Civil Engineering

Siviele Ingenieurswese

July 2005 Vol 13 No 7

ON THE COVER

Franki Africa has again shown its ability to produce cost effective geotechnical solutions in contracts that require decisions 'on the move', as it were. This time it has been for the foundation and lateral support work at the new Bedfordview Mall shopping centre, yet another successful development by the Abrosie Brothers in Bedfordview

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SAICE AND PROFESSIONAL NEWS

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OPINION

The Millau Viaduct – a lesson for engineers?

WHY IS IT THAT ENGINEERS allow others to take the credit for their achievements and remain stoically silent when this happens? Does this not lie at the very heart of our lack of recognition? Who remembers the epic efforts of Ove Arup and his team to realise the flights of fancy of the original architect for the Sydney Opera House? How many know the name of the designer of the Nelson Mandela Bridge in Johannesburg or the many brilliant water schemes without which the PWV area would not be the industrial heartland of the country?

Even our professional magazines are often amiss in giving the credit to those whose public relations teams shout the loudest. The story behind the spectacular Millau Viaduct in France is a classic case study of how this happens.

A recent article in *Civil Engineering* (March 2005), and various articles in *New Civil Engineer International* (NCEI), the international monthly of the Institution of Civil Engineers (May 2003, July 2004 and February 2005), prove the point. They all refer to the architectural practice of Norman Foster and Partners of London as the overall creators and designers of the Millau Viaduct. As late as February 2005 *NCEI* referred to Foster's winning design and the whole article creates the impression that it was all essentially the creation of Norman Foster. Once again an architectural firm claims all the credit for a project that was conceived, designed and masterminded by a French engineer, Michel Virlogeux.

NCEI (April 2005) finally gets to the truth in a lengthy interview with Michel Virlogeux, the engineer who conceived and drove the design from its inception. He is a product of the world famous Ecole des Ponts et Chaussées in Paris, where he was taught that art is an integral part of the engineer's training. Engineering is still as much an art as it is a science and the young engineers of today will do well to appreciate this as they sit in front of their computers.

The Millau Project started in 1988 when Virlogeux, as head of the state transport agency SETRA's bridge department, started looking for an alignment for the A95 Paris to Barcelona auto-route. The original concept was to descend to the Tarn River, bridge it with a 700 m span bridge and then climb up the steeper southern valley slope on a viaduct before entering a tunnel through the upper valley wall to reach the top of the escarpment.

It was a road engineer who asked the key question, 'Why don't we go straight across on a high viaduct?' Virlogeux immediately recognised the merit of the proposal and within months had selected the seven span design. At that time he and his department were also involved in the design and construction of the Pont de Normandie (the magnificent double cable-stayed bridge over the Seine near its mouth) that was beginning to attract intense public interest. The ideas from Pont de Normandie were the basis for Millau.

The appointment in 1992 of a new director of SETRA saw a politician and not an engineer heading the organisation. In spite of the success of the Pont de Normandie, the new director believed that, once the Millau concepts became known, a project of that scale from the department would never be accepted. So in 1993 he opened the project to outside organisations by means of a 'definitive study'. In spite of the huge public response only one was similar to the Virlogeux proposals. At the same time the director announced that Virlogeux's team would take the project no further and that an external team would be appointed.

Virlogeux believed so strongly in his design that he resigned to set up his own design team. Foster had been shortlisted as he liked the Virlogeux concept, and so a partnership followed quite naturally. Virlogeux notes that the initial Foster concept could not be built. The process that followed had been tried and tested. The architect gave his opinion on the solution and the way it fitted into the landscape. At this point the engineers took over while the architect remained to sculpt the concepts of the engineer.

As Virlogeux says:

> The bridge has not been designed by Foster. I am the designer and he is the architect. The engineer must not be reduced to the man who only does computations nor must he reduce the architect to someone who just does the finishing touches. Foster understands structures and he did not, like some architects, push the designers into a dangerous direction technically.

Virlogeux carries 100 % of the risk for the design. He acknowledges that the design became a team effort, but the design engineers never lost control. This is how it should always be.

It then becomes important for the engineer to ensure that credit for his design is not hijacked with high intensity public relations, as Foster appears to have done in the case of Millau. As Virlogeux says: 'It probably would not have happened 50 or 60 years ago. I am as much at fault as anyone – engineers have become very bad at communication.'

Here lies the key to the improvement of our public profile and enhanced status.

