribution.

Owing to the distance and quality of access roads to the reservoirs, a telemetric monitoring system will form an integral part of the management strategy. The water treatment plant functions as the nerve centre from where the whole scheme is being operated and monitored.

Water wastage was also a concern. The widget type stand pipe is ideally suited to prevent water wastage. uThukela Water (Pty) Ltd, the water services provider, indicated that in their experience, the design is prone to blockages and timely maintenance of the standpipes in remote

areas presented a problem. It was decided to construct standpipes using a 20 mm tap with a 10 ℓ/min flow restrictor. The design is tamper proof and also provides a very reliable service.

Positions of standpipes were originally positioned by means of orthographic aerial photographs. Final positions were approved by the community before construction.

Construction challenges

The extreme variations in elevations coupled with boulder strewn areas placed a tremendous strain on construction equipment and operator skills. Daily excavation progress, by means of 20 t excavators, was regularly as little as 60 m.

Dense bushveld required that wider than normal areas had to be cleared in order to facilitate the transportation of pipes to the excavated trenches. Because of the long distances involved this could not be achieved by means of hand labour, which would have been preferable in order to minimise the effect construction activities had on vegetation.

Where blasting was required on steep sections, excavation equipment had to be used to tow the compressors to the

required areas.

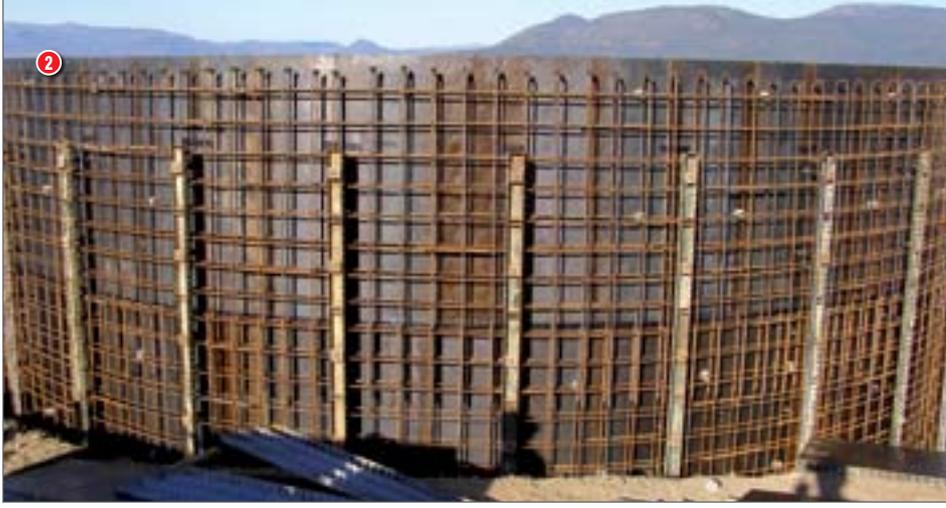
Abnormal rainfall in the area played havoc in destroying steep sections where storm water protection measures were not yet completed.

Delivery of bulk materials to certain reservoir sites was impossible. TLBs had to be used to cart aggregate and water to these sites.

Owing to the large number of communities involved in the supply area, the sourcing of local labour also presented its fair share of challenges. The requirement of the project steering committee was that labourers were to be sourced from within the communities where actual construction activities were taking place. The social consultant and the project liaison officer played a vital role in coordinating the labour source when the construction activities crossed community boundaries.

PROJECT STATUS

The first phase of the project, which included the water treatment plant, 34 km of bulk supply lines, 25 km of reticulation lines and five reservoirs, is already in operation. The second phase is due for completion by September 2007, with the last phase due for commencement in the



► **Figure 2** Reinforcing ready for inspection on a 250 Kℓ reservoir
 ► **Figure 3** Abnormal rainfall caused havoc

2008/09 financial year. The final value of the project is estimated at R75 million.

CONCLUSION

This project is an example of government's determination, through its various organs, to supply people with basic services in even the remotest and most difficult-to-work areas. As a consultant one does not always experience the effect such a project have on a community. One late afternoon I went with the site foreman to an area where we went past a standpipe built in the first phase. There were about ten children with water

containers, each waiting their turn to fill their containers. During construction in the first phase I saw school children drinking water from an irrigation canal in the same spot I had previously seen goats and cattle drinking water. To see these children, laughing and waiving to us, and filling containers with good-quality drinking water, and comparing this picture with the one of the same children drinking water from an irrigation canal a year before, brought a feeling of utter content in the knowledge that we, as a profession, are an integral part of improving the lives of all South Africans.

This specific project will eventually benefit approximately 80 000 people or 11 000 households. □



PROJECT TEAM

- **Consulting and Design Engineers** Ilifa Africa Engineers (Pty) Ltd
- **Water treatment plant** WPCP / Allpass Engineers JV
- **Phase 1: Reservoirs, bulk lines and reticulation networks** WK Construction Natal (Pty) Ltd
- **Phase 1: Subcontractor for reservoirs** T G Corver & Sons
- **Phase 2: Reservoirs** WK Construction South Africa (Pty) Ltd
- **Phase 2: Subcontractor for reservoirs** T G Corver & Sons
- **Phase 2: Bulk supply lines and reticulation networks** Hidrotech Infra (Pty) Ltd

Massive concrete

requirements of new Med harbour

FORTY CONCRETE CAISSONS, each with a mass of nearly 8 000 t, form the main sea wall of the multi-million-rand new Tangier Med Port which is destined to become the biggest harbour on the African continent.

Situated in the Strait of Gibraltar across the ocean from Algeiras in Spain, the first container terminal of Tangier Med is scheduled for opening this year, with the second expected to launch operations in mid-2008. The first terminal covers 40 ha and has an 800 linear metres quay; the second covers 39 ha with an 812 linear metres quay.

The new port, which replaces the old harbour 35 km away in downtown Tangier, is

a mere 15 km across the sea from the Spanish coastline. It is expected to become a key port and hub in the Mediterranean region for the shipment of containers between America and Europe and between the Middle East and Asia. The multi-purpose port has five terminals reserved for containers, cereals, passenger services, the import and export of merchandise, and oil shipment.

The construction of the Tangier deep-water port calls for the erection of a 964 m long sloped dyke with embankments and Accropodes (interlocking concrete blocks similar to the South African-designed dolosse) in the hollow part of the dyke, a series of concrete caissons and a 1 612 linear metre long quay.

The major project in building the new port is the construction of the sea wall that protects the harbour from the open sea. The French firm Bouygues TP (in association with Saipem and Bymaro) won the contract by proposing the use of caissons and Accropodes because the resultant caisson footprint would be substantially smaller than that of an embankment. The space gained made it possible to increase the dock area by 18 ha and brings the total land reclaimed from the sea to 142 ha. The Bouygues tender furthermore reduced the materials required for filling to 7 million tonnes, compared

to 21 million tonnes that would have been required without the caissons.

The sea wall was built in two stages:

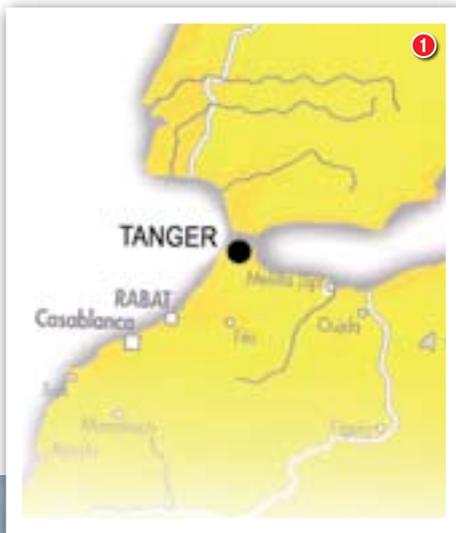
- The first section was built in shallow water, with an embankment reinforced by 7 500 Accropode concrete units
 - The second section used 40 prefabricated reinforced concrete caissons for areas where the water is over 20 m deep
- The 964 m long, 37 m high sloped dyke was installed to form the first part of the main sea wall. After building up the mound and positioning the protective boulders, 7 500 Accropode concrete units in three sizes (from 4 m³ to 16 m³) were installed by divers for additional protection. The heaviest of the Accropodes weighed 40 t, the lightest 10 t.

A total of 72 000 m³ of concrete was required for the production of the Accropodes. Prefabricated on site at an average of 30 per day, the blocks were stored on site before being positioned on the sea wall. Despite their lack of steel reinforcement, the Accropode units are expected to withstand sulphate and chloride attack from the seawater because of the special concrete mix formulated for their production. The inclusion of a special super-plasticiser, Chrysofluid Optima 175, adds vital concrete cohesion, water reduction and extended workability time to the production of the Accropodes.

A total of 115 800 m³ of concrete is required for the production of the 40 caissons. Each caisson weighs 7 900 t, has a surface area equivalent to two tennis courts, and the height of a ten-storey building (length 28 m, width 28 m, and height 35 m).

The caissons are made in three stages, at a rate of one per week. The initial stage takes place on land on a special pre-fabrication site where the first 9 m are fabricated. After two days maturing, the caisson is then transferred to water and the next 15 m are cast in the docks. Finally, the caisson is towed to its final resting place at the end of the dyke and filled with sand to resist swells and currents between tides. Once positioned in the ocean, the last 11 m are fabricated. The top walls have an 'open-work' design to cope with the impact of ocean swells.

The specifications for the caisson construction provides for:



- An operating life of 100 years
- Sea-spray resistance, as well as resistance to salt deposits
- CPJ55R cement with fly ash and silica fumes
- Concrete workability retention of 90 minutes
- 8 cm concrete coverage of the reinforcement steel

It is also essential that the concrete is crack-free.

The Bouygues research laboratory in France took nearly a year to develop the

concrete formula which met specifications such as a water/cement ratio of 0,33; the development of the special cement in collaboration with Lafarge; and the use of four aggregate sizes to obtain the correct particle size distribution in the concrete.

The high-density concrete – which almost has a self-levelling consistency – has to meet the following criteria:

- Slump – 220 plus/minus 20 mm
- Workable time – 1,5 hours
- Compressive strength at 28 days – 90 MPa

- Compressive strength at 90 days – 130 MPa

The use of Chrysofluid Optima 175 super-plasticiser is guaranteeing the necessary 1,5 hours workability retention to ensure good cohesion between each layer of concrete (the sliding form advances at a rate of 20 cm per hour) and also provides sufficient rigidity to enable the form to be lifted after four hours. Chryso is also supplying the admixture, Chrysotard CHR, for the Tangier Med harbour project. Chrysotard CHR is a setting retarder that slows down the hydration of cement.

The old Tangier harbour will in future be used for tourism and other non-export applications. □



► **Figure 1** Tangier Med Port location

Figure 2 Tangier caissons

Figure 3 Dolosse at the new development

PROFESSIONAL TEAM

- **Owners and project managers** Agence Spéciale Tanger-Méditerranée (ASTM)
- **Contractors** SRPTM, comprising Bouygues Travaux Public, Bouygues Morocco, and Saipem
- **Concrete suppliers** SRPTM

Turning challenges into opportunities for innovation

Civil engineering contractors are nothing if not resourceful and each project brings new challenges that test their expertise.

The civil works required at the Sishen Expansion Project (SEP), near Kathu in the Northern Cape, were no exception and complex, massive structures led joint venture partners Grinaker-LTA Civil Engineering and Murray & Roberts Construction to come up with some innovative solutions

- A 37 m high primary crusher
 - A 22 m high secondary crusher
 - A 31 m high tertiary crusher
 - A primary stockpile tunnel with outside dimensions of 9,4 m high x 9,65 m wide and 106,5 m (including wingwalls)
 - Conveyor and transfer tower foundations
- Two concrete batching plants were set up initially to produce concrete for the primary and secondary crushers and later two further plants were established at the tertiary crusher to cover both the tertiary and newly established Phase 2 project at the jig plant.

Cementitious materials were imported by road from both Lichtenburg (cement) and Newcastle (fly ash) with the aggregates (stone) from the on-site crushing facility set up for the project and sand from local suppliers.

Extreme climatic conditions often made working conditions uncomfortable and major concrete pours extremely difficult. Most of the concrete was pumped and control of temperature of the constituent materials played a significant role in the production process. With summer temperatures in excess of 40 °C, coarse aggregates had to be cooled by continuous water spraying and evaporative cooling was used to reduce the mixing water temperature to keep the mixed concrete temperature well below the 35 °C specified maximum. In winter, where temperatures were often below zero, thermal insulation was used to ensure concrete temperatures were kept above 10 °C.

All the formwork on the project was innovative, being purpose-built and based on roll-back technology. The tertiary crusher, for instance, was treated as a tunnel and the formwork designed as such. The formwork was constructed as a travelling unit 'shaped' to the profile of the structure. It was jacked into final position, the concrete placed and the unit jacked away from the concrete once the concrete had attained design strength. The formwork was then moved forward on guide rails and jacked into position for the next section. To save construction time, the primary crusher walls were 'flown' past the deck slabs which were cast at a later stage using Dywidag couplers for



► Above: Thickener for jig plant

THE SISHEN IRON ORE Company's R334 million expansion project comprises the construction of large primary, secondary and tertiary crushers, a jig plant and associated infrastructure. The remote location of the site, and the complexity of many of the structures posed interesting challenges for the joint venture. However, the project team rose to the challenge and completion of the various phases will be achieved.

The project will introduce new jigging process technology that is planned to upgrade traditionally lower grade iron ore

to export quality. Output is expected to increase by 10 million tonnes per annum.

The design engineers for the project are Bateman Africa and Murray & Roberts Engineering Management Services.

ORE CRUSHING FACILITIES – PHASE 1

The team began work on site for Phase 1 in October 2005 with a total concrete requirement of 40 000 m³ for the following structures:



► Left: Tertiary crusher

the deck reinforcing.

In the primary crusher structure, sacrificial precast concrete sections were used, to form the soffit. These were supported by steel beams on top of temporary concrete columns in lieu of conventional shutter and support work. This saved considerable time, labour and equipment.

JIG PLANT AND ASSOCIATED WORKS – PHASE 2

The team established on site in early January 2007 with a workload of an estimated 36 000 m³ of concrete. The contract value on award of tender was R187 million.

The main structures for construction at tender were:

- Two 125 m diameter thickener tanks
- An 80 m diameter octagonal freshwater tank
- Foundations for the main jig plant processing building (modules 1 to 6)
- Twelve kilometres of stacker reclaimer rail beams
- Six substations
- Conveyor foundations
- JIG plant administration office
- JIG plant control building

- Main MCC control building
- Primary crusher administration building
- Primary, secondary crusher MCC and transformer buildings
- Numerous associated smaller works and structures

A further (fifth) concrete batch plant was planned to be established at the jig plant, but the decision was taken to consolidate the production and supply of concrete for both projects in one area at the primary crusher. The already established batching plants on Phase 1 were a distinct competitive advantage in the tender for Phase 2.

The most challenging aspect of Phase 2 has been constructing the two 125 m diameter thickeners which required extensive earthwork blasting to remove rock for construction of the main central caisson and the foundations for the outer walls.

‘Managing 155 staff and the 1 600 hourly-paid workforce, of which 60% were locally employed, was a feat in itself,’ said Dave Spooner, Grinaker-LTA’s operations director for the project. ‘Having other contractors on site only increased the complexity of the site management.’

In spite of this, the safety record for both Phases 1 and 2 has been exceptional. □



Looking after the interests of the quarrying industry

MANKIND IS DRIVEN BY a natural inclination to shape develop and improve the environment in which people live and work.

Since the beginning of time, these goals have been achieved through association; people of similar interests coming together to form bodies that are designed

and destined to represent their common interests. Through these associations, whole industries evolved recognisable codes of conduct, ethical foundations, self-regulatory practices and lobbying skills, techniques and practices to the benefit of their members, their industry, and indeed the society in which they operate in.

The history of the aggregate and sand quarrying industry in South Africa is a history of gradual association. From the early years of family-owned businesses geographically dispersed around the country, the growth of the industry has been paralleled by the amalgamation of these businesses into larger companies.

Other unique products such as armour rock for breakwaters are also difficult to produce and transport. Problems in the manufacture of these products should not be mistaken for an overall shortage in aggregates

As time went by, the need for the formation of a professional body arose, to take up issues on behalf of the industry and to coordinate industry opinion. A number of geographically diverse associations were formed. Despite their best intentions, the officers of these associations were unable to devote the time or the energy required to successfully achieve their mandates. These frustrations were compounded by the fact that individually they could not command the necessary credibility with the authorities.

In a momentous meeting of the captains of the quarrying industry at the Quarrying Annual Conference in Durban



in March 1990, a steering committee was duly appointed to formulate the functions of a new body with the inclusion of full-time staff. As a result, ASPASA was formed on August 23rd of that same year.

ASPASA'S VISION

ASPASA is committed to represent a healthy and sustainable aggregate industry.

PRODUCT TYPE

Concrete stone (26 mm – 9,5 mm), sand (natural and crushed) and specialist road-stone constitute about 65% of demand. The balance is made up predominantly of

material required for layer works (G1–G9) and railway ballast. Specialist products such as cubicle single-size products for proprietary asphalt mixes are difficult to manufacture and create the wrong impression of supply shortage. Other unique products such as armour rock for breakwaters are also difficult to produce and transport. Problems in the manufacture of these products should not be mistaken for an overall shortage in aggregates.

ACTUAL 2006

Actual volumes for 2006 is the estimated sales of aggregate and sand in South Africa based on average conversion fac-



tors used from cementitious sales into concrete (0,35) and then from concrete (1,91) into aggregate and sand. In addition, it is assumed that around 32% of the total aggregate and sand sales are used in non-concretous products such as ballast and roads. Market statistics on the sales of aggregate and sand in South Africa are incomplete because of a lack of reporting from illegal and artisinal operators. Sales reported by the Department of Minerals and Energy are estimated to cover around 55% of actual South African sales. □

WHAT IS THE QUARRYING INDUSTRY?

The average person typically does not give much thought to the subject of aggregates.

Many people think of mining as a single event – somebody acquires a piece of property, mines it for its important mineral resources, and leaves a hole in the ground or a scar on a mountainside when they are done. But this is seldom the case. The mining industry (particularly the aggregate industry) is very active in reclaiming its property. This is done not just to make the property look good again, but to give it a beneficial use to society for ever more.

THE SOUTH AFRICAN AGGREGATE INDUSTRY

Throughout history and prehistory human beings have been quarrying for construction materials.

Aggregate in South Africa have historically encompassed excavation of gravels and sand, which derive naturally from rivers or lakes, and quarrying of stone and limestone, which is mainly used in the manufacture of cement.

Construction aggregates are used primarily in roads and concrete. Ninety-four per cent of a road is aggregate. Eighty per cent of concrete is aggregate, whether road 'horizontal construction', or 'vertical construction' including build-

ings, dams and the like.

The official revenues for limestone, aggregate and sand (LAS) in 2004 were R3,1 billion. But using the projected figures of about 100 million tonnes for LAS in 2004 puts revenues at nearly R5 billion. Irons were R4,6 billion in 2004.

After the major minerals – gold, the platinum group metals (PGMs), diamonds and coal – LAS is the next most important mining sector, ranking alongside iron ore, significantly higher than nickel and double or more chrome, copper and manganese.

WHAT ARE AGGREGATES?

So, what are aggregates? Aggregates are different types of rock fragments, such as rock, sand and gravel. These materials are obtained from the earth through a process called surface mining, or open-pit mining. After these materials are mined, they are usually washed and sorted by size before they are sold to the markets.

In case where natural sand and gravel is unavailable, commercial aggregates are created by crushing large stones or by drilling and blasting massive rock formations and processing them into various sizes of rock and manufactured sand. This process is called 'quarrying' when drilling and blasting of massive rock formations is required

to produce aggregates, and all the materials produced by this process are called 'crushed stone'. Unlike smooth, natural aggregate, crushed stone tends to be angular with sharper edges.

WHY DO WE NEED AGGREGATES?

Aggregate resources are used to make many features of the urban landscape that we depend on in our daily lives. For instance, rock, sand and gravel are each an integral component of concrete, which is used to build houses, sidewalks, water and sewer systems, bridges, airport runways, commercial buildings, streets, highways and other common projects. Aggregate resources are also a key ingredient of asphaltic concrete, as well as the base and fill material required to repair and build streets, highways and parking areas.

Just imagine having to live without the convenience of aggregate products. There would be no patios to braai on, no pools to swim in, no tile roofs on our homes or foundations beneath them. There would be no stone or concrete protecting our flood control channels during heavy rainstorms or runways that are strong enough to support the use of large airplanes for travel. This is just a glimpse of what life without aggregate products would be like.

Hillcrest Boulevard

set to lure shoppers

MURRAY & ROBERTS CONSTRUCTION is reinforcing its presence in KwaZulu-Natal through its role as the main contractor on the R215 million Hillcrest Corner retail development at the major intersection of Old Main and Hospital roads in Hillcrest, north of Durban.

Murray & Roberts Construction was responsible for such iconic projects as the International Convention Centre in Durban, and this 68-shop centre, with a gross lettable area of 19 652 m², is one of the company's largest projects in KwaZulu-Natal to date. It is also the largest development of its kind in the up-market Hillcrest area, and is set to become the shopping destination of choice for its affluent residents.

A joint development by Shoprite Checkers Properties and Acucap, with Shoprite Checkers and Woolworths as the anchor tenants, the centre will include such

► **Figure 1** Internal view of the main rotunda skylight under construction
Figure 2 External view of the main rotunda skylight under construction
Figure 3 Artist's impression of Hillcrest Boulevard



Murray & Roberts Construction brings together a combination of engineering disciplines and expertise that ensure the delivery of world-class solutions to customers across the broad spectrum of building and industrial civils

major retail tenants as Foschini, @Home, CNA, Jet, Ackermans, Home Comforts, Truworths and Identity. 'There is a wide range of tenants which will ensure as diverse and complete a shopping experience as possible,' says Jean-Pierre Du Toit, tenant co-ordinator.

Sampe Theron, Murray & Roberts Construction project manager, says challenges posed on this contract included co-ordinating the large project team, combined with the specific requirements of the broad tenant mix. In addition, there has been a much higher-than-average rainfall in the area, which has hampered the project, as well as unanticipated rock discovered on-site, says Guy Rust, Murray & Roberts Construction contracts manager.

The project commenced in March 2006

and was scheduled for completion in May 2007. A total of 17 000 m³ of concrete and about 900 000 bricks were used, with about 350 workers employed. Hospital Road, the main access to the Hillcrest Boulevard, was upgraded as part of the project.

A unique feature of the project is that it employed nine student technicians who underwent six months' theoretical training followed by six months' practical training on site, during which time the students were exposed to all facets of the construction process.

Cathy Tladi, a successful graduate of this programme, said it provided invaluable hands-on experience. 'Our involvement as students is an outcome of the commitment of Murray & Roberts





We have strived to create a minimalistic interior, with emphasis on repetitive clean lines. Features include recessed demising columns with decorative colour changing light panels

Construction to help meet the chronic skills shortage in the local construction industry, and to empower previously disadvantaged people,' Tladi said.

Francois du Toit, from SVR Quantity Surveyors & Project Managers, explained that Hillcrest Boulevard comprises two separate sites that are being developed simultaneously, and which will ultimately be amalgamated. There are two floors of shopping and dedicated basement parking, in addition to extra parking on all levels.

Tessa Smit, an interior designer from

Retail Architects International, which was responsible for the mall interiors and façade details, said the architectural features of the main site are carried over to the second to ensure continuity. 'We have strived to create a minimalistic interior, with emphasis on repetitive clean lines. Features include recessed demising columns with decorative colour changing light panels,' Smit said.

Jonathan Apsey, an architect from Jordaan, Hartwig Steyn Le Roux, considers the main architectural feature of the de-

velopment the presence of two skylights. One of these skylights, the main rotunda skylight, extends to the ground floor, while the second penetrating right through to the basement. 'This is in keeping with the main emphasis on clean lines and maximum light,' Apsey said.

Murray & Roberts Construction brings together a combination of engineering disciplines and expertise that ensure the delivery of world-class solutions to customers across the broad spectrum of building and industrial civils. □

Tilt-up beams for New Orlando Stadium



► **Figure 1** Once complete, the Orlando Soccer Stadium will accommodate 40 000 spectators

battered with bond breaker.

In the meantime, the Grinaker-LTA construction team ensures that the next batch of supporting columns, including those cast at 10° to support the upper seating levels, are cast in situ to high quality standards, relating not only to dimensions and compressive strength, but also to high aesthetic standards – all the concrete on the stadium is off-shutter finish.

On predetermined days, the Tilt-up Systems crane lifts each beam from the casting bed and positions it to the tight tolerances required to support the precast seating slabs. The seating slabs are the only concrete elements that are not produced on site.

Ensuring correct sequencing between casting columns, slabs and beams is a major part of Grinaker-LTA contracts manager Greg Webber's working life. So is the fast-tracking of construction to meet the May 2008 completion deadline.

Using consistent mixes – produced with the same proportions of identical materials – is essential in ensuring compliance with structural and quality standards throughout the project. To keep the work flow efficient and effective in a complex situation like this, getting the correct mixes to site at the right time is very important.

Holcim Readymix Nancefield plant is supplying the fly ash concrete specified for the stadium. ■

AT SOME POINT, we have all used Lego blocks. Each brightly coloured plastic block is precision moulded to fit tightly into all the other different block shapes, allowing us to build walls, doorways, windows and roofs.

Design principles based very much on a 'building block' system are being used to produce heavily reinforced concrete precast elements for the New Orlando Stadium in Soweto, to be used as a training ground during the 2010 FIFA World Cup. But the 288 stepped beams required to support seats for 40 000 spectators around the soccer field are not being cast in a precast yard and then transported to site for erection. They are cast right inside the stadium, ready for the massive 180 t crane to hoist them into the air and place them precisely into position.

Grinaker-LTA, Formscuff and Tilt-up Systems collaborated to design special moulds for each of the beam shapes required.

The moulds are placed on the surface of casting beds directly in front of each of the four banks of seating. A reinforcing cage bent into shape, with specific lifting points to accommodate the centre of gravity in each beam is, lifted into the mould. Readymix concrete is discharged directly from truck mixers into the moulds, and thoroughly compacted. Once the concrete has hardened, bond breaker is applied to the exposed top surface and the formwork is moved upwards to cast the next beam. Essentially, the result is a 'sandwich' consisting of identical beams



► **Figure 2** A section of stepped beam cast and hardening on site
Figure 3 Holcim Readymix concrete is used to cast 288 stepped beams for the Orlando Stadium





Text **Werner Schiess**
Resident engineer
Stemele Bosch Africa (Pty) Ltd

Welcome to the least-known subject in civil engineering

Werner Schiess has designed and procured support and formwork for 27 years in the civil engineering field and has worked for companies such as Group 5 and Gillis-Mason / M&R.

He would like to create an awareness and share some thoughts on this exiting subject with the younger generation. Werner feels that this aspect of civil engineering is not given the prominence it deserves. Yet if anything ever collapses during construction, it is normally due to people's ignorance in this field

FORMWORK AND SUPPORT WORK

Formwork is used to contain wet concrete in the shape and position in which it is required, and is one of the few areas in which there is some cost flexibility. Formwork is a cost-intensive subject and it is therefore important that the relevant project members have a good knowledge of the systems and methods available, as new methods of constructing formwork are constantly being created. Close cooperation between the engineers and contractors at the planning stage is very important, but not always possible.

Design of formwork encompasses all disciplines of engineering. A working knowledge of the following subjects is needed:

- Reinforced concrete
- Quantity surveying
- Mechanical
- Timber design
- Electrical
- Structural design
- Hydraulics
- Planning
- Mechanical handling
- Shoring of excavations
- Estimating

PLANNING OF FORMWORK

Information for the planning of formwork is contained in the concrete layout drawings, and is an integral part of the overall planning procedure on any project. Reinforcement drawings are also useful in determining the construction joints. Specifications, bills of quantities and pro-

grammes are needed to give an idea of the quantities involved and the quality of the concrete to be used, types of expansion joints and the surfaces of the finished concrete expected. All these factors are important in deciding on a formwork system and the formwork areas required.

Planning of the movement of formwork from contract to contract or from section to section on a big site is important, as it maximises the use of formwork and minimises its purchase.

SELECTION OF FORMWORK

Many questions have to be answered and decisions made.

Which type of formwork elements exist within the company? Will the formwork be hired or purchased? The choice of hired formwork is limited. The purchased formwork may be of a modular nature, which is generally more useful for future applications, or it may be purpose made to suit a specific structure.

The shape of the structure often dictates the type of shutters: a slipform shutter for silos, a special shutter for an incrementally launched bridge deck, a modular support work for a conventional bridge deck, etc.

How often will the formwork be used? For example, on a 30-storey lift shaft the formwork would be moved up 30 times. This re-use factor affects price and the design of the formwork.

What are the required concrete finish and allowable tolerances? Read SABS 1200. Are there time constraints on the project?

The time available to complete the structure would dictate the amount of formwork to be obtained.

Is the formwork manhandled or handled by a crane? If the latter, the reach and capacity of a crane will determine the biggest unit that can be handled in one piece. What is the shape of the excavation? The width of the overbreak may determine the depth of the formwork. There may be no space left for a strongback or for a travelling frame. Often there is not enough space to insert the formwork tie rod, in which case an anchor screw cast into the starter unit is a better proposition. Where are the vertical and horizontal reinforcing splice bars? The vertical splice bars would indicate the horizontal construction joints. The horizontal splice bars have to be allowed for in the shutter by means of a throw-away timber insert. If at all possible, one should use pull-out bars, thus saving labour and formwork. Starter bars must also be considered, as they often interfere with the tie rods.

Will external or internal concrete vibration method be used? The shutter has to be designed stronger if an external vibrator is used, since this method tends to increase the concrete pressure and crack ordinary welding. What method of placing concrete is to be used? And what is the rate of pouring concrete in a wall or column shutter? The faster concrete is poured, the higher the pressure of the wet or green concrete exerted on the formwork. It should be known from the outset whether the concrete is to be pumped or not. Pumped concrete exerts very high pressures on the formwork because of its high slump and fast rate of pouring.

The best formwork scheme will not work if the foreman dislikes it. Involve him in the design if at all possible.

The amount of money to be spent on formwork? This aspect might dictate a completely different approach to the problem. Remember, the best scheme is no use if it exceeds the allowable budget.

Construction companies and consulting engineers are invited to contribute items of unusual method of construction with particular reference to formwork and support work, describing the construction sequence, cost and programme implications – Ed



MEASURING UNITS – A REVIEW

The use of measuring units goes back to antiquity. Different countries developed their own systems, and there was considerable diversity. Nations which dominated commerce were inclined to spread their systems to their trading partners.

In the middle of the previous millennium, there were attempts at achieving uniformity. A notable advance was the introduction of the metric system in France just after the revolution. It was unique in that it was planned system, based on the decimal number system. A limited number of base units were defined, and units for other quantities were derived from these. The use of the metric system gradually spread to many countries around the world. Most English-speaking countries, including the United States of America, adhered to traditional units.

In 1960 a new version of the metric system was introduced. This system is called Le Système International d'Unités, with the abbreviation SI. Countries joining the European Common Market

were required to introduce legislation making the SI the only legal system in their countries. The United Kingdom decided to adopt the SI, and so did South Africa.

There were objections to the change. For understandable reasons, people do not easily desert a system with which they are very familiar. National traditions also support resistance to change.

The metric system is coherent; a minimum number of elemental units are defined, and the other necessary units are established by reference to them, with no multipliers. Multiples or sub-multiples of units are formed by the use of prefixes which indicate which integral power of ten is applicable. A principle of the system is that only one unit should be used for any particular quantity, irrespective of the discipline in which it is used.

The transition in South Africa went comparatively smoothly. It was planned efficiently, with discussions with industry as to the sequence of the steps to be taken. The Metrication Division of the South African Bureau of Standards

coordinated events and set up committees to advise various sections of society on the correct procedures. Towards the end of the process, legislation was introduced which enabled the responsible minister to regulate by notice the units to be employed and their use.

Before 1960, all the metric countries used the comma as a decimal sign. The South African authorities decided to follow this example, but the English-speaking countries did not. The matter of the decimal sign has become a controversial issue.

The introduction of the dynamic unit force, the newton, in the place of the gravitational unit, the kilogram-force, also caused dissent, in spite of the logical arguments in its favour. However, the newton has by now been generally accepted.

In comparison with other countries, South Africa had a smooth conversion to the metric system, and the way it was carried out drew admiration from representatives from other countries.

Meeteenhede 'n Terugblik

DIE MENSLIKE GEMEENSKAP KAN nie sonder die meet van groothede oor die weg kom nie en moet dus meeteenhede uitvind om sy omgewing te interpreteer.

Talle verskillende eenhede is in die verlede gebruik, vanaf die vroegste tye waarvoor daar rekords bestaan. Eenhede is egter baie willekeurig tot stand gebring en het verskil van een land na 'n ander, en ook van een distrik na 'n ander. Lande wat handel binne 'n sekere streek oorheers het, was geneig om hul besondere stelsel te versprei. Baie pogings is aangewend om eenvormigheid teweeg te bring, gewoonlik met min sukses.

Byna veertig jaar gelede het 'n groot deel van die wêreld, insluitend Suid-Afrika, 'n ingrypende aanpassing in die gebruik van meeteenhede ondergaan. Hierdie veranderings was uniek in die menslike geskiedenis, aangesien dit 'n beplande en

internasionaal aanvaarde operasie en 'n verandering van 'n lukrake tradisionele stelsel na 'n rasonale een was. Wat veral interessant was, is die reaksie van verskeie groepe mense op hierdie verandering. Die volgende drie verskynsels was waarneembaar:

- Daar is sterk weerstand teen verandering
- Mense wil graag hulle eie ding doen, en as die resultaat ingewikkelde en vir vreemdes moeilik verstaanbaar is, word dit noodwendig as 'n nadeel beskou nie. Nasionale trots is dikwels 'n belangrike oorweging
- Meeteenhede toon ooreenkomste met konyntjies. As daar net een eenheid vir 'n bepaalde grootheid gebruik word, sal daar waarskynlik net een bly voortbestaan. Maar as 'n tweede een in die hok toegelaat word, weet niemand hoeveel daar op die ou end sal wees nie

THE DECIMAL SIGN

Some comment about the decimal sign is appropriate.

The former metric countries used and are still using the comma as a decimal sign. To quote from the International Standard, ISO 31-1:

Section 3.3.2 The decimal sign is a comma on the line. If the magnitude of the number is less than unity, a zero should precede the decimal sign.

NOTE 17: In documents in the English language, a dot is often used instead of the comma. If a dot is used, it should be on the line.

In accordance with an ISO Council decision, the decimal sign is a comma in ISO documents.

In Britain there was an attempt to introduce the comma, and in fact the British Standards Institution did actually publish some documents using the comma. The attempt foundered at the insistence of financial authorities, who feared that the change could lead to serious errors. In South Africa the comma was adopted and is the legal decimal sign.

In baie gevalle is tradisionele eenhede afgelei van afmetings van die menslike liggaam. Die el was gebaseer op die afstand van die elmboog tot die punt van die uitgestrekte vingers, omtrent 0,5 van die huidige meter. Die myl is afkomstig van die Latynse *mille passus*, 'n duisend tree, waar die tree die afstand tussen twee agtereenvolgende aanrakings van dieselfde voet op die grond was. Ons het die *mille* behou en die *passus* weggelaat. In vergelyking ons huidige myl was die lengte van die tree omtrent 0,80 meter.

In die agtiende eeu het eenhede verander van een distrik na 'n ander, en het ook afgehang van wat gemeet word. 'n Boesel aartappels was nie noodwendig dieselfde volume as a boesel koring nie. Die Engelse *perch* kon 'n meting van lengte, area, of volume wees. Daar was ten minste twee gellings, waarvan een in die Britse

wêreld gebruik is, en die ander as die VSA-gelling oorleef het. Tot 1960 het die Amerikaanse voet effens verskil van die Engelse voet. Daar bestaan vandag nog twee verskillende onse en ponde. Dit is algemeen bekend dat 'n pond vere swaarder weeg as 'n pond goud. In Suid-Afrika het ons voor metrisering drie verskillende voet-eenhede gebruik, en selfs in die ou Suidwes-Afrika, nou Namibië, was daar drie verskillende meters.

Destyds het landmeters die gewoonte gehad om horisontale afstande in Kaapse voet te meet en vertikale afstande in Engelse voet. Die verskil tussen die twee eenhede, omtrent 10 mm, was klein genoeg om verwarring moontlik te maak, en groot genoeg sodat sulke verwarring ernstige gevolge kon hê. Ek het 'n geval teëgekom waar 'n struktuur as gevolg hiervan in 'n verkeerde posisie opgerig was; dit was gelukkig 'n tydelike struktuur.

Die benamings van die tradisionele meeteenhede het dikwels 'n interessante geskiedkundige herkoms gehad, maar daar was natuurlik baie nadele. 'n Mens kon nie van die name aflei wat die grootheid was wat gemeet word nie. Dit was gebruiklik om ook baie eienaardige vermenigvuldingsfaktore aan te wend om van een eenheid na 'n ander vir dieselfde grootheid te beweeg. Daar was 12 duim in 'n voet, 3 voet in 'n jaart, 22 jaart in die ketting, 10 kettings in die furlong, en 8 furlong in die myl. Dit lyk amper of daar 'n ongeskrewe wet was dat geen twee faktore dieselfde mog wees nie. Die arme skoolkinders moes nie net die benamings nie, maar ook die faktore uit die hoof leer. Kommersiële transaksies en wetenskaplike kommunikasie was onnodig moeilik; rekenkundige berekenings met hierdie eenhede was tydrowend, en die moontlikheid van foute onaanvaarbaar groot. Dit is duidelik dat hierdie toestande kon lei

Die benamings van die tradisionele meeteenhede het dikwels 'n interessante geskiedkundige herkoms gehad, maar daar was natuurlik baie nadele. 'n Mens kon nie van die name aflei wat die grootheid was wat gemeet word nie. Dit was gebruiklik om ook baie eienaardige vermenigvuldingsfaktore aan te wend om van een eenheid na 'n ander vir dieselfde grootheid te beweeg

Die metrieke stelsel het in die afgelope vyftig jaar beduidende veranderinge ondergaan.

Die nuwe Internasionale Stelsel van Eenhede (Le Système International d'Unités, met die internasionaal erkende afkorting SI) is in 1960 ingevoer. Alle lede van die Europese Gemeenskapsmark was verplig op na hierdie nuwe vorm van die metrieke stelsel om te skakel

– en wel gelei het – tot oneerlike praktyke. Die uitbuiting van die verwarring van meeteenhede word beskou as een van die oorsake van die Franse Rewolusie.

In 1670 het 'n Franse priester, Gabriel Mouton, 'n nuwe lengte-eenheid voorgestel. Dit was gebaseer op 'n boogminuut van breedtegraad en moes tiendelig onderverdeel word, met rasonale voorvoegsels om veelvoude van die basiseenheid aan te dui. Dit was die voorloper van die metrieke stelsel. Maar dit het honderd-en-twintig jaar geduur, en 'n rewolusie gekos, om die oorskakeling na dié stelsel aan die gang te kry. Dit was 'n prominente lid van die Franse Nasionale Vergadering, Charles-Maurice Talleyrand, wat voorgestel het dat die Akademie van Wetenskappe versoek word om 'n rasonale stelsel van meeteenhede op te stel. Hul aanbeveling was dat die meter vasgestel word as een tienmiljoenste van die afstand van die ewenaar na die Noordpool langs 'n meridiaan deur Parys (nie juis 'n briljante besluit nie).

Terloops, teen hierdie tyd was die lengte van 'n meridiaan van die ewenaar na die Noordpool reeds vasgestel, en nogal deur Franse ingenieurs, maar nie langs die boog deur Parys nie. Twee ander Franse ingenieurs het toe begin om die lengte van die meridiaan deur Barcelona en Duinkerken te meet; hierdie twee stede is op daardie meridiaan, en dit was nie nodig om die hele reis tussen die ewenaar en die Noordpool af te lê nie. Die werk was moeisam, die Pireneë-gebergte was in die pad, en daar was oorloë en rewolusies aan die gang, gevolglik het die twee ingenieurs ses jaar geneem om die taak te voltooi. Intussen het die beplanning van die metrieke stelsel voortgegaan, en nadat vasgestel is hoe lank 'n meter was, kon die stelsel in 1799 ingevoer word. Sedertdien het dit geleidelik wêreldwyd posgevat.

Die metrieke stelsel is samehangend: 'n minimum aantal elementêre eenhede word gedefinieer en ander noodsaaklike eenhede word van hulle afgelei sonder vermenigvuldigers. Standaard-voorvoegsels word gebruik om vermenigvuldigers of sub-vermenigvuldigers van die basis-eenhede aan te dui. Voorvoegsels is uitgedink om alle vermenigvuldigers van 10^{-18} tot 10^{+18} aan te dui. Die eenheid van massa, die gram, is bepaal vanaf die massa van een kubieke sentimeter suiwer water. Die gebruik van verskillende eenhede vir dieselfde grootte deur verskillende dissiplines sou nie meer geregverdig wees nie. Die ingenieurs, natuurwetenskaplikes en boere sou almal mekaar maklik kon verstaan. Standaard-simbole (wat nie as afkortings beskou moes word nie) is vir al die eenhede ingevoer.

Dit is interessant om daarop te let dat die geskiedkundige oorsprong van 'n eenheid geen aanduiding gee van die huidige wetenskaplike of wetlike definisie nie. Die definisies is geneig om te verander

wanneer die tegnieke van meting meer presies uitgevoer kan word. Die oorsprong van die meter is duidelik nie 'n praktiese definisie vir alledaagse gebruik nie, en dit is gevolglik agtereenvolgens verander: van die afstand tussen twee groefies op 'n platinum-iridium staaf wat in Frankryk bewaar is, as die lengte van 'n sekere aantal golflengtes van 'n sekere tipe straling – tot die huidige definisie, die afstand waardeur lig in 'n sekere tyd (voorgeskrif tot nege tellende syfers) beweeg.

Die oorsprong van die sekonde is $1/86400$ van 'n sonnedag. Die probleem met hierdie definisie is dat die aarde nie altyd teen dieselfde spoed roteer nie, en die huidige definisie is a gegewe aantal siklusse van 'n gespesifiseerde tipe straling geassosieer met die sesium-atoom. Al die elementale eenhede, behalwe een, word so gedefinieer dat 'n plaaslike standaard in 'n goed toegeruste laboratorium gekontroleer kan word. Die uitsondering, verbasend genoeg, is die eenheid van massa, die kilogram, wat die massa is van 'n silinder van platinum-iridium wat in Sevres, naby Parys, Frankryk, bewaar word. Dit is net nie moontlik om met die nodige akkuraatheid water as 'n standaard-materiaal te gebruik nie.