President Herbert Hoover, the only American president who was an engineer, said:

> To the engineer falls the job of clothing the bare stone of science with life, comfort, hope. No doubt as the years go by the people forget which engineer did it, even if they ever knew. Or some politician put his name to it. Or they credit it to some promoter who used other people's money … but the engineer himself looks back at the unending stream of goodness which flows from a success with satisfactions that few professions may know. And the verdict of his fellow professionals is all the accolade that he wants.

The words of Herbert Hoover express the deepest motivations of engineers. However, there is also an implied warning to engineers of today. We can no longer rely on our inward satisfaction alone and maybe this was never enough. It certainly was not to Thomas Telford or I K Brunel or Andre Coyne or Ove Arup. To what extent have we been influenced by the many years during which it was regarded as unprofessional to advertise?

If engineers are to achieve their rightful place in the modern economy and the prominence and status they deserve, they will have to ensure that the beneficiaries are aware of the skills that have gone into their projects. After all, it is engineers who create, design and build the infrastructure on which our modern society depends. Where would we be without our roads, railways, water supply, sewage disposal and wastewater treatment, electricity supply and many other projects? In truth, of all the professions, engineers are the greatest creators of wealth because without them all economic development is stunted. South Africa is about to face this truth as our development is slowed by the looming shortage of engineers in all disciplines. Already we are seeing the signs of public dissatisfaction because of government's failure to deliver. This is entirely due to lack of capacity, which is not going to improve in the near future because of our shortage of skills.

Never have engineers had a greater opportunity to make the public and government aware of the pivotal role they play in development. Our abilities to make things happen must be recognised and not be circumscribed with endless new regulations and changes in contract formats. More than anyone else engineers build the world. It is up to us to communicate our achievements to the public. Learn the lessons of Millau. Our institutions and professional bodies, together with individual firms, must take an aggressive lead in making our voices heard. We remain silent at our peril. □

I am indebted to the editor of NCEI, *Mr Antony Oliver, for permission to quote from the articles on the Milllau Viaduct in* NCEI. *The opinions expressed are, however, all my own.*

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PART 2

The Orange River

The world's longest tunnel

About a quarter of the flow in the Orange River that enters Gariep Dam is diverted through the 82 km Orange-Fish tunnel into the headwaters of the Grassridge Dam. Controlled releases from the dam supply water to irrigators and other users in the Great Fish River valley. In the vicinity of Cookhouse, water is diverted out of the Great Fish River through another tunnel and system of canals into Lake Mentz in the Sundays River. Downstream of Lake Mentz dam a further diversion of water takes place, some of which ensures stable water supplies to the Port Elizabeth area.

This is the longest and most complex water supply system in South Africa. This article is a brief description of the concept, planning, design and construction of the world's longest tunnel

THE ORANGE RIVER PROJECT TAKES SHAPE

By 1960 it was possible to formulate a comprehensive development plan for the Orange River, which would provide for the ultimate requirements of irrigation, urban water supply, industrial water supply, hydro-electric power development and flood control. This new concept widened the emphasis from the single purpose Orange-Fish-Sundays diversion project to the multi-purpose Orange River development project.

The major effect of this change of emphasis on the Orange-Fish tunnel was the choice of the dam site at Ruigtevallei near Norvalspont, instead of the previously proposed sites further upstream. It would now be possible to build a tower in the dam basin and so tap the stored water directly instead of diverting it out of the riverbed. The promontory of high land on which Oviston has since been built was selected for the site of the tunnel inlet. Fortunately this involved only a slight deflection from the optimum gravity line previously proposed. One further advantage of the relocation of the dam site was that the additional height of water in the dam could be used to increase the capacity of the tunnel. The tunnel would now have a length of 82,8 km; a fall of 1:2000; an internal diameter of 5,33 m; and a capacity of 56 m^3/s. The tunnel would be concrete lined throughout and excavated from seven vertical shafts along its length.