In baie lande is die metrieke stelsel gedurende 'n rewolusie of 'n politieke omwenteling aanvaar – dit het in Rusland, Suid-Amerika, China en Japan so gebeur. Die meer onlangse wysiging en uitbreiding van die metrieke stelsel in Europa het gepaard gegaan met die instelling van die Gemeenskapsmark.

Die metrieke stelsel het in die afgelope vyftig jaar beduidende veranderinge ondergaan. Die nuwe Internasionale Stelsel van Eenhede (Le Système International d'Unités, met die internasionaal erkende afkorting SI) is in 1960 ingevoer. Alle lede van die Europese Gemeenskapsmark was verplig om na hierdie nuwe vorm van die metrieke stelsel om te skakel. Die essensiële verskil was dat, terwyl die eenhede in die vorige stelsel van die sentimeter en die gram afgelei is, die nuwe eenhede op die meter en die kilogram gebaseer is. Gevolglik het die Verenigde Koninkryk begin oorskakel, en Suid-Afrika het besluit om dit ook te doen. Die VSA het nog nie gevolg nie, maar interessant genoeg was dit sedert 1860 wettig om die metrieke stelsel in daardie land te gebruik, en sommige nywerhede het dit wel gedoen.

Met die instelling van die SI is die tradisionele eenhede soos die voet en die pond gedefinieer in terme van die metrieke eenhede. Die hele Britse Gemenebes het amptelik – hoewel miskien nie heeltemal in die praktyk nie – na die SI oorgeskakel. Die ou metrieke lande moes ook oorskakel, aangesien geen van hulle voorheen die SI gebruik het nie. Dit was dus vir Suid-Afrika voordelig omdat

ons net een oorskakeling moes doen, maar dit het die nadeel gehad dat ons nie veel gesonde advies van vorige gebruikers van die metrieke stelsel kon verwag nie.

Verskillende beroepe het in die verlede dikwels verskillende eenhede vir dieselfde grootheid gebruik. Selfs in lande waar die metrieke stelsel lankal die norm was, is daar by voorbeeld sestien verskillende eenhede vir drukking (krag per eenheidsarea) gebruik. Een van die doelwitte van die SI is dat in alle beroepe net een eenheid vir enige grootheid gebruik sou word, met 'n toepaslike voorvoegsel waar nodig.

Die omskakeling het sekere aspekte van menslike gedrag laat blyk, veral die inherente weerstand teen verandering. Ons kom so dikwels in aanraking met meeteenhede dat hulle deel van ons kultuur en sienswyse word. Dit neem 'n ruk om gewoon te raak aan die betekenis van getalle. As 'n atleet agt meter ver spring, is dit goed of swak? 'n Mens se eerste reaksie is om 'n omskakeling na die bekende eenhede te maak, maar dit is nie aan te beveel nie; dan word jy nie gewoon aan die nuwe eenhede nie.

In Brittanje was daar sterk reaksie teen die metrieke stelsel. Anthony Lejeune

en Sir Fred Hoyle was bekendes wat hul daarteen uitgespreek het. Daar was selfs 'n organisasie, The British Weights and Measures Association, wat hulle sterk teen die oorskakeling uitgespreek het met die woorde: 'This is evidence of the thinly veiled aggression by the European Commission against all things Anglo-Saxon.'

In Suid-Afrika was daar ook sterk besware teen sekere aspekte van die oorskakeling. Dit het veral geblyk uit die reaksie van sekere ingenieurs teen die SI-eenheid vir krag, naamlik die newton. Ingenieurs oral ter wêreld was gewoon aan gravitasie-eenhede, naamlik die pond-krag of die kilogram-krag. Sulke eenhede is egter net van pas in statiese probleme, en het nie eintlik 'n logiese regverdiging nie.

■ In die eerste plek is hulle nie maklik om te definieer nie. 'n Kilogram-krag is veronderstel om gelyk te wees aan die gewig van 'n voorwerp met 'n massa van een kilogram. Maar die aantrekkingskrag van die aarde verskil meetbaar op verskillende plekke – as baie akkuraat gemeet word, varieer dit selfs by dieselfde plek as gevolg van die gety-krag van die son en die maan. 'n Kunsmatige

Ingenieurs oral ter wêreld was gewoon aan gravitasie-eenhede, naamlik die pond-krag of die kilogram-krag. Sulke eenhede is egter net van pas in statiese probleme, en het nie eintlik 'n logiese regverdiging nie

Die SA Buro vir Standaarde het 'n lys van die voor- en nadele van die komma opgestel. Daar was sewe of agt voordele, en net twee nadele. Die ooglopende voordeel is dat die komma duideliker en makliker herkenbaar as die punt is. Soos een beampte dit gestel het: 'n vlieg kan 'n punt maak, maar net 'n mens kan 'n komma veroorsaak!

waarde vir die gravitasie-krag moet dus aanvaar word, dus is die gewig van 'n voorwerp met massa een kilogram feitlik nooit presies een kilogram-krag nie. Die kilogram-krag is dus gedefinieer op dieselfde wyse as die newton; as die grootte van die krag wat 'n bepaalde versnelling (9,80665 meter per sekonde kwadraat) op 'n voorwerp van eenheidsmassa veroorsaak.

■ Tweedens, as 'n mens die kilogram-krag in Newton se vergelyking 'krag is gelyk aan massa maal versnelling' gebruik, word die gewig deur die gravitasie-versnelling g gedeel; maar die massa is nie 'n funksie van g nie!

■ Derdens, om die stelsel se samehang te behou, moet 'n eenheidskrag noodwendig 'n eenheidsversnelling van 'n voorwerp met eenheidsmassa veroorsaak. Dis geen wonder nie dat die natuurwetenskaplikes al lankal die dine of die newton as kragteenheid gebruik. Die newton is toevallig ongeveer die gewig van 'n gemiddelde appel; die dine is 'n honderdduisendste van 'n newton, en is ver te klein vir gebruik deur ingenieurs.

Daar was ongelukkig ingenieurs, insluitend senior lede van ons Instituut, wat die behoud van die kilogram-krag vir sekere dissiplines bepleit het. Dit sou die doelwitte van eenvormigheid en samehang verydél het. Ek verstaan dat in Europa die SI met newton en al nou posgevat het. In die VSA bepaal ASCE dat SI-eenhede ook verskaf moet word in referate waarin die tradisionele eenhede verskyn.

DIE DESIMAALTEKEN

Die desimaalteken is ook 'n kontroversiële aangeleentheid. Die ou metrieke lande het almal die komma gebruik. Daar moet in ag neem word dat in die metrieke stelsel, wat tiendelig van aard is, die desimaalteken 'n belangriker rol het as in die tradisionele Engelse stelsel. 'n Tipiese ingenieurstekening met die ou eenhede het die afmetings in voet, duim, en breuke van 'n duim aangegee; die desimaalteken het selde verskyn.

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Section 3.3.2 The decimal sign is a comma on the line. If the magnitude of the number is less than unity, a zero should precede the decimal sign.

NOTE 17: In documents in the English language, a dot is often used instead of the comma. If a dot is used, it should be on the line.

In accordance with an ISO Council decision, the decimal sign is a comma in ISO documents.

In Brittanje was daar 'n poging om die komma in te voer, en die British Standards Institution het wel 'n paar dokumente met die komma as desimaalteken gepubliseer. Sekere instansies het egter beswaar gemaak. Hier het weerstand teen verandering geseëvier.

Een rede waarom die oefening in Suid-Afrika suksesvol afgehandel is, is die versigtige beplanning en die logiese volgorde waarin die verskillende stadiums deurgevoer is. Aan die begin is heelwat tyd bestee aan samesprekings met nywerhede. Toe is die rooster vir die oorsakeling opgestel, en verskillende rade en komitees tot stand gebring omskakeling met die verskeie liggame wat betrokke was ordelik te laat plaasvind. Daar is besef dat aan die einde van die proses 'n sekere mate van dwang nodig sou wees. 'n Firma sou miskien heeltemal bereid wees om na die metrieke stelsel oor te skakel, mits sy mededingers dieselfde doen. Dat so 'n drastiese verandering nie vrywillig sou plaasvind nie, word aangedui deur die feit die gebruik van die metrieke stelsel sedert 1922 in Suid-Afrika en sedert 1860 in die VSA wettig was, sonder dat die gebruik daarvan algemeen posgevat het.

Die Wet op Meeteenhede en Nasionale Meetstandaarde (Wet 76 van 1973) het op 5 Julie 1974 in werking getree. Die wet het die Minister van Ekonomiese Sake bevoegtig om deur kennisgewing die gebruik van meeteenhede en die simbole daarvoor te beheer. Die voorskrifte kragtens hierdie wet is bevat in die *Staatskoerant* van 5 Julie 1974. Daar is ook 'n paragraaf oor die desimaalteken:

Waar die grootte van 'n grootheid in 'n eenheid uitgedruk word, word 'n komma op die reël gebruik as desimaalteken in die numeriese gedeelte van die uitdrukking en die syfers word in groepe van drie syfers aan weerskante van die komma deur middel van spasies geskei. Die teken het altyd ten minste een syfer aan elke kant, by $25\,130,12\text{ mm} = 25,130\,12 \times 10^3\text{ mm} = 25,130\,12\text{ m}$; $0,51\text{ g}$; $1,61\text{ N}$.

Hoe het ons gevorder? Redelik goed, maar nie heeltemal perfek nie. Sommige konyn-tjies is nog nie geïsoleer nie. Die sterrekundiges is nog getroud met die astronomiese eenheid, die ligjaar en die parsek om afstande te meet; stadsrade verkoop steeds elektriese energie in kilowatt-uur (waarna verwys word as 'n 'eenheid') in plaas van die megajoule, en die mediese professie meet nog graag jou bloeddruk in mm kwik, pleks van kilopascal, wat eintlik 'n meer gepaste eenheid sou wees. Vir die desimaalteken word die komma of die punt dikwels lukraak gebruik; in sommige koerante sal 'n mens sommer albei op een bladsy raakloop.

Ons moet beseef dat die metrieke stelsel gebreke het. Omdat mense elkeen tien vingers het, is ons getalstelsel op die grondtal tien gebaseer, en tien is nie 'n ideale basis nie. Waarom koop ons eiers per dosyn? Omdat ons twaalf eiers in 'n netjiese reghoekige kassie kan verpak. Tien het net twee faktore, twee en vyf, en die reghoekige kassie vir tien eiers sou dus taamlik langwerpiger wees; dit sou minder ekonomies wees wat betref verpakkingsmateriaal. Ons tydeenhede en meting van hoeke op die grondtal sestig gebaseer. Die getal sestig is die kleinste een wat deur 2, 3, 4, 5, en 6 deelbaar is, en is derhalwe al deur die Babiloniërs in historiese tye gebruik. 'n Ooglopende anomalie is die feit dat die basiseenheid vir massa, die kilogram, 'n voorvoegsel het wat normaalweg 'n veelvoud aandui. Dit oorsaak hiervan lê in die geskiedenis. Die defek is internasionaal erken en voorstelle is gemaak om dit uit te skakel deur 'n nuwe naam vir die massa-eenheid te vind. Maar ongelukkig kon internasionale eenstemmigheid vir so 'n nuwe naam nie gevind word nie. Elke nasie het sy eie nasionale held wat vereer moes word.

Ons kan trots wees op die wyse waarop die oorskakeling na die SI in

Suid-Afrika deurgevoer is. Mense wat internasionale konferensies bygewoon het, het vertel dat dikwels die helfte van die tyd bestee is aan bespreking van wat Suid-Afrika besig was om te doen. Ons het 'n jaar na Engeland begin en lank voor hulle klaargemaak. □

G P R von Willich het 'n baccalaureusgraad (met lof) in siviele ingenieurswese aan die Universiteit van die Witwatersrand verwerf, en magister- en doktorsgrade aan die Massachusetts Institute of Technology. Die laaste vyf-en-twintig jaar van sy aktiewe loopbaan was hy aan die departement siviele ingenieurswese van die Universiteit van Pretoria verbonde, waar hy in 1984 afgetree het as departementshoof. Sy hoof-belangstellingsveld was struktuur-ingenieurswese.

Hy was vir baie jare aktief in die Instituut se bedrywighede, en was president in 1983. In die vroeë sewentigerjare het hy die Instituut verteenwoordig op die Buro vir Standaardse Werkgroep vir Metrisering, en was hy ook voorsitter van die Komitee vir Metrisering aan Universiteite.

Ons kan trots wees op die wyse waarop die oorskakeling na die SI in Suid-Afrika deurgevoer is. Mense wat internasionale konferensies bygewoon het, het vertel dat dikwels die helfte van die tyd bestee is aan bespreking van wat Suid-Afrika besig was om te doen

Versnelling op konstruksie- of bouprojekte

'n Paar basiese riglyne om dispute te voorkom

SUID-AFRIKA BELEEF TANS 'n bloeitydperk in die konstruksie- en boubedryf.

Die snelbaan- ('fast-track'-) afhandeling van projekte is 'n voorvereiste by haas elke privaatsektorkliënt of -werkgewer wat kapitaal wil belê in produksieaanlegte, nuwe mynbouprojekte, gebouekomplekse en selfs wooneenheidontwikkelings.

Geoordeel aan die toenemende aantal eise en dispute tussen die partye tot konstruksie- en boukontrakte (waarby die skrywer die afgelope paar jaar in een of ander hoedanigheid betrokke was in dispuutresolusie), het dit duidelik geblyk dat die begrip versnelling ('acceleration') nog grootliks 'n vae begrip is. Die gevolg is onvoorsiene uitgawes deur alle partye, winsgrense van kontrakteurs en konsultante wat beïnvloed word, en rentabiliteit van werkgewers se kapitaalprojekte wat verswak.

Die tipiese scenario is dat êrens gedurende die looptyd van 'n konstruksie- of bouprojek

- 'n verwagte of vooruitskatting van laat voltooiing gemaak word, gevolg deur
- 'n instruksie van die werkgewer aan die kontrakteur om te versnel met die bedoe-ling om die projek steeds op die kontraktueel ooreengekome voltooiingsdatum af te handel, gevolg deur
- die nie-behaling van die kontraktueel ooreengekome voltooiingsdatum deur die kontrakteur, gevolg deur
- die kontrakteur wat geld eis vir sy insette met die 'versnelling', gevolg deur
- die werkgewer wat weier om te betaal want die kontraktueel ooreengekome voltooiingsdatum is nie bereik nie, gevolg deur
- 'n dispuut

Die doel van hierdie oorsig is om 'n paar gedagtes en riglyne oor die konsep van versneling aan te stip. Moontlik kan dit deur partye in die konstruksie- en boubedryf aangewend word wanneer versnelling oorweeg word en kan dit help om dispute te vermy.

HOE VERSNELLING ONTSTAAN

Vertraging is die resultaat van wanneer werklike vordering op 'n projek stadiger is as die beplande vordering, in so 'n mate dat die kontraktueel ooreengekome voltooiingsdatum van die projek in die gedrang kom.

Dit neem gewoonlik nie baie lank vir die partye om mekaar te oortuig dat versnelling die oplossing gaan bied vir die dilemma van laat voltooiing nie. Die verwagting word immers gewoonlik geskep dat die projek, na die toepassing van versnelling, weer op die oorspronklike kontraktueel ooreengekome datum voltooi gaan word.

Ek meen dat 'versnelling' nie toegepas kan word indien die oorsake van vertraging nie ten volle verstaan word nie. Dit is dus nodig dat ons kortliks na vertraging kyk.

VERTRAGING

Ek is van mening dat die hoofsaake van vertraging te vinde is by 'n gebrek aan prestasie ten opsigte van die tydverwante verpligtinge van een of meer van die drie algemene partye tot konstruksie- en boukontrakte, te wete kontrakteurs, werkgewers en konsultante.

Tydverwante verpligtinge van kontrakteurs

Die op en af sikliese aard van die konstruksie- en boubedryf het veroorsaak dat daar tans groot tekorte aan sekere soorte hulpbronne in Suid-Afrika ondervind word.

Menslike hulpbronne

Vertraging vind plaas tydens die uitvoeringsfase van projekte wanneer onvoorsiene en té lae produksieuitsette realiseer (dit wil sê produksie wat laer is as dit waarvoor in tenders toegelaat is). Dit het nie net te doen met lae produktiwiteit van ambagsmanne, werkers en bestuurslui nie, maar ook met tekorte aan hierdie menslike hulpbronne. Hierdie soort vertraging is gewoonlik 'n kontrakteursrisiko.

Materiaal- en toerustinghulpbronne

'n Verdere faktor wat binne die kontrakteursverantwoordelike vertraging kan veroorsaak is die laat voorsiening van materiaal en toerusting. Vanweë die opbloeit wat die afgelope paar jaar in die konstruksie- en boubedryf in Suid-Afrika ondervind is, is baie materiaal is nie meer geredelik van die rak af beskikbaar nie. Langer looptye ('lead times') om bestellings af te lewer as waaraan ons baie jare lank gewoond was, is aan die orde van die dag. Indien dit nie in ag geneem word nie, kan vertraging veroorsaak word waarvoor kontrakteurs gewoonlik verantwoordelike moet aanvaar, afhangende van hulle kontrakvoorwaardes.

Voorafvervaardiging

Dieselfde geld wanneer 'n kontrakteur self verantwoordelike is vir detaillering en voorafvervaardiging van konstruksie-elemente (byvoorbeeld struktuurstaal) en daarna vir die konstruksiewerk. Laat voorsiening van detaillering, laat vervaardiging ('fabrication') en laat aflewering lei tot laat oprigting en uiteindelijke vertraging van projekte.

Spesialistoerusting

Kontrakteurs, veral dié in die spesialis-toerustingsbedryf, moet soms inligting aan die werkgewer se konsultante voorsien. Hierdie inligting word dan gebruik vir die ontwerp en konstruering deur andere van strukture en elemente om die toerusting te huisves, te ondersteun, te anker, van elektriese krag en ander bykomende fasiliteite te voorsien, en desnoods die rou produk wat vir die bedryf en onderhoud van sodanige toerusting noodsaaklik is. Laat voorsiening van hierdie kontrakteursinligting en/of veranderings in kontrakterspesifikasies het dikwels 'n vertragende effek in die uitvoeringsprogram waarvoor kontrakteurs verantwoordelike moet neem.

Tydverwante verpligtinge van werkgewers

Die gewone verantwoordelikhede van 'n werkgewer in 'n konstruksie- of boukontrak het gewoonlik te doen met die tydigde voorsiening van toegang tot die konstruksie- of bouterrein of voltooië strukture ('access'), die tydigde voorsiening van dienste soos water, elektrisiteit en ander vooraf ooreengekome dienste of strukture of die rou produk, en dan ook inligting vir die konstruksie- of bouwerk self. Laat voorsiening van enige van hierdie items het gewoonlik vertraging en 'n verlenging van tyd tot gevolg; die koste waarvoor die werkgewer verantwoordelik gehou sal word.

'n Redelik algemene verskynsel in die konstruksie- en boubedryf is egter ook die veranderende behoeftes van werkgewers nadat 'n aanvang met die konstruksie- en bouwerk gemaak is.

Hier word nie verwys na klein, normaalweg aanvaarbare praktiese detaileringsveranderinge nie, maar na wesenlike veranderings en byvoegings wat 'n negatiewe invloed het op die kritieke pad van die uitvoeringsprogram van 'n konstruksie- of bouprojek. Baie van hierdie werkgewersversoeke het nie te doen met die spesifikasie of funksionele doeltreffendheid van die finale gekonstrueerde struktuur of toerusting nie, maar met werkgewers se persoonlike voorkeure en wense ('wish lists').

Dikwels kan veranderings en byvoegings nie deur die kontrakteur met dieselfde aantal menslike en toerustinghulpbronne in die oorspronklik toegelate tyd voltooi word nie, met vertraging as resultaat.

Tydverwante verpligtinge van konsultante

Die tyd toe 'n konsultant met sy rol tekeninge by 'n terreinoorhandigingsvergadering opgedaag en vir die kontrakteur gesê het: 'Jy sal alles bou soos my tekeninge sê jy moet' is waarskynlik vir altyd verby.

Snelbaanprojekte vereis as 't ware van 'n konsultant om die einde te voorsien voordat hy begin het. Dit het waarskynlik aanleiding gegee tot die ontstaan van die begrip ontwerp-groei ('design growth').

Ontwerp-groei is veranderings en byvoegings, deur die werkgewer se konsultantspan, van noodsaaklike items wat redelikerwys nie oorspronklik, in die tyd wat vir beplanning en ontwerp toegelaat was, voorsien kon word nie.

Ontwerp-groei is relatief daarom sal die voorkoms daarvan van projektype tot projektype verskil.

Ek volstaan met die stelling dat oormatige ontwerp-groei kan hand uitruk indien die konsultantspan se ervaring gebrekkig is – die gevolg waarvan vertraginge kan wees.