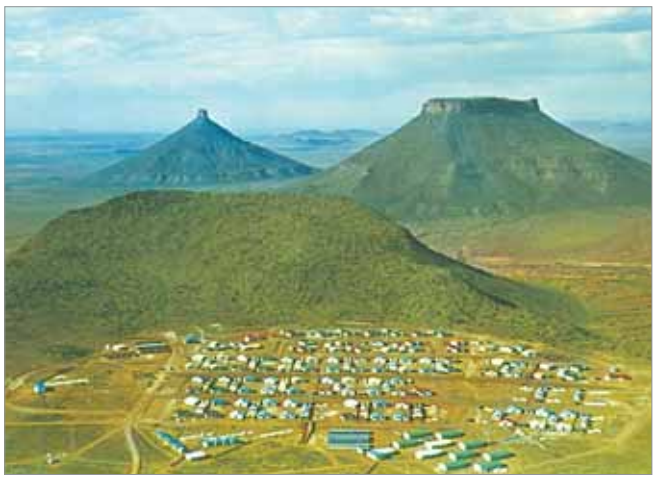
In July 1962 the government announced that it was to proceed with an extensive construction programme for the development of the Orange River, and the white paper giving details of the proposal was laid before Parliament for approval. Within a year a start was made on what would be the world's longest tunnel as a key element of the largest water supply undertaking on the continent of Africa up to that time.

Work on the Orange-Fish Tunnel project was effectively started on 29 July 1963 when a Department of Water Affairs construction team set up camp on the banks of the Orange River at Oviston. Soon afterwards the staff of the Orange-Fish Tunnel Consultants (consortium of Sir William Halcrow and Partners of the UK, and Keeve Steyn and Partners of South Africa) started arriving at the site.

There were two important tasks that had to be undertaken before detailed planning and design could commence. These were the establishment of a precise survey benchmark system and a detailed analysis of the material through which the tunnel had to be excavated.

SURVEY

Owing to the considerable length of the tunnel, the earth's curvature, as well as the effect of gravity, anomalies had to be taken into account during the design and construction of the tunnel. All survey observations had to be carried out with a very high order of accuracy in order to ensure satisfactory horizontal and vertical alignment of the tunnel over the long distances between the construction shafts. The coordinates of the existing tertiary triangular network were not sufficiently accurate, so a selected framework of existing beacons straddling the tunnel was re-observed by the Trigonometrical Survey Office to first-order standards. Both normal



Left: Outlet construction township with Teebus and Koffiebus in the background
Middle: Intake tower nears completion
Right: Drilling the first holes in the Orange-Fish Tunnel

Project

triangulation and trilateration were used to recalculate a completely free network for the tunnel – the maximum allowable misclosure being 75 mm per triangle. For vertical control a benchmark at the Gariep Dam was chosen and this level was transferred to benchmarks along the length of the tunnel by a precise levelling traverse.

A gravity survey of the Republic of South Africa was undertaken from 1949 to 1957. This survey disclosed a remarkable gravity anomaly centred on the town of Trompsburg, some 90 km north of the tunnel inlet. Subsequent drilling at the centre of the anomaly disclosed the presence of an intrusive body of large size at depths between 1 000 and 1 600 m. The intrusion consisted of red granite and other rocks akin to those of the Bushveld Igneous Complex. Negative isostatic anomalies were also found to occur in the vicinity of Smithfield and Colesberg. The original survey of the Republic did not traverse the tunnel area, and because steep gravity gradients could affect the accuracy of the surveys, it was decided to carry out a more intensive gravity survey of the tunnel area. The survey was carried out by Geological Survey, and two anomalies in the vicinity of the tunnel were, in fact, discovered. The effects of these anomalies and the local gravitational effect of dolerite intrusions were then studied and accommodated in the design.

These procedures resulted in the achievement of misclosures between adjacent tunnel headings, approximately 11 km apart, being within the range of 76 mm to 482 mm in line and between 0,6 and 3,6 mm in level.