Op die basis van estoppel, oënskynlike outoriteit of alternatiewelik die agentskapsverband wat tussen 'n werkgewer en sy konsultante op 'n konstruksie- of bouprojek bestaan, is konsultantaksies sinoniem met werkgewersaksies – die verantwoordelikhede

en dus ook gevolg waarvoor die werkgewer as party normaalweg verantwoordelik gehou word in 'n konstruksie- of boukontrak.

Ek is verder van mening dat vertraging in baie gevalle nie 'n enkelvoudige oorsaak het nie maar 'n konglomerasie is van laat prestasie deur bogenoemde drie entiteite (kontrakteur, werkgewer en konsultant) wat elkeen in 'n meerdere of mindere mate 'n rol in 'n spesifieke situasie kan speel.

NOODSAAKLIKE VERTREK-PUNTE RAKENDE VERSNELLING

Die voortgaan deur partye met versnelling vind baie keer halsoorkop plaas sonder dat almal presies weet waaroor dit gaan.

Ek wil dus graag 'n paar algemene vereistes aanstip wat as vertrekpunte behoort te dien by die onderhandelings, die besluit en die finale amendement waarin die ooreenkoms om te versnel vervat is.

Voorspelde vertrapde voltooiingsdatum

Die partye gaan dikwels tot die stap van versnelling oor sonder dat die voorspelde vertrapde voltooiingsdatum bepaal is.

Dit is belangrik om te kan onderskei tussen gebeurtenisse ('events') wat vertrapde op die kritieke pad van 'n uitvoeringsprogram veroorsaak en gebeurtenisse wat nie kritiek is nie. Die begindatums van kritieke voorvalle of gebeurtenisse, die duur daarvan en die voorspelde effek daarvan op die voltooiingsdatum moet bekend wees. Dit is ook belangrik om te weet dat 'n uitvoeringsprogram se kritieke pad soms kan verander gedurende die uitvoeringsperiode: Aanvanklike nie-kritieke werkitens kan as gevolg van sekere gebeurtenisse kritieke werkitens raak.

■ *Stelling:* Versnelling kan nie bepaal of beplan word as die voorspelde vertrapde voltooiingsdatum nie eers bepaal en daarvoor ooreengekom is nie.

Wie verantwoordelik is vir die vertrapde

Die partye gaan by ooreenkoms dikwels tot die stap van versnelling oor sonder om te bepaal wie verantwoordelik was vir die vertrapde.

Die 'wie' is op sigself nie 'n maklike onderwerp nie, veral as 'n mens in ag neem dat vertrapde dikwels nie die enkelvoudige, afsonderlike verantwoordelikheid van een party is nie. Vertrapde, soos hierbo aangedui, het dikwels 'n konkurrente oorsaak waar die werkgewer (insluitend sy konsultante) aan die een kant en die kontrakteur aan die ander kant vertrapde gelyktydig of gesamentlik veroorsaak.

■ *Stelling:* Die partye moet ooreenkom wie van die partye verantwoordelik was vir watter deel van die kritieke vertrapde.

Voorspelde monetêre effek van voorspelde laat voltooiing

Dit help nie dat die voorspelde voltooiingsdatum bepaal is, asook wie verantwoordelik

is vir elke gedeelte daarvan nie, maar die monetêre invloed op elke party hang in die lug nie.

Dat ons hier te doen het met voorspelling en nie met iets wat reeds gerealiseer het nie, kan onderhandelings soms bemoeilik.

Vir partye wat egter beoog om die koste-aspek na die tyd aan te spreek, eindig dit gewoonlik in 'n dispuut.

■ *Stelling:* Die volle monetêre implikasies van die voorspelde vertrapde voltooiingsdatum vir alle partye moet eers bepaal word voordat versnelling onderhandel kan word.

Kritieke vertrapde wat nie beëindig is nie

Partye gaan dikwels tot die stap van versnelling oor sonder dat die kritieke vertrapde tot 'n einde gekom het. Dit is eitlik 'n anomalie of 'n teenstrydige begrip om te praat van versnelling terwyl die vertrapde nog nie tot 'n einde gekom het nie.

Hier is dit weereens noodsaaklik dat realisme oor die oorsake van vertrapde en bona fides van die partye teenoor mekaar 'n deurslaggewende rol moet speel.

As vertrapde byvoorbeeld veroorsaak is deur 'n tekort aan ambagsmanne omdat daar eenvoudig nie ambagsmanne beskikbaar is nie, dan help dit nie om tot die gevolgtrekking te kom dat versnelling deur meer ambagsmanne in diens te neem die oplossing is nie.

■ *Stelling:* Versnelling kan nooit suksesvol wees solank 'n voortslepende vertrapde gelyktydig daarmee plaasvind nie. Die resultaat van so 'n 'gelyktydige poging' is in elk geval vertrapde, maar gewoonlik dan nog met die vermorste koste van sogenaamde versnelling daarby.

Risiko

Partye wat betrokke is by onderhandelings oor die moontlikheid om te versnel moet besef dat daar nie so iets is soos absolute sekerheid dat sukses behaal sal word nie.

Versnelling het in die meeste gevalle 'n effek op al die partye. Die mate waarin versnelling suksesvol sal wees, hang samevatend af van die omvang van insette wat van elke party verlang word en die mate waarin elke party sy deel nakom.

■ *Stelling:* 'n Risiko-analise wat bepaal wat die risiko-elemente is wat 'n invloed op sukses of mislukking van 'n versnellingspoging sal hê, is noodsaaklik.

Die omstandighede waaronder 'n werkgewer 'n instruksie aan 'n kontrakteur kan gee om te versnel

Die meeste konstruksie- en boukontrakte maak voorsiening vir boetes ('penalties') indien 'n kontrakteur laat sou wees met die voltooiing van 'n projek. Sommige kontrakte maak ook voorsiening vir die verhaling van likiede skade ('liquidated damages') as 'n alternatief vir boetes. Sommige kontrakte gee

aan die werkgewer die keuse om óf boetes óf likiede skade te kan eis vir laat voltooiing.

Indien 'n kontrak dus bepaal dat vertraging waarvoor die kontrakteur verantwoordelik is, onderhewig is aan een of ander vorm van boete-straftbepaling om die werkgewer te vergoed, is dit belangrik om te verstaan dat dit die werkgewer se enigste remedie is in terme van die kontrak – geen kontrak maak voorsiening daarvoor dat 'n werkgewer 'n instruksie aan 'n kontrakteur kan uitreik om die werk wat deur die kontrakteur self verdrag is, in te haal deur te versnel nie.

Kontrakte kan egter 'n bepaling bevat wat 'n kontrakteur verplig om 'n program voor te lê wat aantoon hoe 'n kontrakteur beoog om werk wat deur die kontrakteur self verdrag is, in te haal. Inhaal ('recover') sal egter in meeste gevalle nog steeds neerkom op versnelling en die voortgaan daarmee of nie sal nog steeds by wyse van onderhandeling met en aanvaarding deur die kontrakteur moet geskied.

Indien die kontrakteur egter uit eie vrye wil voorsien dat versnelling 'n goedkoper opsie is as boetes/skadevergoeding, kan hy besluit om die verdraagde gedeeltes van die werke uit sy eie vrye wil te versnel, op sy eie koste en sonder enige inmenging van die werkgewer.

'n Werkgewer wat aan 'n kontrakteur 'n instruksie gee om in te haal of te versnel (al is die kontrakteur verantwoordelik vir die vertraging) kan verantwoordelik gehou word vir die koste van sodanige inhaal of versnelling. Die rede is voor die handliggend, naamlik dat die werkgewer se remedie vir laat voltooiing boete en skade is en nie die reg om inhaal of versnelling op die kontrakteur af te dwing nie.

Die vraag wat dus oorbly is om te vra is of die werkgewer self, of deur sy toepaslike konsultant, 'n instruksie aan die kontrakteur kan gee om te versnel om vertragings wat deur die werkgewer (en/of sy konsultante) veroorsaak is in te haal.

Die meeste konstruksie- en boukontrakte wat in omloop is maak voorsiening vir spesifieke tipes en kategorieë van instruksies wat wel deur die werkgewer en/of sy konsultante uitgereik kan word. Dit is van kardinale belang dat werkgewers en/of hul konsultante nie hulle magte moet oorskry met die uitreik van instruksies wat buite die outoriteitsperk van sulke konsultante in terme van konstruksie- en boukontrakte val nie.

Ek het nog nie 'n kontrak teengekom wat voorsiening maak daarvoor dat 'n versnellingsopdrag of instruksie gegee kan word sonder dat die partye vooraf ooreengekom het oor die terme en voorwaardes van die beoogde versnelling nie; afgesien van die oorsake van die vertraging.

- **Stelling:** Daar bestaan nie so iets soos 'n instruksie aan 'n kontrakteur om te versnel nie; afgesien van die omstandighede

wat gelei het tot die vertraging.

- **Stelling:** Die enigste manier waarop versnelling kan plaasvind op konstruksie- of bouprojekte is by wyse van ooreenkoms tussen die partye. Sodanige ooreenkoms moet duidelik vervat wees in 'n geskrewe amendement tot die oorspronklike kontrak en behoorlik bekragtig wees deur die ondertekening daarvan deur verteenwoordigers van elke party wat behoorlik daartoe gemagtig is.

Invloed van versnelling op konsultante

As erkenning gegee word aan die feit dat konsultante se werk vertragings op 'n projek kan veroorsaak, dan moet versnelling van 'n projek logieserwys ook die werk wat deur konsultante gedoen word, en gevolglik ook die koste daarvan, kan beïnvloed.

Om die een of ander rede word die werk wat konsultante doen dikwels geïgnoreer wanneer versnelling tussen kontrakteurs en werkgewers onderhandel word; so asof die konsultant se insette nie ook tydverwant en hulpronafhanklik is nie.

Dit is natuurlik gewoon net nie logies nie. Soos reeds kan afgelei word uit die voorafgaande: konstruksie- en bouwerk is spanwerk.

- **Stelling:** Versnelling durf nie tussen 'n werkgewer en 'n kontrakteur onderhandel word sonder dat die invloed, insette en monetêre invloed op konsultante se werkkuitsette ook deeglik oorweeg is en as deel van die globale ooreenkoms om te versnel ingesluit is nie.

Die partye wil dikwels te vroeg uitkom by die aksies van versnelling sonder dat voorafgaande vertrekpunte hanteer is.

Ek is van mening dat voorafgaande vertrekpunte, die aanvaarding daarvan en ooreenkoms daarvoor desnoods vervat in 'n memorandum van verstandhouding ('memorandum of understanding') 'n voorvereiste is vir suksesvolle versnelling. Daarna kan die moontlike aksies wat in 'n spesifieke omstandigheid versnelling tot resultaat kan hê, oorweeg word.

Die aksies van versnelling

Die volgende is tipiese voorbeelde van aksies wat afsonderlik of in kombinasie gebruik kan word om versnelling te bewerkstellig:

- Vermeerdering van hulpbronne soos toerusting, werkers, bestuur, konsultante
 - Verandering na beskikbare alternatiewe materiaal
 - Die werk van oortyd binne die toelaatbare arbeidsregtelike voorskrifte daarvan
 - Die werk van meer as enkelskofte, dit wil sê dubbele en trippelskofte
 - Die vries van alle ontwerp ('design froze')
 - Die staking van verdere werkgewerveranderingers
 - Verandering van werkmodes
- Elkeen van hierdie opsies kan voor- en

nadele oplewer. Die effek van elke opsie sowel as die koste daarvan moet noukeurig oorweeg word.

Onderhandeling van versnelling

Die onderhandeling van die toepaslike aksies self behoort, net soos bogenoemde vertrekpunte, deel te vorm van

- 'n Oopboekonderhandeling waarin alle partye sonder benadeling van regte onderhandel en ook mekaar se bona fides aanvaar

- 'n Verstandhouding waaronder die werkgewer verstaan dat geen kontrakteur of konsultant versnelling sal aanvaar indien sy basiese koste daarvoor nie gedek is nie

- 'n Verstandhouding waaronder die kontrakteur en die konsultante op hulle beurt verstaan dat geen werkgewer wins aan 'n kontrakteur wil betaal indien die versnelling onsuksesvol is nie

Die oplossing lê waarskynlik verder in die onderhandeling van een of ander vorm van insentief aan die kontrakteur en die konsultante vir suksesvolle versnelling wat dan nie materialiseer indien versnelling onsuksesvol is nie.

Die aspek van boete vir laatvoltooiing behoort opnuut deel te vorm van die onderhandeling, met ander woorde onder watter omstandighede boetes gehê sal word – dit wil sê die datum waarop boetes van toepassing sal word asook die hoeveelheid. Die resultaat hiervan behoort deel te vorm van die uiteindelijke amendement.

SLOT

Die bepaling van vertraging, die voorspelde verdraagde voltooiingsdatum, wie daarvoor verantwoordelik is, wat die monetêre implikasies daarvan vir elk van die partye is en wat die kans op suksesvolle versnelling is, is 'n voorvereiste vir suksesvolle versnelling.

Enige party tot 'n konstruksie- of bouprojek wil graag hê dat die projek suksesvol afgehandel moet word. Realisme, insig in die oorsake van laat voltooiing, kennis van die basiese konsep van versnelling, kennis van die regte en verpligtinge van partye en van wat die begrip sukses vir enige ander party beteken, kan alles bydra tot die suksesvolle afhandeling en voortgesette langtermynverhoudings tussen werkgewers, konsultante en kontrakteurs in die toepassing van versnelling.

Wynand Bloem Pring, FAArb, PMP, Lid SAISI, SACPCMP is die stigter en eienaar van WFB Projekbestuursdienste wat reeds die afgelope 17 jaar vanaf Kimberley sy dienste lewer in Suid-Afrika en sy buurlande. WFB Projekbestuursdienste is 'n lidfirma van SAACE, spesialiseer in projekbestuursdienste en in dispuutresolusie, en verskyn op die president van SAACE se lys van arbiters, mediators en adjudicators



An alternative approach to implementing codes of good practice

THE BROAD BASED BLACK Economic Empowerment Act, 2003 passed into law in January 2004. The broad based black economic empowerment (BBBEE) codes of good practice were gazetted and passed into law on 9 February 2007. This ended a three year long debate and delay in respect of implementing the practical workings of BBBEE legislation.

The codes of good practice held some surprises. First, the two distinctive categories have a higher threshold than originally envisaged. The turnover in the first of the exempted micro enterprise categories was raised to R5 million. This means that organisations with a turnover of less than R5 million per annum are exempt from the implementation of BBBEE and automatically qualify as 100% compliant. Such organisations need to get a certificate from an auditor or accountant verifying that their turnover is below R5 million per annum and they automatically qualify for level 4.

The second surprise was the moving of qualifying small enterprises (QSEs) to a turnover of between R5 million and R35 million per annum. An organisation

that falls into this category also has a scorecard of seven elements to comply with, but it can elect four elements. This was much greater than was envisaged in respect of the original drafts, and both these categories constitute a big compromise to business from the original draft position.

Organisations with a turnover of more than R35 million turnover per annum fall in the final category and have to implement the full generic scorecard.

IMPLEMENTATION THE KEY

Notwithstanding the above, implementation is the key for both qualifying small enterprises and enterprises with a turnover of above R35 million per annum. The key to full compliance is to know where to start implementing the codes of good practice.

The traditional method of implementation has been through the element of ownership. The results of this approach have been problematic, however, and the approach that might be more appropriate to South Africa and many enterprises is to start where the greatest impact for the

organisation will be.

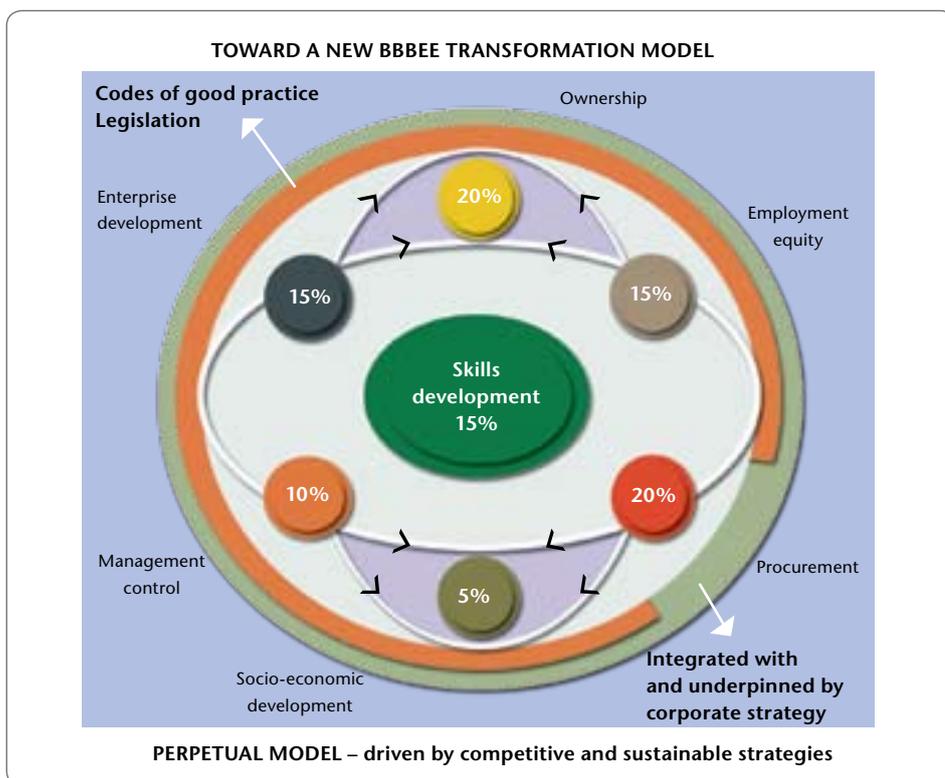
It has been our experience that rushing into ownership deals without the necessary careful thought process around organisational strategy has disastrous consequences. Organisations need to make sense of the implementation of BBBEE. To do so they need to find an entry level in the organisation from a strategic perspective.

For most organisations, strategic entry must revolve around the element of skills development. Most South African organisations are currently thin on skills – if not completely lacking skills – in various elements of their organisational structures. It is here that South African organisations are going to have to spend in order to survive in the long term and it is here where we recommend the BBBEE entry point for many organisations.

The diagram shows that skills will affect the employment equity and management numbers over a period of time. Through this approach you will be addressing 40 potential points of the scorecard. As you invest more in skills development (15 points), your employment equity numbers improve (10 points) and over a period of time so does your management representation (10 points).

One can take this approach and look at the entry level of enterprise development and corporate social investment. These are investments of a monetary and non-monetary nature. A number of innovations are taking place in organisations. For example, they are outsourcing various parts of their businesses, such as logistics, warehousing, and owner driver schemes, to support the drive of enterprise development. The support of such organisations will also have an effect on your procurement.

Through the strategic application of the codes, organisations get the benefit of BBBEE and it is highly recommended that this process, unlike many other approaches in South Africa on transformation, be tackled from a truly strategic transformational perspective.



To assist you in implementing the codes, download the free BBBEE software from www.globalbusiness.co.za



Making a difference

ENERGYS

Over the past eighteen months, the SAICE-SABTACO ENERGYS project has benefited people all over the country in many ways:

- Fifty four retired engineers enjoyed a second lease on (their professional) life by being afforded the opportunity to apply their decades of experience in a useful and meaningful way
 - A hundred and fifty technical university students and graduates were given jobs and experienced mentors for their intern year
 - Service delivery in local government was improved, where it was sorely needed
- A few case studies follow, recounting instances where SMMEs were given opportunities to earn income, create jobs and become more familiar with the tendering system for government contracts.

SAICE-SABTACO se ENERGYS-program om af- en uitgetrede ingenieurs terug te lok om diens te doen in plaaslike owerhede het vroeg in 2006 onder die leiding van 'n vorige president van SAISI, Allyson Lawless, begin.

Die program se mikpunt is beter dienslewering deur munisipaliteite. Dit skep terselfdertyd die geleentheid vir tegnoloogstudente om hulle internjaar onder 'n bevoegde mentor af te handel. Befondsing kom onder andere van die sentrale regering se Departement van Plaaslike Bestuur en Behuising.

Tans is daar landwyd 54 senior ingenieurs en 150 studente en graduandi betrokke. Die program word uitstekend geadmistreer deur Allyson en haar span

in Johannesburg.

Gedurende my jaar in De Aar by die Pixley ka Seme Distriksmunisipaliteit se Tegniese Afdeling, het dit vir my duidelik geword dat vir beter dienslewering in die Bo-Karoo (terloops, 'n gebied byna so groot soos die ganse KwaZulu-Natal), die allesoorheersende behoefte is aan groter getalle tegniese opgeleide en ervare personeel. In al agt plaaslike munisipaliteite en die distriksmunisipaliteit is daar geen enkele professionele ingenieur in permanente diens nie en slegs twee met 'n formele tegnikus-agtergrond, beide by die distriksmunisipaliteit. Gelukkig is daar wel 'n aantal toegewyde amptenare wat hul bes doen om die wiede aan die draai te hou.

'n Bevredeigende aspek van my dienstyl hier was om geleenthede te skep vir klein entrepreneurs uit die voorheen benadeelde gemeenskap om meer vertrouwd te raak met die tenderstelsel, en om werkgeleenthede te verskaf.

VAN DER KLOOF ROADWORKS: THE JIM LYNCH STORY

Hennie Greeff managed to secure ringfenced funding for repairing storm damage to roads at four localities in the Pixley ka Seme District, in the aftermath of the unusually copious rains the Karoo was blessed with in the early months of the year 2006.