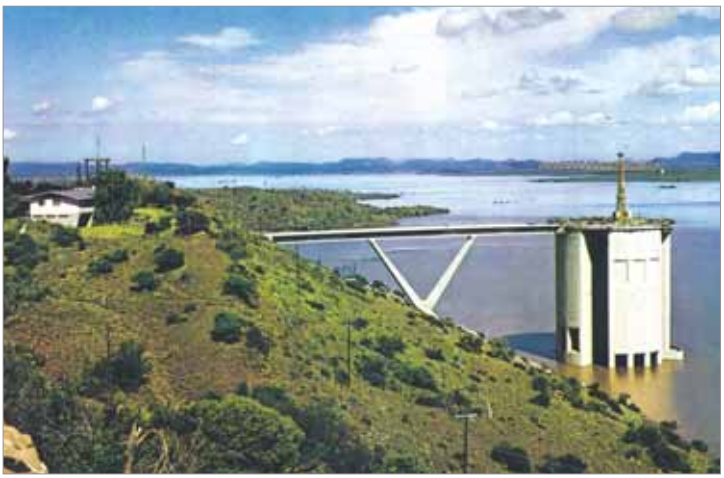
GEOLOGY

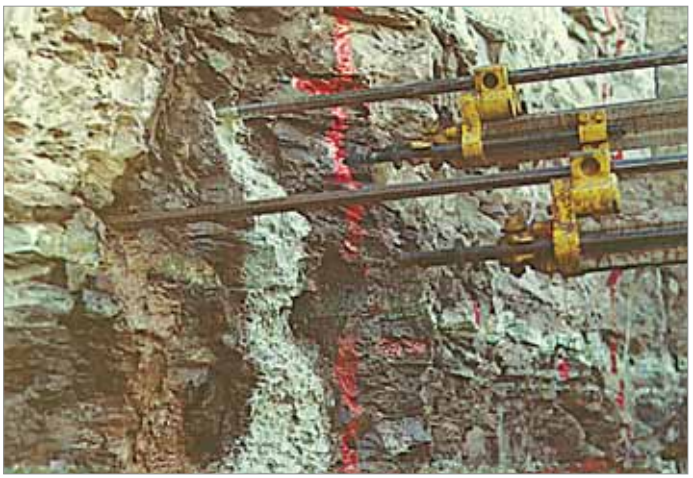
In all, 208 boreholes were drilled to tunnel level during the 1948–1953 and 1964–1966 drilling programmes. A total length of 27 500 m (nearly 28 km) of cores was recovered. Some of the boreholes were over 450 m in depth. Tests carried out during the latter programme included measurements of the verticality of the bore holes, variation of temperature with depth, water rest levels, water analyses, and groutability of the rock. The cores of the different rock types were subjected to petrographic and X-ray analyses and the determination of their mechanical properties. In addition to the drilling programme, magnetometer and seismic surveys were carried out along the inlet and outlet sections of the tunnel where the rock is covered by alluvium. The surveys were used to ascertain the depth of the alluvium and the presence of dolerite intrusions.

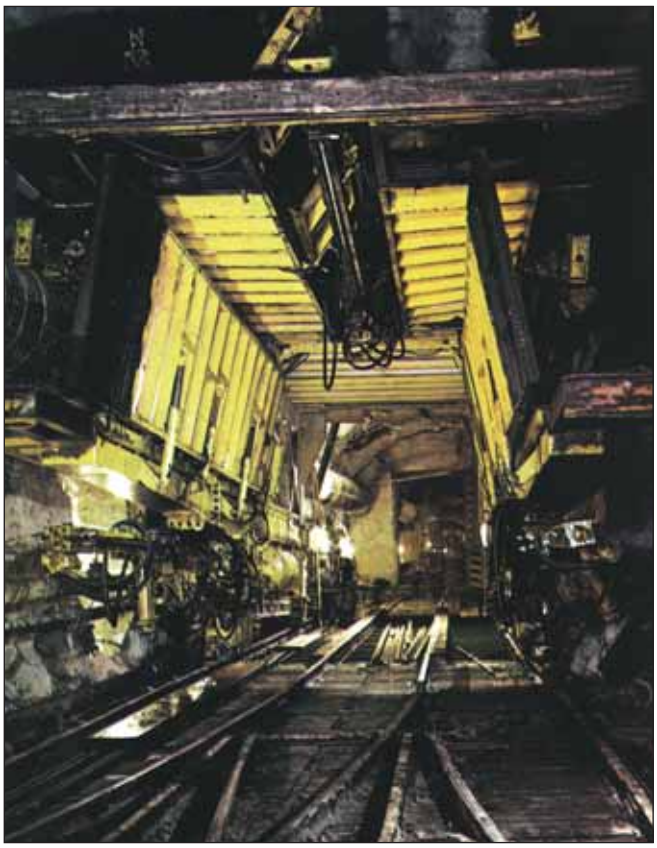
The tunnel was excavated through the sediments of the Beaufort series. These consisted of near horizontal layers of sandstone and shale, which were deposited some 150 to 200 million years ago. It is interesting to note that the particular layers through which the tunnel was excavated contain fossils of animals which were passing from the reptilian to the mammalian stage and for this reason the area is of great interest to palaeontologists. Archaelogical and palaeontological surveys of the dam basin were carried out by scientists who were provided with accommodation at Oviston. The writer of this article had one of the newly discovered, 150 million year old fossils named after him in recognition of his assistance – *Chasmatosaurus alexanderii*.