One such a case was the washed-out one metre wide gravel shoulder between the edge of the tarred road surface and the existing concrete drain where the rather steep access road to Van der Kloof was in side cut.

Considering the abundance of hard dolerite stones in the area, and the fact that stone pitching was a well-established craft, it was decided to go for grouted stone pitching flush with the road surface, bedded in a 150 mm deep trench between

the edge of tar and the side of the concrete drain.

Where there was no existing concrete drain, it was decided to hand-dig a side drain after ripping with a tractor fitted with a single tine. The focus had to be on job creation, thus the requirement for hand-digging, for the benefit of the historically disadvantaged section of the community, including emerging contractors.

Considering the lack of sophistication of the targeted 'emerging' small contractors, the tender document was drafted to be as informal as possible without missing out on vital legal requirements. It turned out to be twenty pages long, which included five A4-size drawings.

Because of the limited size of the tender documents, it was practical to make them available in both English and Afrikaans. All eight documents taken from the Van der Kloof municipal offices were in Afrikaans. As the secretary explained, 'Nee wat, ons is hier mos almal Afrikaans.' It could just be that the English documents were censored by her, or at least hidden at the bottom of the pile.

Following the site meeting (compulsory for all prospective tenderers) fairly extensive re-arrangement of the section on hand-digging the side drain became imperative and a letter to tenderers was dispatched with additional contract data which was to form part of the contract.

The extent of the lack of sophistication of the tenderers became apparent in the tenders. The column for rates was ignored and only amounts for the various items of construction were entered. No one took any notice of the additional contract data.

The contract, which was mainly for labour, supervision, transport and equipment, therefore had to be limited to stone pitching, which was not affected by the additional contract data. Acting on the Tender



► **Figuur 1** Hans van Petrusville met groen oorpak en Trinity agter met wit

Figuur 2 Hans se werkspan in aksie

Figuur 3 Desmond Hugo of Vosburg and some of his team members

Figuur 4 A total of 4 500 top-quality concrete kerbs were completed

Figuur 5 Quality kerb blocks at Vosburg

Figuur 6 Keurtjieskloof: die terrein vir die voetpad



for his team of sixteen workers (one guy was far too portly and had to be exempted), his CIDB registration Category CE 1 cost R450 and his daily expenses were to be of the order of R1 000, mainly for wages. There were also the requirements for gloves and boots for his workers. The first payment certificate would only be due after two weeks and would, of course, be based on the amount of completed construction of acceptable standard. Another week or so for processing by the client would take his accumulated negative cash flow to about R15 000.

ABSA Bank in Petrusville – where he had his savings account – refused any assistance. My efforts at talking to the bank manager was met with a locked door and a messenger scurrying to and fro between us. Eventually the manager informed me, via the messenger, that ‘Mr Lynch knows why he has been refused a loan’. That left Mr Lynch with no other option than to avail himself of the kind assistance of Helpmekaar Finansiële Dienste in Petrusville who lent him R4 000 at an interest rate of about 30% per month.

Shortly after the nomination of Lynch Construction as preferred tenderer, we were stopped in the street in Petrusville by one of the other (unsuccessful) tenderers to tell us that a big protest meeting was due to take place in Petrusville that evening because Lynch Construction could not possibly be eligible for getting the contract. We explained that, as far as we were concerned, all the paperwork had been done and all legal requirements met and that they would be well advised to forget about a protest meeting and get ready for a similar contract that was due to be advertised within a week or two. Fortunately nothing more was heard about the protest meeting.

Meantime construction had started at Van der Kloof with fourteen men and two female flag wavers, all resplendent in their brand-new orange-coloured overalls (except for the portly guy) and only two wheelbarrows, picks and shovels. This was serious, for success hinged entirely around production. A pick and spade which we had with us increased his excavating complement by 50% and we enquired from local farmers about the availability of disused tools in

Evaluation Committee’s recommendation, the Tender Adjudication Committee of the Pixley ka Seme District Municipality identified Lynch Construction from Petrusville, a village fifteen kilometers from Van der Kloof, as the preferred tenderer. Their tender was well balanced and provided for the possibility of a reasonable profit if all went well.

Legal requirements stipulated that tenderers had to produce a tax clearance certificate, submit proof of an application for registration with the Construction Industry Development Board (CIDB), have a competent assessor prepare a risk assessment, and submit a health and safety plan for the construction. A further requirement was that during the construction period, a health and safety file had to be kept on site and regularly updated.

At our meeting with representatives of the Department of Labour at De Aar, their Mr Anthony Olifant hinted that the engineer (me) was, in this case, the obvious ‘competent person’ referred to in the Act. After having been appointed in writing by Messrs Lynch Construction as their risk assessor, I produced an assessment and a health and safety plan on behalf of the tenderer, which was approved by Mr Olifant for the Department of Labour.

As negotiations proceeded, it began to emerge that Jim Lynch, the owner of Lynch Construction, could neither read nor write. At the first meeting he brought his son along, and at the next meeting his wife and daughter accompanied him. He was, however, able to ‘draw’ his name when required to sign a document. The site instruction book entries were later on to be signed for by his ‘wife’, Ms U A R Emmelien.

With the signed contract for R94 775 (plus VAT) in his pocket, Jim Lynch set off to procure bridging finance for the initial period of construction. He had to buy orange-coloured overalls of the correct sizes

ABSA Bank in Petrusville – where he had his savings account – refused any assistance. My efforts at talking to the bank manager was met with a locked door and a messenger scurrying to and fro between us. Eventually the manager informed me, via the messenger, that ‘Mr Lynch knows why he has been refused a loan’. That left Mr Lynch with no other option than to avail himself of the kind assistance of Helpmekaar Finansiële Dienste in Petrusville who lent him R4 000 at an interest rate of about 30% per month



their sheds.

On next visiting the site, we were pleased to find that Lynch Construction had six wheelbarrows and more than enough picks and shovels and consequently production was impressive. Mr Lynch explained that his foreman, Johnny Moos, was lending him these tools and barrows. The very next day a telephone call from a Van der Kloof town councillor revealed a very concerned individual. It transpired that Mr Moos was the organiser of a job creation programme of the municipality for street resurfacing in Van der Kloof and that their production was hampered by their being short on wheelbarrows and other tools. It could well be that Mr Johnny Moos reckoned that the indifferent rate of progress in street surfacing did not warrant the excessive amount of equipment available there.

Mr Lynch being a house builder at heart, it took some effort to convince him that the prescribed grout mix of one part cement to four parts sand (SABS 1200 DK-1996 Section 3.2.2) was not outrageously strong (and expensive). He was only convinced when he was reminded that, as far as he was concerned, the cement was provided free, according to the contract.

A payment certificate for R20 249,25 was agreed upon and signed by Mr Lynch with no knowledge of what it was about, apart from our verbal communication. Allowing one week for processing by the client, three weeks into construction Messrs Lynch Construction had produced a surplus over expenses of R5 000. The quality of his work was good and members of the public at Van der Kloof had com-



mented favourably on the pleasing results of the construction. There was little reason to expect anything but a successful outcome for contractor, client and the public.

WERKGELEENTHEID VIR HANS VAN PETRUSVILLE

Hans, 'n man in sy laat dertigerjare, sy vrou Dina en hulle kinders woon in 'n sinkhuisie in 'Die Plakkerskamp'. Dina vertel hoe bitter koud dit in die winter in die huisie word, maar sy hou alles silwerskoon en vee ook elke more rondom die huis.

Hans kan nie lees of skryf nie, maar kan wel sy naam 'teken' – H A N S. Hy het 'n bakkie, 'n selfoon en 'n bankrekening, en sy vennoot Trinity kan lees, 'n kontrak verstaan en ook taamlik goed skryf.

Jacques, 'n boer van naby Petrusville wat saam met Hans grootgeword het, het Hans aan my voorgestel vir die werk om die reserwe oor twee kilometer van die pad tussen Petrusville en Colesberg skoon te kap. Die digte stand van doringbome in die reserwe het meegewerk om ernstige stormskade aan die pad te veroorsaak tydens die swaar reën vroeg in 2006.

Jacques, 'n gekwalifiseerde landbou-ekonoom, het baie tyd saam met Hans deurgebring om 'n goeie kwotasie voor te berei, en die tweemaandekontrak is toe aan Hans en sy span van sewe mans en een vrou toegeken. Hulle het met mening ingeklim en die werk binne drie weke tot 'n baie bevredigende standaard afgehandel. Hans is betaal volgens sy kontrak en nadat hy met sy werkers afgereken het, het hy brood op die tafel om sy familie te versorg.

Hans het aan my gesê dat hy nog nooit tevore enige kontrak geteken het nie, en dat hy baie in sy skik was met die uitkoms van hierdie een.

KERB MANUFACTURE AT VOSBURG

Desmond Hugo from Granaatbosstraat in Smartietown at Vosburg was successful with his labour-only quote for producing concrete kerbs at R15,00 per kerb for the proposed street works in the township.

Forty welded steel forms, concrete aggregates (stone and sand), cement, water and tools were to be provided by the Kareeberg Local Municipality. Desmond and his thirteen workers, nine of whom

were women, would share the R520 per day and he, as foreman and entrepreneur, would receive an extra R80 per day – R600 in total.

When we arrived at the District Municipality the first few batches of concrete had been produced, and it was obvious that something had gone horribly wrong. It transpired that the incorrect coarse aggregate (stone) size had been provided to Desmond, and in his frantic efforts to produce a workable mix, the resultant cube strength was well below the required standard of 25 MPa.

We recommended that the correct size coarse aggregate be ordered from De Aar Stone Crushers and prescribed a trial mix which was very successful. Cube crushing strengths were monitored during the five months of cube manufacture, courtesy of the Rocla and Grinaker laboratories in De Aar.

With crushed dolerite coarse and fine aggregate of superb quality produced by De Aar Stone Crushers, the correct mix proportions and careful monitoring of cube strengths, the kerbs produced by Desmond Hugo and his team right up to when the final batch of the 4 500 kerbs was delivered during November 2006 was comparable to the best to be found anywhere in South Africa.

A R67-million road building contract for surfacing of the road between Britstown and Vosburg started at the beginning of 2007, and Desmond Hugo and his team were well placed to be employed in concrete work on this project.

KEURTJIESKLOOFVOETPAD EN -PADWERK

Die gemeenskap van Keurtjieskloof (voorheen die 'bruin' werkers se woonplek naby Van der Kloof) moet drie kilometer ver loop om in Van der Kloof te gaan werk of inkoopies te doen. Die teerpad daarheen is kronkelend, steil en met smal skouers, en dus gevaarlik, en ons beoog om 'n voetpad teen die hang van die berg te bou wat 'n halwe kilometer korter sal wees, met 'n gemaklike helling. 'n Deel van die voetpad sal dien vir die vissermanne wat in die reuse- Van der Kloof dam gaan lyn natmaak om vir hulle families 'proteïne' te vang.

Die terrein waaroor die voetpad moet





Die verskaffing van fasiliteite van 'n goeie gehalte en deeglike onderhoud van die bestaande infrastruktuur kweek 'n trots en selfrespek wat die gemeenskapslewe verryk



gaan is baie rof en is op sekere plekke met groot doleriet-rotsblokke besaai. By ons vergadering met die gemeenskap van Keurtjieskloof het ons voorgestel dat ten minste drie verteenwoordigers van die gemeenskap met ons die roete van die voorgestelde pad sal stap om dan terugvoering aan die gemeenskap te gee oor die wenslikheid, haalbaarheid en veiligheid van die projek. Die verteenwoordigers moes kennis hê van klipwerk en die berge ken.

Almal was vol geesdrif vir die voetpad, en die eerste tender vir die deel van die pad wat in die hang van die berghelling uitgegrawe kan word, is aan 'n plaaslike klein kontrakteur toegeken. Die deel oor die rotsblokke sal 'n verhewe voetbrug wees wat tans in samewerking met 'n plaaslike ingenieursfirma (staalwerk) beplan word.

Dit kan moontlik prakties wees om langs die pad bome te plant en te besproei met 'n pyplyn waarby 'n waterdrinkplek aangesluit kan word.

Die skouers van die teerpad na Keurtjieskloof, omtrent een meter wyd tussen die rand van die teer en die bestaande beton-kantsloot, het sowat veertig jaar nadat dit destyds tydens die bou van die Van der Kloofdam gebou is, gevaarlik uitgespoel. 'n Plaaslike SMME-kontrakteur is aangestel om die skouers met gevlooderde klipbestrating te herstel. Terselfdertyd is die bestaande skramreling skoongemaak en geverf, en 'n aantal vrot pale vervang. Alle werk, insluitend die meng van dagha, is met die hand gedoen om maksimum werkgeleentheid aan die plaaslike inwoners te bied.

Die verskaffing van fasiliteite van 'n goeie gehalte en deeglike onderhoud van die

► **Figuur 7** Verteenwoordigers van die gemeenskap van Keurtjieskloof na 'n vergadering met hulle

Figuur 8 Die uitgespoelde skouer

Figuur 9 Philipstown: wal met grafte regs

Figuur 10 Uitgrawing vir oorloop met Pramborg agter

Figuur 11 Rietfontein dam-oorloop

bestaande infrastruktuur kweek 'n trots en selfrespek wat die gemeenskapslewe verryk.

STORMWATERBEDREIGING BY PHILIPSTOWN

Tydens die swaar reën in die eerste helfte van 2006 is huise in die Philipvale-gedeelte van Philipstown oorstrom. Die oorsaak was 'n ou dam langs Philipvale wat nie oor genoegsame oorloopkapasiteit beskik nie, met die gevolg dat die surpluswater na sommige huise afgekeer is.

Ons het 'n tache-opmeting gedoen en 'n kontoerplan van die dam en omliggende terrein voorberei. 'n Hidrologiese ontwerp het die vereiste grootte oorloopkapasiteit gelever en ons kon 'n geskikte ontwerp doen.

Tydens ons opmeting het ons vasgestel dat, onderkant en direk teenaan die klein uitlooppyp van die dam, 'n uitgestrekte ou begraaftplaas geleë was. Kleinklaas, ons stafman vir die opmeting, het vertel dat al sy direkte voorouers ook in die begraaftplaas lê. Materiaal uit die uitgrawing vir die nuwe oorloopstruktuur word gebruik om 'n stewige wal te bou wat vloedwater van die begraaftplaas sal wegkeer.

Al die werk word met die hand met pik, graaf en kruit gedoen ter wille van werkskepping vir die inwoners van Philipvale, vir wie werkgeleentheid uiters skaars is. □

CREATING ENTHUSIASM FOR CIVIL ENGINEERING

THE SKILLS SHORTAGE IN our country has reached crisis proportions, with more and more skilled professionals being lured overseas by big incentives and a low graduate turnover.

To counteract this shortfall, Goba Pty (Ltd) has embarked on a civil engineering promotion campaign aimed at high schools. The aim of the project is to promote civil engineering as a career at high school level, targeting learners doing maths and science.

In May 2007 Leon Mbongwa from Goba Pty (Ltd) visited the Drakensberg High School in KwaZulu-Natal to give a presentation about civil engineering.

The learners were exposed to all facets of the civil engineering world: railway, structures, water, transportation and construction. As part of the presentation the learners were informed of the requirements for civil engineering qualification, tertiary education and where to get financial assistance. Other related issues such as the demand for civil engineers, work opportunities and working conditions were also discussed.

These practical seminars aimed at tertiary institutions are an ideal platform to inspire and stimulate the interest in the young engineers of tomorrow. The response that was received was excellent and generated great excitement amongst the learners. It was evident that very little is known about the civil engineering profession judging from the questions that were asked, like 'Will there be work for civil engineers after 2010'.

The feedback was enough to validate the need to promote career guidance at this level of our society in civil engineering.

Below: Leon Mbongwa



BE ANYTHING YOU WANT TO BE!



AFRICON HAS, FOR THE third year in succession, embraced Cell-C's 'Take a Girl to Work Day' initiative.

The day focuses on introducing female learners in Grades 10 to 12 who are studying science and mathematics to the diversity of careers that are open to them.

Africon staff members were invited to bring their daughters or female relatives to work for a day of interaction with the company's professionally qualified staff.

Twenty one girls were welcomed by Africon's training and development manager, Sibongile Maratana, who explained that the theme for the day was 'Be anything you want to be'.

The girls toured the company's business units and spent time with female professional staff including attorneys, engineers, accountants, laboratory technicians and IT and human resources specialists.

Linsey Dyer, an Africon technical director, led a discussion on 'Women in Engineering'. 'I certainly feel that we have helped the girls to better define what opportunities there are for them and to put into better perspective their preconceptions of gender barriers to a career,' says Linsey. 'If the day helps just one girl to discover what she wants to be, it will have been a success!'

Above: Vanguard moved the 600 t MV Ellen Khuzwayo from the shipbuilder's warehouse to the synchrolift at the Cape Town Waterfront

VANGUARD MOVES HUGE RESEARCH VESSEL

VANGUARD, SOUTH AFRICA'S PREMIER heavy lifting and rigging specialist, has completed a project using its unique imported Goldhofer trailer system to transport a newly constructed research vessel, the MV *Ellen Khuzwayo*, from the shipbuilder's warehouse to the synchrolift at the Cape Town Waterfront.

Built by prominent Cape Town shipbuilder Farocean Marine (Pty) Ltd, the vessel was commissioned by a government department to conduct fishery research. The ship weighs approximately 600 t and can accommodate 23 people. It is 16,5 m (five storeys) high, 10,2 m wide and 43,2 m long, and has taken two years to build.

According to Vanguard's managing director, Bryan Hodgkinson, the move was successfully completed on 23 May 2007 using the company's Goldhofer modular trailer system.

'This is one of the reasons that we purchased the Goldhofer trailer system. In addition to its versatility and modularity, the trailer is incredibly robust and can be used in a host of applications.'

Vanguard initially imported 24 axles, with a 600 t site capacity, and two Mercedes Titan horses. Following the successful use of the trailer in various projects, the company imported a further 12 axles, giving the trailer system a capacity of over 1 000 t.

'Another reason we chose the Goldhofer is that it offers virtual axle configuration. We used two six-axle trailers, side by side, to transport the heavier stern, while the bow rested on one 12-axle trailer. There was a 15 m to 20 m gap between the trailers, which was bridged by hydraulic cables. The virtual axle configuration, set up via computer, enables the axles to function in the same way as they would if the middle axles were actually present. Both horses were used to pull the load on the 4 km trip,' says Hodgkinson.

The vessel was constructed in cradles and mounted on pedestals to ensure a smooth transition onto the trailers. Once the overhead crane and one of the warehouse walls were dismantled,



► Above: Vanguard's imported Goldhofer modular trailer system transported the ship, pulled by two Mercedes Titan horses

the trailers were lowered and manoeuvred beneath the ship. When in place, the trailer was jacked up and the move began.

'As far as we know, this is the heaviest item to be transported on a public road in South Africa,' says Hodgkinson.

The stretch of road from the warehouse to the synchrolift was cordoned off to ensure safe passage.

► **MORE INFO**

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HIGHLANDS VILLAGE DEVELOPMENT SOLD OUT

THE MOLADI BUILDING METHOD proved its worth when 230 housing units in Mitchell's Plain were sold out within two days.



The Highlands Village development was launched on 12 and 13 May 2007. Potential buyers, some of whom had waited for more than a full year for their prized homes, had their last laugh when the Moladi method proved an instant winner to all and sundry.

The Highlands Village development will consist of two and three-bedroomed homes, to be constructed over four phases. Graham Finlayson, project development manager for Cape Town Community Housing Company, the property developers, said the first phase will be constructed towards the end of June 2007. 'Given the overwhelming interest by potential purchasers, our aim is to complete the entire project by March 2008. We are buoyed that there are an estimated 500 potential buyers who are already waiting in the wings for similar type developments.'

Finlayson said the housing company is seriously considering using the Moladi method in future projects. 'Moladi has been used successfully elsewhere in the country and there is a case to be made for its use in other developments such as the planned Westcape development, also in Mitchell's Plain.'

The Westcape development, another CTCHC project, is planned to provide a mixture of housing typologies catering for different income

markets. Finlayson stressed that integrated housing developments are the way to go. 'One only has to look at the successful Cosmo housing project in Johannesburg to realise that different income brackets can be accommodated within the same development.'

'Depending on reaching an agreement with all stakeholders, the planned housing development in Gugulethu could provide us with yet another opportunity to go this route.' The Gugulethu development is still in its planning stages and could yield up to 1 600 homes upon completion.

NEW PERMEABLE PAVING

RAPID URBANISATION IS PUTTING increasing strain on South African cities' stormwater drainage systems, as run-off overloads sewers and culverts during heavy rain, contaminating streams and rivers and inflicting environmental damage. Now an answer to the problem has been found with an ingenious permeable paving drainage system which prevents run-off and flooding by collecting and cleaning stormwater.

It's called Aquaflow, and it's being manufactured under licence by concrete paving specialists Concor Technicrete. Known as a sustainable urban drainage system (SUDS) and originally developed and tested in the UK, the specially designed paving block has been designed for large catchment areas such as shopping centre car parks, pedestrian malls, housing complexes and industrial estates.

Explaining how the system works, Taco Voogt, Concor Technicrete's commercial product manager, says: 'The system allows the stormwater from heavy rain fall to penetrate through the slots of the permeable concrete paving block into a well compacted sub-base of large stones before being released in a controlled manner into sewers or water-courses or directly to the groundwater table. The storm water literally vanishes into the slots between the paving blocks. Water leaving the system has been cleaned naturally by filtration and microbial action.'

Voogt says water can be attenuated in the sub-base by using a choice of retention methods, including plastic or specialist geomembrane liners, where the water can be held for a few days before being released, pumped out or harvested. He says a number of sites in the UK are harvesting and re-using the 'grey' water from the system for flushing toilets and irrigating landscape gardens. He adds: 'I'm told that it has been found that the water from the Aquaflow system is kinder to plants than tap water.'

During dry weather, heavy metals, hydrocarbons, silt, rubber dust and other detritus are deposited on impermeable surfaces, Taco Voogt says. 'The problem is that when it rains, these materials are scoured off and carried into municipal water systems and rivers where they can cause severe environmental harm. Most

sewerage works are not equipped to handle and treat these contaminants. Aquaflow is one way of preventing these pollutants from entering the environment.'

Concor Technicrete is using a specially modified form of its Trojan paving block, aptly called AquaTrojan, in two sizes – 135 mm square and 206 mm x 135 mm – for the new system.

► **MORE INFO**

Concor Technicrete
011-495-2200

► Typical Infiltration system with sub-grade CBR of 5% or greater

WINTER-LONG ENERGY EFFICIENCY DRIVE LAUNCHED

THE NATIONAL ENERGY EFFICIENCY Agency is poised to become the leading voice on energy efficiency issues in South Africa, with the launch of a winter-long awareness campaign.

In conjunction with its key partners – the Department of Minerals and Energy, the National Energy Regulator of South Africa (NERSA) and

Eskom – it is hoped the NEEA will deliver significant energy savings and help avoid power cuts.

Currently, during peak demand the 'Power Alert' running on TV is proving a success, reflecting a public willingness to save power.

The NEEA's acting general operations manager, Barry Bredenkamp, explained: 'When the alert turns red, people are responding by turning off non-essential appliances, causing a significant dip in demand.'

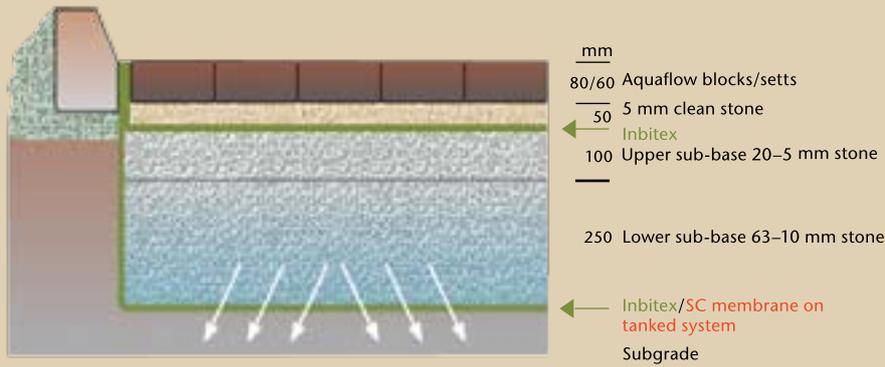
'This is very encouraging, as it shows South Africans are willing to do their part to save energy. I believe an excellent opportunity exists to change people's attitude to energy consumption.'

To capitalise on public awareness and interest, a national television advertising campaign began on June 1 to create an educated public. It will run until the end of August.

The main aims of the NEEA campaign are to:

- Work with commercial partners to promote practical energy efficiency measures among their employees and to the broader public. Current partners are Nedbank, Clicks, Pick 'n Pay and Finish
- Work to improve consumers' efficient use of energy – whether they are commercial or private – and their abilities to save energy through upgrading old technology
- Stimulate public and stakeholder interest and debate in energy issues

Parking areas subject to trafficking by cars and light vans



■ Make sure energy efficiency does not become a byword for electricity efficiency – the NEEA is concerned with the efficient use of gas, liquid fuels, renewable energy and all energy-intensive processes

Bredenkamp cautioned that South Africa still had a way to go.

'South Africa lags well behind Western Europe and America when it comes to energy consciousness and the importance of saving power wherever possible – it is critical this attitude is changed.

'We want to develop South Africans into energy conservers by nature – not only will it help protect our environment, it will help people save money on their utility bills too.'

Bredenkamp said: 'Our commercial partners are right behind us in this campaign, and they are definitely not the only ones who want to be involved. I believe other companies will help turn this from a campaign into a national movement.'

The NEEA began operations in April 2006 and is a division of the Central Energy Fund.

POPULARITY OF MULTI-STOREY SLAB SYSTEM GROWING

THE TASS (thermal acoustical expanded polystyrene multi-storey slab system), which has seen exceptional growth in the local building sector over the last two years, is now being taken to the market by the supplier, Automa Building Products.

The company is perfectly positioned to market this increasingly popular building system through a network of carefully selected licensed consulting structural engineers.

'This innovative TASS multi-storey "rib and block" floor slab system was developed by MRH Consulting Engineers after extensive research into alternative floor slab trends locally and overseas. To date, over 50 000 m² of TASS slabs have been successfully installed in the Gauteng area through MRH alone,' says Craig Paton-Ash, director of Automa Building Products (ABP). 'By licensing this proven system to consulting structural engineers, specification and control will be under the supervision of qualified engineers. This licensing arrangement also gives the engineering fraternity the opportunity to re-claim a revenue stream that has been lost to turnkey concrete "rib and block" system suppliers.

'With the trend towards more thermally efficient buildings, driven by rising energy costs and concerns over global warming, this insulating floor slab allows the reduction of air-conditioning capacity and with it, reduced heating and cooling costs. This system also leads to more comfort through the moderation of internal building temperatures.

'From a design and building perspective, the TASS system also conforms with the general shift towards "rib and block" slab systems. With



► Above: The TASS system is now being taken to the market by the supplier, Automa Building Products

all system components being lightweight, labour costs are reduced and heavy duty lifting equipment requirements for installation are minimal. This system is also much quicker and cheaper to install than conventional slab systems.'

The TASS system comprises a patented expanded polystyrene void former that stays in place and a unique cold rolled lipped channel which acts as the 'rib'. This system is completed conventionally with a reinforcement bar, mesh and concrete.

TASS blocks are available in four different depths to cater for different slab lengths and free spanning requirements up to 10,5 m.

► MORE INFO

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CONSTRUCTION ON WORCESTER CASINO HOTEL UNDER WAY

CONSTRUCTION IS UNDER WAY on a new R68-million Sun International hotel adjoining the Golden Valley Casino site in Worcester.

Due to open in Autumn 2008, ahead of the Easter holiday period, the two-storey hotel will comprise 100 rooms including two suites and, in keeping with the neighbouring casino complex, will boast a Cape Dutch architectural theme.

The hotel complex, positioned against a spectacular mountain backdrop, will offer a compact business meetings facility, a lounge/breakfast room and a small swimming pool. It will bring Sun International's total investment in Worcester to date to R218 million, adding significant value to the region's leisure product.

In addition to boosting job creation during the construction phase, once opened the hotel will implement a preferred procurement policy. The policy will be aimed at maximising economic opportunities in the Worcester region, both with regard to employment, and also to servicing the hotel's other business needs.

The hotel development's architects are Northpoint and Western Cape-based Longworth and Faul are the principal contractors.

THE GOLDEN VALLEY CASINO

The casino:

- Is the largest investment ever made in tourism in Worcester and is expected to have a significant impact on the Breede Valley district
- Has created 316 new jobs. Of these, 126 are directly related to the casino and 190 to concessionaires such as the restaurant and bars
- Has a BEE shareholding of 60%. Of this percentage, Grand Parade Investments holds 38%, Stripe 7 Investments 8% and Business Venture Investments 10%. Importantly, the community-based Breede Valley Community



Trust owns 4%, with the specific aim of empowering local people in the Breede Valley

■ The casino's operator, Sun International, holds the balance of 40% of the shares, and, from its shareholding will come the 3,5% which is to be allocated to previously disadvantaged employees through the Sun International Employee Share Trust

MASERU BRIDGE MULTI-MODAL CENTRE

VELA VKE BLOEMFONTEIN WAS recently appointed to provide a concept plan for a multi-modal public transport centre in the vicinity of the Maseru Bridge border post in the Free State.

The project was characterised by a complex set of design parameters. These included the incorporation of a future passenger railway station, more than 120 parking spaces for mini-bus taxis, 30 bus parking spaces, a truck inspection area for SARS activities at the border post, and existing pedestrian streams to be divided from vehicular traffic.

The optimum location proved to be the existing border post area. A facility with an estimated cost of R320 million was designed with the help of Henriette Hoon Architects. The concept



► Top: Graphic of Maseru multi-modal facility

plan was completed within a very strict time frame of five weeks.

► MORE INFO

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DEVELOPING A COMMUNITY

THE THABA 'NCHU COMMUNITY Development Project stretches as far back as April 2003. The background to this venture began when it was

found that the National N8 route between Bloemfontein and the Maseru border post passed through the southern outskirts of Thaba 'Nchu, some 65 km east of Bloemfontein. As a result, this section of the N8 was proclaimed a national route, resulting in the South African Roads Authority Agency Ltd (SANRAL) taking full responsibility for the road.

The development initiative, estimated at a value of R11,9 million, forms part of the larger SANRAL outreach programme designed to uplift rural communities along the N-road routes. The venture was awarded in a joint venture with SNA Civil and Structural Engineers. According to Civil Engineer Naomi Nieuwoudt, the two-year contract, which began in March 2006, entailed the upgrade of various streets with specific emphasis on the utilisation and development of SMME/BE subcontractors.

The area of Thaba 'Nchu has 14 352 households and is subdivided into four wards. The large underdeveloped residential area is located to the south of the N8 with community facilities such as schools and clinics, as well as the commercial centre, located to the north. The N-routes upgrade originated because many school children from the community who commuted on foot required safe facilities and pedestrian crossings. Dedicated pedestrian crossings were therefore introduced to improve pedestrian safety.

The generally poor state of gravel urban



streets in the Thaba 'Nchu area led to a project to improve surrounding streets. The venture was implemented by SANRAL in consultation with a project steering committee (PSC) which consisted of various community representatives, traffic officials and the Mangaung local and Motheo district municipalities.

Discussing the needs of the community in correlation with the PSC created problems of a different kind and led to many lengthy discussions. 'Arising from the committee's involvement, the need was identified for a pedestrian bridge across a spruit towards the west of Thaba 'Nchu to serve a large number of school children. The final scope of the project therefore entailed the improvement of streets, the provision of walkways to serve pedestrian crossings on the N8 and the construction of a pedestrian bridge,' notes Nieuwoudt.

There was also a public liaison committee (PLC) which was established to act as mediator between community members and the contractor. According to Naomi, dealing with a PLC made life easier in some cases but was also challenging in other areas. 'The PLC has the power to control the use of labour on a project. With this venture, the project was bound by a strict labour target which was prescribed at 15% of the contract value. The contractor therefore had to liaise with the PLC when sourcing local labour. They also tried as far as possible to make use of local contractors and suppliers within the Thaba 'Nchu area.'

SNA Civil and Structural Engineers are long-standing users of Civil Designer and AllyCAD and have integrated the software with great success into all of their branches. The infrastructure design software was used to produce the final designs for the Thaba 'Nchu Community Development Project.

SNA Civil and Structural Engineers were also responsible for the design of the bridge that would assist school children and other pedestrians who needed to cross the stream. The position of the bridge was determined after surveying the number of pedestrians crossing at identified crossing points. The most frequently used location was then chosen for the construction of the bridge.

Challenges identified on the project consisted of the contract itself as well as the actual terrain.

Community reaction to the project has been extremely positive. With the completion of the project, it is anticipated that the community will benefit from the upgraded services and additional facilities provided.

► **MORE INFO**

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MONTECASINO'S MAGICAL FOUNTAIN POWERED BY DENORCO

AT THE HEART OF MONTECASINO'S new musical fountain, the focal point of its R350-million piazza development, lies South African pump manufacturer Denorco's NormaFlo NM range of compact centrifugal pumps.

Says Ian Hopkins, managing director of Pool Spa and Filtration Contracts, the company that



► Top: Pump at Montecasino

built the fountain: 'We have been dealing with Denorco for over 20 years now and have come to trust their pumps. So when it came to deciding what pumps to use in this complex project, we did not look anywhere else.'

The NormaFlo NM range was chosen as it is able to switch from full to low speed in seconds.

'Because this is a musical fountain, the water flow has to change rapidly to keep up with the beat of the music. This is very demanding on the pumps, as they move from high to low flow within seconds. The NormaFlo's are able to handle this.'

Riaan Labuschagne, product manager at Denorco explains: 'The NormaFlo NM compact centrifugal pumps are ideal for high-pressure pumping applications and booster systems.'

'These pumps are also suitable for irrigation, fire fighting, air-conditioning and heating purposes,' Labuschagne says.

Concludes Hopkins: 'This was a huge project. The fountain is only the fourth musical fountain in the country, and only one of these was locally designed and built. We have used the latest technology in the project and quite frankly, the pumps work really well in this application.'

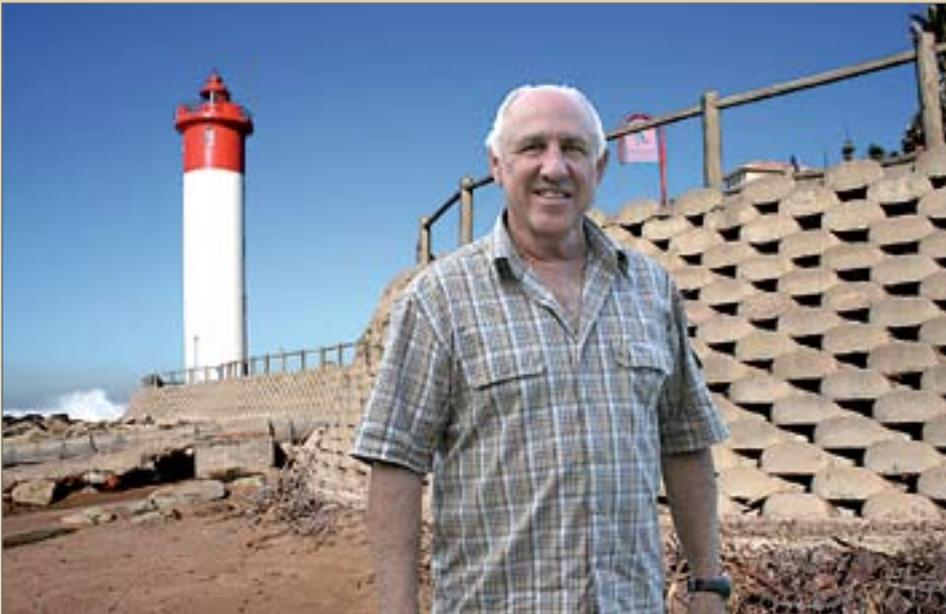
'The fountain performs three shows per night and has to be seen to be believed,' says Hopkins.

► **MORE INFO**

Denorco
011-609-4190

GIANT WAVES MAKE LITTLE IMPACT ON WATERLOFFEL WALLS

MARCH'S TURBULENT SEAS and extraordinarily high tides, which wreaked havoc on large stretches of beach on the north and south coasts



of KwaZulu-Natal, resulted in only slight damage to those sections of the coast protected with Waterloffel sea walls.

Waves as high as 12 m were recorded from Richards Bay to Port Edward, and beaches in Durban, Umhlanga, Umdloti, Ballito and Umkomaas were particularly hard hit. Many remained closed over the Easter holidays due mainly to health concerns about ruptured sewage pipes and a lack of sand.

Cuane Hall, sales and marketing manager of Infraset Landscaping Products in KwaZulu-Natal, says that the Waterloffel sea walls at Margate, Durban, Umhlanga, Umdloti and Westbrook beaches withstood the destructive power of the waves exceptionally well and required only minimal and superficial repair work.

'This was not the case at unprotected beaches, for instance Ballito's, which were severely damaged. Large sections of unprotected boardwalk were completely destroyed and some buildings, for example the popular holiday resort Santorini, were undermined by the force of the water.'

Hall acknowledges that some walls using

► *Top: The unprotected Umdloti Beach, which shows exposed piping and roadway damage shortly after the extraordinarily heavy seas battered the coastline of KwaZulu-Natal in March*

Above: Cuane Hall, sales and marketing manager of Infraset Landscaping Products in KwaZulu-Natal, standing in front of a Waterloffel sea wall in Umhlanga which withstood a pounding from the highest tides in living memory during the week of March 17th.

Huge waves, some as high as 12 m, severely damaged beaches, private property, roads, and infrastructure on unprotected parts of the coastline between Richards Bay and Port Edward

the system were damaged by the heavy seas, for instance those at Isipingo, but the reason for this is that they were built with foundations on sand instead of bedrock.

'Standard designs for the correct installation of Waterloffel walls must insure that they are founded on bedrock. They must also incorporate specially designed behind-the-wall drainage and selected free-draining backfill material such as beach sand. The current designs were developed jointly by Infraset and Kaytech, and these have proven extremely effective.

'Waterloffel, which is one of several Loffelstein retaining wall products, will be used

to repair beaches at Umhlanga, Umdloti, Ballito and Umkomaas as well as others in KwaZulu-Natal. It is certainly ideally suited to protect our beaches, not only those of KwaZulu-Natal, but of the entire South African coastline,' says Hall.

Waterloffel sea walls have been built along selected sections of the KwaZulu-Natal coast, in Knysna and in Cape Town, over the past 15 years. They were first introduced after research conducted by the Civil Engineering Department of the University of Stellenbosch in the early 1990s demonstrated conclusively that their shape and configuration dissipated wave energy and vastly reduced the destructive power of wave action, while contributing to a redepositing of sand on the protected beaches.

Waterloffel retaining walls are also used to create marinas, protect embankments in estuaries and as scour protection on river banks. They and other Loffelstein retaining wall systems are registered as a global trademark for which Infraset Landscaping Products holds the licenses worldwide.

► MORE INFO

Cuane Hall

Infraset Landscaping Products

T 031-569-6900

CONSTRUCTION COMPANIES ELIMINATE CASH WITH WIZZIT

CASH HEISTS AND ARMED robberies are common in South Africa. And if you thought it was tough being a security guard in a bank or armoured vehicle, try being a construction company on payday!

All too often, stories of employers and their staff being targeted by syndicates or criminals on payday have left them worried for the security of themselves, their staff and their money.

A site manager at a construction company in Alexandra was recently robbed of over R80 000 in wages meant to be paid to his workers. A woman was pick-pocketed of R16 500's worth of wages in a retail store in Edenvale. These are real stories that have affected real people and have left some small construction businesses financially crippled.

The truth is that securing one's money and ensuring the safety of staff on payday has become top priority for construction companies. Research suggests that 80% of construction companies' employees are still either paid by cash or cheque and few banking organisations have come up with cost-effective solutions to help them do away with their reliance on cash.

Criminals know that the construction company managers will be transporting hundreds or even thousands of rands to pay workers on any given payday. Workers are also easy prey and are

actively targeted by criminals on payday, while making their way back home or to the shops.

For those construction companies paying their employees by cheque, the issue of exorbitant bank fees associated with cheques, coupled with the increasing prevalence of cheque and identity theft makes paying workers a veritable nightmare every week or month.

The only alternative is to transfer salaries directly into a bank account, reducing the amount of cash being handled, and reducing fees being paid when drawing cash at a teller or issuing cheques.

ENTER WIZZIT

The main aim of WIZZIT – a division of the South African Bank of Athens Limited – is to eliminate cash and cheques from the equation altogether by using simple and cost-effective bank accounts allowing construction companies to pay their employees or suppliers in total security using cellphones or the Internet.

By opening cost-effective and easy-to-use bank accounts for their workers, construction companies are able to pay their staff electronically rather than in cash. Apart from the security and convenience benefits to the employers, workers also feel safer not carrying large amounts of cash and have the added benefit of having somewhere to keep their money safe.

Over the last few years WIZZIT has pioneered the use of cellphones as a method of banking, essentially turning the cellphone into a one-stop-shop for banking services. These include the ability to make payments to WIZZIT and non-WIZZIT account holders, buy prepaid airtime, recharge prepaid electricity, do balance enquiries, and stop stolen or lost WIZZIT Maestro cards.

Cellphones are prolific in South Africa and the adoption of cellphones is growing exponentially every year, even amongst the lower income earners of the country. Cellphone literacy is relatively high in lower income groups as well, so using the cellphone as a primary method of banking makes sense.

Employees benefit from having instant, easy access to their money via their cellphones or a Maestro debit card, while it is kept safe in a bank account, and employers are less at risk of being held up and robbed of their cash.

In a nutshell, WIZZIT is a completely functional virtual cellphone bank. This means that it does not have a large branch network to support and is therefore extremely cost effective.

WIZZIT aims not only to be easy to use, but to be as accessible as possible to ensure that anyone who opens a WIZZIT account will be able to take full control of their finances, without paying the earth in bank fees to one of the larger established banks.

WIZZIT accounts can be opened on the spot within a few seconds by accredited WIZZkids, who operate as human bank branches. These WIZZkids carry R39,99 starter packs, which include a WIZZIT Maestro debit card and all the documentation to get up and running with a new bank account, in minutes.

A major benefit for employers is that if

required, the bank 'comes to you' – another proof of WIZZIT's success. As Biltworx site manager, Gideon Engelbrecht, points out: 'Time is money in the construction market. If a worker is spending time in a bank branch, or has to take a day off work to get all the required documentation together to open a bank account, the loss of his or her man-hours could hurt a project badly.'

Biltworx is a construction company with multiple projects on the go throughout South Africa and does most of its work through sub-contractors. Around 300 sub-contracted employees working for Biltworx have WIZZIT bank accounts, but this number is increasing substantially as new employees or sub-contractors come on board.

Construction companies are also able to use the WIZZIT payroll system, called iWIZZ, which facilitates the payment of workers on a payment schedule set up in advance so that the employers do not waste time on payday making the bank payments.

These companies say they have even seen a change in their employees' banking behaviour after just a year of using the service.

Initially the workers would withdraw all their cash immediately as they were still building up trust in the product. However, once they have built up the confidence that any money not withdrawn would still be there the following month, they begin to leave a portion of savings in their account.

Another feature of the card, which is supported by international payment system MasterCard, is that it can be used anywhere in the world. This is particularly important for regions like Mpumalanga and Limpopo, where many of the workers are from Mozambique and Zimbabwe and want to access their money back home.

GE TO BUILD DESALINATION PLANT AT COEGA

GE WATER AND PROCESS TECHNOLOGIES, a unit of General Electric Company, is to design and construct a reverse osmosis seawater desalination plant which will provide 70 000 m³ per day of fresh water. In a first for South Africa, the plant will recover ultra-pure salt from the concentrated brine stream for the production of chlorine, caustic soda, and hydrochloric acid at the refinery.

The project is part of a larger investment to build a new chlorine refinery in the Coega Industrial Zone near Port Elizabeth. This new 600 t per day refinery will be owned and operated by Strait Chemicals and will meet the growing global demand for chlor-alkali and its derivatives.

GE's seawater desalination and thermal evaporation technologies will create around 630 000 tonnes of 99,9% pure salt annually,' said

Earl Jones, general manager, structured projects for GE Water & Process Technologies. 'Reclaiming salt from the desalination brine stream not only improves the overall economics of the refinery project, but also removes logistical issues by ensuring a reliable and locally available supply of high-grade salt for use in the refining of chlorine.'

Pure water produced by the desalination process, which in this case is considered a by-product, will supply up to 70 000 m³ a day of potable water to about 150 000 local inhabitants of the Nelson Mandela Metropolitan Municipality, for drinking and local municipal use. This quantity of water will also meet the anticipated water demand for the expansion of the industrial zone. As freshwater resources in South Africa become increasingly limited, this sustainable, new source of potable water from the Coega desalination plant will help alleviate water scarcity challenges caused by low rainfall, a growing population and a rising demand.

'Our customer, Straits Chemicals, has an exciting vision for infrastructure development in South Africa, and we are excited to contribute great technology and innovative solutions in support of this vision. Our strength in seawater desalination and thermal evaporation processes, combined with our world-class partners, allowed our team to provide a robust solution with superior lifecycle economics,' said Jones.

'GE is committed to providing environmentally friendly technology solutions, which we operationalise through our global initiative called ecomagination. This project reflects our commitment to the environment, by providing fresh water to help lessen the social and economic impact of water scarcity; and by taking what would otherwise be a brine waste stream, and turning that into a valuable source of salt production,' said Nellie Swanepoel, managing director of GE Water and Process Technologies in South Africa.

'We are furthermore working with world-class partners in the construction of the facility, namely Baran Engineering from Israel and Group 5, which is well known to the South African market.'

Clive Rice, director for Straits Chemicals, commented: 'The construction of this desalination plant will not only impact positively on the South African economy, as the Straits Chemicals refinery will produce over 600 tonnes of chlorine a day for both domestic and non-domestic markets, but will also be beneficial to the local community in terms of providing a solution for water scarcity concerns.'

Construction of the refinery is expected to take between 18 and 24 months, with the completed plant being officially commissioned towards the end of 2009. It is expected around 600 local jobs will be created during the construction phase and that once operational, over 250 people will be employed. The refinery will be constructed in Zone 7 on an initial 30 ha site with an additional 5 ha for the desalination plant.

► MORE INFO

www.gewater.com

Impacting South Africa



IN MAY THIS YEAR, South Africa found itself in the privileged position of hosting the triennial CIB 2007 World Congress at the Cape Town International Convention Centre. The congress had the theme 'Construction for Development' and focused on the important role that construction plays in the development of nations.

Cape Town saw the arrival of some 350 delegates from more than 40 countries bringing together their research findings in the scientific, technical, economic and social domains related to building and construction. Past CIB International President Dr Rodney Milford explained that 'the delegates have a wealth of experience in international mega-projects from across the world and are here to support improvements in the building process and the performance of the built environment'.

The CIB is a worldwide organisation linking 7 000 construction researchers in over 50 countries and there is no doubt that the sheer volume of work by the members and the exchange of this wide-ranging information creates a significant resource base. In addition, the importance of this congress to the South African context has never been more evident as the huge infrastructural projects relating to 2010 and beyond gain momentum.

► Above: Professor Peter Barrett, the new CIB president, delivering his presentation

While its relevance goes without question, a more pressing question might be as to the accessibility of the research findings and the extent to which there is an effective hegemony of knowledge taking place between the academic world and those who make up the 'ground force' of the construction industry.

Addressing this issue, the newly elected CIB president, Professor Peter Barrett, explained that the CIB has taken steps to ensure that their research findings are disseminated effectively. 'The CIB is proud to be able to announce that, working with ICONDA [The International Construction Database], free access to the refereed papers from CIB conferences will be launched in the very near future with around 3 500 articles already available. This reflects the CIB's commitment to contribute powerfully to building a better world for everyone.'

The CIB is also paying increasing attention to the education sector. It has always contributed to skills development in the construction research area but more recently it has also created student chapters in many countries, run by the students but supported by local CIB members and these

are helping to create the next generation of researchers, and research-informed practitioners. In addition, the CIB has had a significant impact on education specifically for the built environment. In the process there is an active exchange of information around major topics such as disaster management.

The theme of this year's congress encouraged a number of contributions which had specific relevance to South Africa. The congress was used as a platform for information sharing and a cross exchange of research findings relating to materials and processes used in informal housing, as well as a discussion of the associated legal and financial issues.

Also of relevance to the South African context was the call for integrated approaches in handling large infrastructural projects. Companies need to 'harness intellectual horsepower using integrated teams instead of diversifying their risk in the management of mega construction projects', explained Keith Potts from the University of Wolverhampton. Vincent Bester, CEO of Knowledge Base, a local South African company that develops and distributes Civil Infrastructure design software, pointed out that there is an irrational fear of using local South African expertise and technology while internationally South African professionals and resources are highly esteemed. Integrated business models which develop incentives for the success of entire projects, harnessing and developing local technology, expertise and labour are all part of the important lessons that South Africa needs to grapple with.

Currently concerted actions are emerging in areas such as the creation of integrated design solutions for particular situations; understanding users' experiences of spaces; optimising construction as a driver for positive change in society and disaster management (natural and man-made).

Looking to the future, Professor Barrett explains that the CIB will focus on the continuous 're-engineering' of the construction industry, streamlining its operations to be to be 'fit for purpose'. It would also synthesise experience from many countries and provide templates for action. □

TO ALL CORPORATE MEMBERS

Nominations for election of Council for 2008

NOMINATION FOR ELECTION TO Council must be accompanied by a curriculum vitae of the nominee not exceeding 75 words. According to a 2004 Council resolution, candidates are requested to submit a focus statement. Please see Section C.

The CV will accompany the ballot form and the format of the CV is shown below.

SECTIONS

Section A

Information concerning the nominee's contribution to the Institution

Section B

Information concerning nominee's career, with special reference to civil engineering positions held, etc

Section C

A brief statement of what the nominee intends to promote/achieve/stand for/introduce/contribute or his or her preferred area of interest

Please note: Nominations received without an attached CV will not be considered

Closing date: 31 July 2007

Acceptable transmission formats – email, fax and ordinary mail. All ballots are treated with due respect of confidentiality.

If more than ten nominees from Corporate Members are received a ballot will have to be held.

If the ballot is to be held, the closing date for the ballot will be 31 August 2007.

Notice of the ballot will be sent out using two formats:

- By e-mail to those Corporate Members whose electronic address appears on the SAICE database, and
- By normal surface mail to those members who have not informed SAICE of an e-mail address

D B Botha Pr Eng
Executive Director
17 April 2007

THE SOUTH AFRICAN INSTITUTION OF CIVIL ENGINEERING

Nomination for Election of Members of Council for the year 2008 in terms of Clause 3.1 of the By-Laws

In accordance with Clause 3.3 of the Constitution, the Council has elected Office Bearers for the Institution for 2008 as follows:

President

President-Elect	Professor E P Kearsley
Vice-President	Mr C J Campbell
Vice-President	Mr W Jerling
Vice-President	Mr A M Naidu
Vice-President	Mr T McKune

In terms of Clause 3.2.4 of the Constitution, the following are ipso facto members of the Council for the year 2008:

The immediate
Past President Mr N A Macleod

The two most recent
Past Presidents Mr S A S Amod
 Mr M R D Deeks

Clause 3.1.1 of the By-Laws reads as follows:

'Every candidate for election to the Council shall be a Corporate Member and shall be proposed by a Corporate Member and seconded by another Corporate Member.'

Nominees accepting nomination are required to sign opposite their names in the last column of the nomination form.

10 Corporate Members

SURNAME	FIRST NAMES	PROPOSER		SECONDER		SIGNATURE OF NOMINEE
		Signature	Name in block letters	Signature	Name in block letters	

Please fax this form, plus the CV of the nominee, back to SAICE National Office, for attention Mrs Memory Scheepers, by **31 July 2007**. Fax number: 011-805-5971



Changes and challenges ahead says ECSA

THE ENGINEERING COUNCIL of South Africa (ECSA) hosted a cocktail party for stakeholders on 31 May 2007 to inform them of changes in South Africa within the engineering industry.

SKILLS SHORTAGE

South Africa currently faces a massive skills shortage in the engineering industry. With developments such as 2010 and Gautrain, it has become a tremendous challenge to supply the demand of engineering work. In general the country is experiencing a major increase in infrastructure development as well as the development of various engineering hubs. The current skills shortage is threatening to slow down the country's infrastructure development unless it is addressed immediately and aggressively.

To assist in solving the skills crisis, ECSA is undertaking a variety of actions in partnership with the private sector, public sector and government.

EDUCATION

South African tertiary institutions are currently producing approximately 1 400 engineers per annum. According to the JIPSA (Joint Initiative on Priority Skills Acquisition) report, we need to produce an additional 1 000 graduates per year to supply the growing demand of the industry. Unless a greater skills pool can be created, our current and future infrastructure development will be radically slowed down.

While ECSA cannot prescribe to tertiary institutions which courses to offer or what their educational programmes should look like, it does ensure that the programmes offered to our engineering students are of an international standard. ECSA also gets involved in establishing training and mentorship programmes through memoranda of understanding (MOUs), like the one between ECSA, the University of KwaZulu-Natal and the Centre of the Advancement of Science and Mathematics Education (CASME).

MOUs such as this one help create an enabling environment towards capacity building by promoting mathematical and science skills at school level, creating an appreciation and understanding for careers in science, technology and engineering.

CASME and UKZN will work in consultation with ECSA's Engenius campaign (a campaign which aims to promote careers in engineering to learners across the country) to assist in accessing schools and learners in rural areas of KZN. UKZN engineering lecturers who will be visiting these schools will introduce learners to engineering. CASME will also provide support programmes to maths and science teachers at selected schools to help improve the performance of their learners. The top-performing students in maths and science will then be awarded bursaries to study engineering at UKZN.

ECSA will create a national mentorship programme, based on this one, at a workshop where all universities will be present.

Many secondary schools are in dire need of proper teaching facilities. ECSA signed a cooperation agreement with 600SA, University of Johannesburg and the Jabulani Technical High School to improve their facilities, which are currently in dire need of repair. Although this is a technical high school, equipment is inadequate and basic hygiene facilities are virtually non-existent.

PRIVATE SECTOR

The private sector should realise that they share the responsibility of solving the skills shortage. Many engineering students simply cannot afford to complete their studies, contributing to the inadequate output of engineering graduates. Bursaries will not only see a student through his tertiary education, but such a student will then also have a registered employer from whom he can glean the kind of practical training that will ensure he is au fait with the required standard of work. In order to pay off the bursary, such a student will be obligated to work for his employer after graduation, ensuring in turn that such skills are retained in our country.

Training is not only important to students and graduates, but also to professional engineers. As of 1 January 2006, all registered engineers were required to start recording their CPD (continuing professional development) activities. This can include attending practical and academic courses as well as work-based activities. As of the beginning of this year, ECSA started doing random audits of registered engineers' CPD. It is required that, should an engineer be audited, he would need to provide proof of further development. This can be done through provision of certificates, receipts, statutory reports, employer reports, etc. In-house training courses will be accepted, provided that a registered voluntary association approved these courses. Voluntary associations are registered with ECSA and a list can be obtained by contacting our offices.

Membership and participation in activities of voluntary engineering associations will further contribute towards CPD points. Engineers are required to earn five CPD points per year, or 25 every five years.

Not only do the engineers themselves benefit from CPD in terms of developing personal competence and new areas of expertise, the public can rely on skilled professional service and technical competence. In addition, it lends credibility to the industry, raises professional standards and ensures that the engineering industry remains dynamic.

IDENTIFICATION OF ENGINEERING WORK

Further regulation through the Identification of Engineering Work (IDoEW) will ensure that engineering standards and best practices

are adhered to.

The purpose of IDeOW is to identify the type of work that may be done by certain categories of engineers according to their qualifications, experience and expertise. This is done in collaboration with the CBE (Council for the Built Environment) and ensures that engineering skills are applied correctly thereby increasing the quality of work and minimising the risk of disaster and legal action. Registered engineers will then only be allowed to do work that is identified as suitable to their specific registered category. Once this identifying process is complete, engineers will not be allowed to perform any work in categories that they are not registered for.

In addition and in support of this, the registration of engineers will become compulsory in the near future.

PARTNERSHIPS

We need to continue building partnerships with the private sector, the public sector and the government, as we are all dependent on each other to create an environment where engineering skills in our country is no longer a crisis. In our quest, we need to ensure that these partnerships bring sustainable solutions that are beneficial to everybody – engineers and engineering firms, society as well as the built environment and the industry as a whole.

BEYOND OUR BORDERS

ECSA is embarking on, in partnership with DBSA, promoting itself and the existence of such regulatory bodies to SADC countries. This follows collaborative talks with Africa Partnership and Nepad. It will also encourage capacity building in other countries. ECSA and DBSA will present a model used by the University of Botswana for the accreditation of their programmes. They are further in collaboration with the CSIR to create centers of excellence in the SADC region. ■

CONSULTING ENGINEERS SURVEYORS PLANNERS

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To find out more about relocating to New Zealand and working for us, visit our website www.harrisingrierson.com. Company Representatives will be visiting South Africa to meet and interview soon.

ICE @ SAICE House

IN JANUARY THIS YEAR the Institution of Civil Engineers (ICE) president, Quentin Leiper, and the ICE director general, Tom Foulkes, paid a visit to South Africa. Discussions at a meeting with Dawie Botha, other members of SAICE and a delegation from Zimbabwe focused on current business, mutual interests and joint future developments, including the potential for capacity-building and progressing the United Nations Millennium Development Goals (MDGs). This was followed by the signing of an agreement of cooperation between ICE and SAICE.

SAICE and ICE enjoy an excellent relationship. ICE reported in their executive summary on the visit that 'SAICE has good links to UNESCO, WFEO and the African Engineers Forum and is interested in working with ICE to promote capacity building of professional institutions and the civil engineering profession in Zimbabwe and other developing countries in Africa. Handled sensitively, this could become a powerful means of progressing ICE's work on "Engineering Without Frontiers" and in support of the UN MDGs.'

According to Foulkes, 'This was an extremely important and productive visit to the thriving economy of the new South Africa and to ICE's closest partner institution on that continent. We learnt a great deal about the business conditions and professional challenges faced by such a fast-growing economy. ICE's NEC3 is well regarded there and demand is growing. The president's messages about ICE revitalisation, knowledge and young engineers were well received by members wherever we went.'

This visit took the ICE president and DG to meetings from Pretoria to Durban and Cape Town where meetings with a variety of stakeholders were held. All in all a mutually beneficial endeavour!

► Top: ICE President Quentin Leiper and SAICE President 2007 Neil Macleod signing an agreement of cooperation. At the back are Andrew Baird (ICE representative in South Africa), Tom Foulkes (director general of ICE) and Dawie Botha (executive director of SAICE)

► Bottom: Discussing issues of mutual interest were members of ICE, SAICE and ZIE, the Zimbabwe Institute of Engineers



2007 SAICE PHOTO COMPETITION

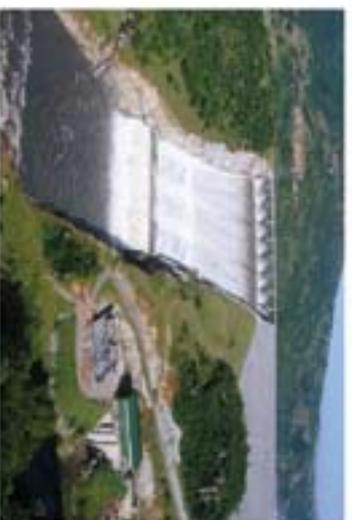
COMPETITION RULES:

1. The competition is open to the general public to submit photographs.
2. It is essential that entries portray people and/or projects in civil engineering.
3. Photographs will be judged in ONE general category only.
4. Entries must be colour prints and in A4 size. Only quality prints will be accepted. Please supply electronic copies of the prints in jpeg format, 300dpi.
5. Please complete an entry form for each entry and supply an appropriate title & short description of each project. It is essential that the photographer's name is included.
6. Please supply details of the client, consultant and contractor involved in the project.
7. The entrant is responsible for obtaining permission for the use of the photographic material as well as subject material from the authority or project manager concerned.
8. Entries submitted by organisations must be accompanied by written consent of the photographer.
9. Permission for the reproduction of photos for any exhibition or publicity is assumed unless the entrant specifies otherwise. Due recognition will be given to the photographer.
10. No responsibility will be accepted for any loss or damage to entries.
11. Closing date: 7 September 2007
12. Adjudication: September 2007 - SAICE National Office - Midrand

NB: The entrant's name, address and title (all of which must correspond with details on the entry form) must appear on the back of the print

* All participants will be notified of the results in writing.

Please complete the **entry form** and **send to:** Private Bag X200, Halfway House, 1685. Fax: (011) 805 5971
This form is available on the SAICE website: <http://www.civils.org.za/photocomp.html>



2006 winner: Mogyga dam spill, taken by Ziso Frosser from Kribbia Island



Not named yet: Launching the Mmabana Arch by Sany O'Donoghue from Group 4



One of the joint Zaf winners-40: Cranes at the docks, also taken by Sany O'Donoghue

ENTRY FORM

This section must be completed by the person submitting the photos

NAME _____

ADDRESS _____

TEL _____ FAX _____

E-MAIL _____

PHOTO TITLE _____

DESCRIPTION _____

PROJECT INFO _____

PHOTOGRAPHER _____

(Name and surname of the photographer to be inserted)

This section must be completed by the photographer or the company that owns the photo.

If you are not the photographer or if you are submitting the photograph on behalf of a company owning the photograph, please sign on behalf of.

I hereby grant permission for reproduction and agree to abide by the rules of the competition.

Signature: _____

The ExCEED Teaching Model

WHILE THE FIRST FIVE articles in this *Journal of Professional Issues in Engineering Education and Practice* (JPI) series covered a variety of teaching tools and techniques such as the chalkboard, questioning, drama, board notes, physical models and demonstrations, the last issue took a broader view and introduced a model instructional strategy. This strategy provides a conceptual framework that an instructor can use to develop classroom instruction in an organised and coherent manner. The strategy reflects the way that students actually learn and prompts the instructor to make conscious decisions about the allocation of responsibility for student learning and the sequencing of the contributing activities. This article takes an even wider perspective and attempts to answer the question, 'What constitutes good teaching?'

The ExCEED teaching workshop strives to demonstrate and then develop good teaching skills. To do this, good teaching, at some point, must be defined. The ExCEED Teaching Model represents our best attempt to do this. The ExCEED model was developed by examining what attributes make a good teacher, how students learn best, and what tools are available to assist the teacher. The model is based on teaching and learning theory from the literature, supported by years of practical experience from veteran instructors.

This article traces the development process of the ExCEED Teaching Model shown in figure 1. Once established, this model serves as a definition of good teaching that can then be used consistently throughout the workshop. Admittedly, many others have attempted to answer this same question, and no two answers are the same. Nevertheless, the ExCEED Teaching Model is relatively simple, and if an instructor is doing everything in it, she is most likely teaching well.

Defining quality teaching is a contro-

versial and perilous task. Teaching is a very personal activity, and no two people do it the same way. Teaching effectiveness is often dependent on the personality and individual talents of the instructor. What works superbly for one teacher may totally flop for another. The answer often becomes, 'I can't define good teaching, but I know it when I see it.' Evidence of good teaching can be seen in the infectious enthusiasm of the teacher, the obvious engagement of the students, the clarity of the presentation, or the successful measured evaluation of what the students have learned. While there are an infinite number of ways to teach well, there are some consistent elements, activities and attributes that seem to be present with all good teachers. The ExCEED model attempts to capture these.

WHAT ARE THE ATTRIBUTES OF A GOOD TEACHER?

Seymour and Hewitt (1997) took an interesting approach to this question in their landmark study to determine why so many students were leaving maths, science and engineering programmes. By interviewing hundreds of maths, science, and engineering students from seven major US institutions, they were able to compile a substantial list of practices that constituted bad teaching. The list includes such deficiencies as indifference to academic difficulty of the material, inadequate preparation, boring lectures, preoccupation with research, inability to communicate, presentation of material at too high a level, lack of practical application, grading on a curve, no concern for the intellectual needs of the students, a lack of structure or sequence to course material, no fit between homework and graded events, a sarcastic

and degrading attitude toward students, and no awareness of how people learn. If these student comments are all reversed, the list becomes a reasonable compilation of what constitutes good teaching.

Lowman (1995) quantified what makes a good teacher by collecting descriptions of exemplary teaching using teaching award nominations from over 500 students and faculty members. The study collected adjectives and descriptive phrases from the award recommendations, divided them into like categories and tallied the results. The descriptors fell neatly into two statistically independent categories, which Lowman defined as intellectual excitement and interpersonal rapport.

Lowman described intellectual excitement as the clarity of the instructor's presentations, the instructor's disciplinary

1 THE EXCEED MODEL

- **Structured organisation**
 - Based on learning objectives
 - Appropriate to the subject matter
 - Varied, to appeal to different learning styles
- **Engaging presentation**
 - Clear written and verbal communication
 - High degree of contact with students
 - Physical models and demonstrations
- **Enthusiasm**
- **Positive rapport with students**
- **Frequent assessment of student learning**
 - Classroom assessment techniques
 - Out-of-class homework and projects
- **Appropriate use of technology**

Teacher as role model

► **Figure 1** The ExCEED Teaching Model used in the ExCEED teaching workshops as a description of what constitutes good teaching

*This is the third of three articles about ExCEED, its philosophies and background. The first article appeared in April 2007 and the second in June 2007

expertise, and the degree to which the students were stimulated emotionally by the classroom experience. The most common adjectives that described this intellectual excitement included enthusiastic, knowledgeable, inspiring, humorous, interesting, clear, organised, exciting, engaging, prepared, and energetic. Interpersonal rapport measures how much an instructor cares about his students and the degree to which they are effectively motivated by the teacher. The most common descriptive indicators were concerned, helpful, caring, encouraging, challenging, available, fair, friendly, accessible, demanding, approachable, and patient.

Lowman created the two-dimensional matrix shown in figure 2 and divided the categories of intellectual excitement and interpersonal rapport into high, medium and low capabilities. This two-dimensional model then describes nine categories of teachers based on their relative strengths in these two areas. Teachers can range from those who are inadequate (low in both categories) to complete exemplar (high in both categories) with every possible combination in between. The numbers indicate a priority of development from (1) being the least effective to (9) being the most effective.

The resulting conclusions are that the best teachers are highly skilled in both interpersonal rapport and intellectual excitement, but the intellectual excitement dimension is the more important of the two.

HOW STUDENTS LEARN

There is no shortage of studies in the literature that attempt to define how students best learn. The relevance of these to quality teaching is that the best teachers will understand how students learn, account for the differing types of learners in the classroom, and then develop teaching strategies to best accommodate the learning process.

Wankat and Oreovicz (1993), for example, developed a compendium of learning principles that reflect best practices in teaching. These include the need

to guide the learner through lesson objectives, provide structure and organisation, use images and visual learning, ensure the student is active, require practice through problem solving and repetition, provide prompt and positive feedback, have positive expectations from students, challenge students but set them up for success, use a variety of teaching styles, make the class cooperative, ask thought-provoking questions, be enthusiastic, encourage students to teach each other, and care about what you are doing.

Similarly, Chickering and Gamson (1991) compiled a list of seven principles of good practice that will enhance learning. The principles are to encourage contact between students and faculty, have students work together, encourage active learning, provide prompt feedback, emphasize time on task, communicate high expectations and respect diverse talents and learning styles.

Angelo (1993) offered a 'teacher's dozen' which equates to fourteen principles for improving higher learning. Some relevant examples from this list include an emphasis on active learning, focused attention from the student, student awareness of what is important, positive and reasonable goals for the learner, instructor feedback provided early and often, high expectations, frequent interaction between teachers and learners, and student understanding of the value of the learning. The principles also emphasise that learning requires time, practice, context, connections to prior knowledge and the ability of the student to organise information in personally meaningful ways.

Still another list of learning principles is provided by Davis (2001), who emphasises higher levels of cognitive development, sensitivity to student struggles, real world experiences and applications of the material, meaningful structure to course material, connections to prior knowledge, active learning, cooperative learning among students, and frequent and specific feedback.

Success comes when students know

what they are supposed to learn; material is presented in ways that are meaningful to the student; students can organise the material to suit their individual framework; and teachers account for different learning styles.

While all of these lists were developed independently, there are some consistent themes that run through them all. One is that students and teachers should understand the desired results of the learning process and there should be a structured approach to getting there. The use of clearly articulated learning objectives facilitates this and helps define the appropriate intellectual level of student achievement.

Bloom's taxonomy (Bloom 1956) defines six levels of cognitive development (knowledge, comprehension, application, analysis, synthesis, and evaluation) and emphasises the use of action verbs to describe them. Such quantifiable lesson objectives are useful for lesson planning, distinguishing between critical and extraneous material, communicating expectations, assessing student learning, writing exams, and assessing a course.

A second thread that appears throughout is that students learn in different ways and teachers need to understand and accommodate these varied learning styles. Felder (1993) classified these differences based on the various ways that students perceive, receive, organise, process and understand information and concepts.

With respect to how students perceive the vast array of information presented to them, learners are classified as either sensory, meaning they favour information coming through their senses, or intuitive, where information comes through memory, reflection or imagination.

Students prefer to receive information visually through pictures, graphs and physical demonstrations or verbally through words and mathematical equations. Similarly, students process information with either an inductive or deductive preference, depending on whether they prefer to learn specific examples prior to the overarching general theory or vice versa.

Students process information with either an active or reflective preference and understand material in either a sequential or global manner. Most engineering instruction naturally favours the intuitive, verbal, deductive, reflective and sequential learner.

Different students can exhibit every possible combination of learning style preferences. The teacher that desires to ensure that all students have an opportunity to learn in their preferred style should therefore occasionally prepare instruction designed to appeal to the sensory, visual, deductive, active and global learners, who

Figure 2 Lowman's (1995) two-dimensional model that categorises teachers based on their levels of intellectual excitement and interpersonal rapport

		INTERPERSONAL RAPPORT		
		LOW	MODERATE	HIGH
INTELLECTUAL EXCITEMENT	HIGH	6 Intellectual authority	8 Exemplary lecturer	9 Complete exemplar
	MODERATE	3 Adequate	5 Competent	7 Exemplary
	LOW	1 Inadequate	2 Marginal	4 Scratcic

are often neglected in the normal course of instruction.

TECHNOLOGY: THE TOOLS OF TEACHING

Technology can be thought of as those tools that assist the teacher to teach and the learner to learn. Just as the carpenter relies on a hammer, saw and tape measure, the teacher has a toolbox as well.

Although they have been around for so long that many no longer think of them as technology, the textbook, chalkboard (Ressler 2004), pencil and writing pad all qualify as instructional technology. These advances help the student to learn a subject on her own, the teacher to enhance the classroom presentation, and the learner to record notes and thoughts so they can be used again for further reflection.

As such, understanding and appropriately using technology is an important aspect of quality teaching. But technology also tends to be overrated and can easily be abused. The skilled hands of the carpenter are more important to a successful project than the hammer and chisel he chooses to use. The same is true of teaching.

Leamson (1999) wrote that technologies are more 'peripheral than central to the business of teaching' where the core

of education remains 'a personal interaction between teacher and student'. Some technologies, if used ineffectively, will reduce rather than enhance that personal interaction.

Classroom technology has proliferated in the past few decades. Previously the vu-graph machine, opaque projector, copier machine, television set, calculator and movie projector were examples of modern classroom technology. More recent advances include presentation graphics such as PowerPoint, engineering software packages, computer-aided instruction software (often included with textbooks), electronic textbooks, spreadsheets, math packages, simulation software, digital photographs, and the most significant source of information technology: the internet. Course websites, e-mail, instant messaging and course management tools such as Blackboard have altered the teacher-student relationship for better or worse, depending on how they have been used.

Software can be used in an effective or ineffective manner. Some packages serve as black boxes, allowing the student to obtain very precise answers with little or no understanding of the underlying concepts that produced them. Jonassen (1996) dis-

tinguishes these types of programs, which rely on the computer to do the thinking, from software such as spreadsheets, programming languages, and math packages that require the learner to provide the algorithm and logic before the computer can perform the required calculations. Such software becomes a 'mindtool' that engages and facilitates critical thinking. Mindtools cause learners to enhance, extend, amplify or restructure the way they think about content.

Like all computer software, PowerPoint presentations can be used and misused. PowerPoint is appropriate for showing charts, illustrations, and photographs that enhance instruction. PowerPoint files can be shared electronically and are easily modified for future presentations. Conversely, there is a danger that such presentations incorporate more material than students are able to absorb, provide an inflexible structure that can hinder spontaneity, and can cause passivity – especially when students are provided with hard-copy handouts of the PowerPoint slides in advance.

THE EXCEED TEACHING MODEL

The ExCEED Teaching Model (figure 1) in-

Because every student is different, teaching methods need to be varied to accommodate and appeal to the diverse needs of all students. The goal should be for each student to occasionally use his or her favoured learning style and for all students to eventually be comfortable in learning with all learning styles

corporates the most relevant of these concepts into a single framework that defines effective teaching, based on what makes a good teacher, how students best learn, and what technological tools are applicable to the desired learning outcomes. A key feature of the model is that the teacher is the role model and the leader throughout this entire process. The responsibility for learning lies with the student, but the teacher guides the process and sets the example to be followed.

Structured organisation

Structured organisation is derived from the intellectual excitement dimension of Lowman's two-dimensional model and is a continuing theme throughout the various lists of learning principles described above.

The model instructional strategy (Welch et al 2005) attempts to apply structure and sequencing to classroom instruction. The framework is based on well-articulated, lucid learning objectives that are appropriate to the subject matter. The objectives need to target the appropriate cognitive level, and the students need to understand the relevance of the topic.

The instruction should allow the student to make connections with previous learning and organise the material in a personally meaningful way. Because every student is different, teaching methods need to be varied to accommodate and appeal to the diverse needs of all students. The goal should be for each student to occasionally use his or her favoured learning style and for all students to eventually be comfortable in learning with all learning styles.

Engaging presentation

Clarity of presentation is one of the two elements associated with the intellectual excitement dimension of Lowman's model.

Obviously, a major component of a clear presentation is the instructor's subject matter expertise and mastery of the content. The ability to explain concepts clearly and the willingness to prepare in advance

are also key. Poor presentation skills were listed prominently as an element of bad teaching by the students in the Seymour and Hewitt study. An engaging presentation begins with the instructor's clear verbal and written communication (Ressler et al 2004).

Effective communication starts with clear handwriting, voice articulation, and adequate volume but also extends to varying the pitch and speed of the instructor's voice, avoiding idiosyncrasies, and using gestures effectively. The exemplary presentation will often incorporate humour, drama (Estes 2005), and good storytelling.

Students cannot be passive observers; teachers need to maintain a high degree of contact and engagement. Physical position and movement around the classroom will help, and any presentation can be enhanced through effective questioning of the students (Estes et al 2004). Contact can also be improved through spontaneity and the willingness to take the class in a direction that the students want to go. Ironically, this can only be achieved when the instructor is so well prepared that she can take that journey and still successfully return to complete the lesson objectives.

In engineering classes, physical demonstrations enhance almost any lecture and are also a form of instructional technology. Textbooks do an excellent job of describing physical phenomena in terms of words, equations, graphs and even pictures on the page. A physical demonstration appeals to the visual and sensory learner who might not otherwise appreciate the deflected shape of a beam, the strength of concrete, or the path of a projectile until she can see it, touch it and feel it in the real world. Vander Schaaf and Klosky (2005) present a variety of demonstrations that are appropriate for the engineering classroom and will stimulate critical thinking in students.

Enthusiasm

The second element of intellectual excitement in Lowman's model involves the stimulation of positive emotion in students. If the instructor demonstrates passion for the material, such emotion tends to be contagious. Another consistent theme throughout the learning principles involves attaching an importance and real world context to the course material. If the teacher is excited about the lesson, then that alone helps make it relevant – especially if the teacher is viewed as a role model.

A natural enthusiasm brings focused energy and a strong sense of presence to the classroom. Students are more likely to remain awake. They get more excited about the material, and this excitement increases the chance that they will study it on their own. Students will experience the positive

emotions of laughter, suspense, and dramatic tension and may ultimately share the instructor's joy of discovery – all of which will cause them to remember some aspect of the material.

Positive rapport with students

This element of the ExCEED Teaching Model is clearly linked to the interpersonal rapport dimension of Lowman's model. The quality of the relationship between student and faculty appears several times in the various lists of learning principles.

The deficiencies of being haughty, unapproachable, unconcerned and unavailable cited by the students in the Seymour and Hewitt study clearly deal with lack of interpersonal rapport. Unlike an engaging presentation, the effects of which are immediate, interpersonal rapport is developed over time and is cultivated throughout the semester and even longer.

An effective relationship with students can begin in the classroom by learning students' names, investigating something about their interests, implementing policies that are perceived as fair, soliciting and then responding to student feedback, demonstrating some flexibility in scope and timing of requirements, being available for questions, and displaying a warm and friendly demeanor.

Rapport is just as effectively established outside the classroom by answering student e-mail promptly, welcoming students when they attend office hours and using the one-on-one time to get to know them, attending student activities such as ASCE student chapter events or athletic events in which they might be participating, and recognising students around campus or in the local community and greeting them with a smile and a handshake.

Lowman (1995) identifies a key attitude necessary for establishing a relationship with students when he states that a great classroom instructor 'must genuinely like college-age students and identify with their interests, both serious and foolish'. Highet (1966) adds: 'It is easy to like the young because they are young. They have no faults, except the very ones they are asking you to eradicate: ignorance, shallowness, and inexperience.'

Frequent assessment of student learning

The most prevalent theme throughout the lists of effective learning principles was that students must practice what they are taught and receive prompt feedback in order to effectively learn a subject.

The model instructional strategy (Welch et al 2005) contained a feedback loop that involved student practice in a familiar context and then in an unfamiliar context followed by performance feedback – and new opportunities to practise. Active

learning requires hands-on applications both in and out of class through in-class examples and out-of-class homework and projects.

The in-class examples allow for the practice of skills in a non-threatening environment. Out-of-class problems and projects allow the students to apply their skills in a new situation where time is less of a factor. It is the out-of-class assignments that provide the best opportunities for students to teach and learn from each other, to accept an active learning role, and to devote the high-quality time on task necessary for genuine learning to take place.

The frequent assessment element of the ExCEED Teaching Model unfortunately necessitates substantial grading, which is widely considered a thankless task.

Engineering students are both perceptive and busy; they will allocate their time to those tasks that offer the highest payoff. If students don't receive feedback in a timely manner, they will typically stop doing the assignments.

Cross (1996) uses an archery analogy to emphasise the importance of feedback. One could purchase the highest quality bow, hire the most accomplished archery instructor and understand completely the theoretical dynamics of flight, but if that student never received feedback as to whether the arrows were hitting the target, it would be impossible to learn and improve.

Grades are clearly not the only way to attain feedback on student learning. An interactive classroom environment in which the instructor is asking directed questions and students feel free to ask their own questions will provide a limited basis for assessing student understanding.

Angelo and Cross (1993) proposed a number of classroom assessment techniques that assess student learning in a non-threatening manner. A few examples include the minute paper, muddiest point paper, and the approximate analogy. In these techniques, students are asked to summarise the main learning point, identify the topic that needs the most clarification, or make a connection between the new material and something they have seen before.

A teacher should plan the assessment technique to target specific feedback and then share the results with the students. The feedback and corresponding lesson adjustments can help develop rapport with students.

Appropriate use of technology

There has never been more technology available to assist both the teacher and the learner than currently exists. Instructional technology is neither inherently good nor bad. It is a set of tools that can be used

appropriately or inappropriately. If these tools are used in a manner that supports the other tenets of the ExCEED Teaching Model, they are probably being used appropriately. The danger is that technology will be used simply because it is available, rather than because it enhances the quality of either teaching or learning.

With the increased availability of new technologies such as wireless networks and laptops for every student in the classroom, the challenge to use technology appropriately has never been greater.

CONCLUSION

While a single universally accepted definition or model of what constitutes good teaching will remain elusive, the ExCEED Teaching Model presented herein is supported by the literature, has been tested by veteran instructors and has been used effectively in seven years of ExCEED teaching workshops. Such a framework, once accepted, becomes a useful validation tool for deciding whether or not to try something new.

If the new method is supported by an element of the model, it has a higher likelihood of being beneficial. The model is similarly helpful as a checklist for the inexperienced instructor: 'If I am doing all these things, I am probably teaching effectively.' Furthermore, if this model as valid, then it can be used the basis for assessing effective teaching – the subject of the next article in this series.

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Registration opens for IMESA annual conference

REGISTRATION HAS OPENED FOR the 71st Annual Conference of the Institute of Municipal Engineering of Southern Africa (IMESA), widely recognised as the industry's most important event of the year. The conference will take place between 23 and 26 October 2007 at the International Convention Centre in Durban, covering presentations of practical and technical content that will stimulate the interest of all disciplines involved in the entire engineering industry.

All those involved with municipal engineering have the responsibility of thinking beyond the 2010 milestone, which is less than three years away, and hence the timing and theme of the

conference, 'Sustainable Municipal Engineering 2010 and Beyond', could not be more fitting.

Besides the conference itself, designed to connect municipal engineers and professionals, public agencies, organisations, institutions and businesses involved with municipal engineering and public works in order that they share a global pool of knowledge, a trade exhibition relevant to the municipal engineering industry will take place alongside the conference.

WHO SHOULD ATTEND?

■ Officials, consultants, contractors and suppliers of equipment involved in all aspects of mu-

nicipal engineering (water, wastewater, waste management, construction, infrastructure, roads and transport, etc)

- Local government councillors and administrators responsible for service delivery
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Date	Event and CPD validation number	Presenters/venue	Contact details
24–25 July – Grahamstown 2–3 August – Pretoria	Flood estimation and storm water drainage for roads SAICEwat07/00158/10	Contributing authors of <i>Drainage Manual</i> www.sinotechcc.co.za	Carla de Jager registration@carlamani.co.za
23–27 July – Durban 10–14 September – Gauteng	The Application of the Finite Element Method SAICEstr06/00018/08	Roland Prukł	Dawn Hermanus dhermanus@saice.org.za
16–17 July – Durban 23–24 July – Midrand 30–31 July – Cape Town	Advanced Microsoft Project SAICEproj06/00042/08	Andrew Holden	admin@classic-sa.co.za 073 533 6590
23–25 July – Pietermaritzburg	Contract documentation SAICEtr07/00148/10	D van As	Dianne Myles sarfuse1@acenet.co.za
23–25 July – Swakopmund, Namibia	The 4th Southern African Base Metal Conference 'Africa's base metals resurgence'	www.saimm.co.za	conferences@saimm.co.za +27 11 834 1273/7
24–27 July – Midrand	Pro-Active Project Management SAICEproj07/00150/10	Andre Nortier	Sharon Muger Cpd.sharon@saice.org.za
30–31 July – Cape Town 7–8 August – Gauteng 30–31 October – Cape Town	Technical Report Writing SAICEbus06/00014/08	Peter Bailey	Sharon Muger Cpd.sharon@saice.org.za
15 August – Gauteng 5 September – Cape Town 10 October – Grahamstown	Structural Steel Design to SANS 10162:1-2005 SAICEstr06/00050/09	Greg Parrott	Sharon Muger Cpd.sharon@saice.org.za
17 August – CSIR, Pretoria	Water Law of South Africa SAICEwat06/00073/09	Hubert Thompson	Dawn Hermanus dhermanus@saice.org.za
28–29 August – Gauteng	Traffic Calming Measures	J Coetzee	Dianne Myles sarfuse1@acenet.co.za
4–7 September – Melbourne, Australia	XXXV IAHS World Congress on Housing Science 2007 – planning design construction performance	www.Housing2007.org.au	housing2007@meetingplanners.com.au
11–12 September – Gauteng	Business Finance for Built Environment Professionals SAICEfin06/00004/08	Wolf Weidemann	Dawn Hermanus dhermanus@saice.org.za
17 & 18 September 2007 – China	5th International Conference on Current and Future trends in Bridge Design, Construction and Maintenance	ICE	Dayle Long Dayle.long@ice.org.uk
18–19 September – Gauteng	Handling Projects in a Consulting Engineer's Practice SAICEproj06/00003/08	Wolf Weidemann	Dawn Hermanus dhermanus@saice.org.za
25–27 September – Cape Town	Compaction of road building materials SAICEcons06/00012/08	M White	Dianne Myles sarfuse1@acenet.co.za
4–9 November 2007	'HELP in Action' - Local Solutions to Global Water Problems	www.wisa.org.za	Taryn Van Rooyen conference@soafrica.com

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