Numerous vertical dykes varying in width from 50 mm to about 15 m were intercepted by the tunnel, and several major horizontal sheets of dolerite with thicknesses of several hundred metres were encountered. Approximately 11 % of the tunnel length was excavated through dolerite; 25 % through massive sandstone and muddy siltstone; 31 % through sandstone and siltstone; 30 % through thinly banded alternating layers of various sedimentary rock types; and 3 % through weathered, fissured or water-bearing rocks.

Routine rock mechanics tests were carried out during construction on borehole cores obtained from more than one thousand short exploratory boreholes drilled as a routine into the tunnel roof. These tests were carried out to assess the variation in rock behaviour and to assist in the selection of the correct roof support measures. Further tests on rock behaviour included rock deformation tests in the tunnel and







Drilling jumbo folded against the tunnel wall to allow excavation equipment to pass

large-scale jacking tests carried out in fifteen 3 m diameter jacking galleries, driven off the main tunnel, as well as three full-size pressure test galleries, excavated under different depth-of-cover environments. The galleries were fully instrumented, concrete lined and provided with pockets to determine the behaviour of both the rock and the concrete lining under operating conditions. Research was also carried out on the weathering mechanics of the Karoo rock types and the engineering classification of such rocks with reference to tunnelling.

The sediments were relatively impervious and so no water problems were envisaged, except where they were intersected by dolerite dykes. However, artesian water was encountered in six of the boreholes drilled, one of which had been flowing since 1948. No major zones of intensively fractured rock were expected, but limited lengths of fissured rock were anticipated, some of which could be water-bearing.

Gas was encountered on 17 occasions during the drilling of exploratory boreholes, but positive identification proved difficult. In nearly every case the gases occurred within bodies of dolerite or in indurated sediments closely associated with large dolerite intrusions.

EXPLORATORY ADITS

Four exploratory adits were driven into the four major rock types which would be encountered during tunnelling. These were dolerite, sandstone, green siltstone and purple mudstone – the latter being structurally the worst material likely to be encountered. Semi-circular test chambers of the same diameter as the tunnel were excavated at the ends of the adits. The tests that were carried out in these chambers included measurements of the initial state of stress in the rock, the modulus of deformation, the extent of fracturing around the tunnel, the change of stress with time, efficiency of various types of rock bolts, observations on the spalling and behaviour of unprotected rock surfaces, and the protection of exposed services to prevent disintegration on exposure. Rock samples were also obtained for more detailed laboratory analyses, and tests were made on drilling methods.

Tunnelling probably involves a greater degree of risk and greater number of unknowns than any other civil engineering work. Every effort was therefore made to reduce these by extensive exploratory work. The contractor's risk was further reduced by making provision in the contract document for payment of as many items on a measurement basis as was feasible.

INFRASTRUCTURE

The project was divided into three sections, each with its own construction township, railhead and access roads. During the first six months of 1965, nine major contracts were awarded for the construction of housing and ancillary services in the three construction townships, as well as 106 km of tarred access road along the length of the tunnel. The construction townships each consisted of some 120 houses, servants' quarters, garages, staff and artisans quarters, a primary school, clubhouse, and recreation hall, sports fields, a swimming bath, offices, and workers' compounds. Each town was completely reticulated for water, electricity and sewage. A pumping station was erected on the banks of the Orange River at Oviston and water was pumped from this source all along the length of the tunnel.

TUNNEL DESIGN

The tunnel was excavated from the two portals and from seven intermediate shafts roughly 11 km apart. At its deepest point the tunnel is 405 m below ground level. The tunnel operates under pressure as far as Shaft 7, where underground control works are located.

The completed tunnel has a length of 82,45 km and is the longest tunnel in the world. Except for the inlet tower structure in the Gariep Dam, the shaft heads dotted along the tunnel route, and the inconspicuous outlet structure, this spectacular multi-million rand work of engineering is completely hidden from the eyes of the public. The inside diameter of the tunnel is 5,33 m, which is similar to the size of a railway tunnel in South Africa. The volume of the excavated material was 2,4 million cubic metres, enough to fill approximately 100 000 average-sized railway trucks. Approximately 684 000 m^3 of concrete were used for the tunnel lining, the minimum lining thickness being 230 mm. The tunnel invert is 9 m above the original bed level of the Orange River, and 30 m below the water level of the Gariep Dam when it is full. These levels dictated that the physical gradient of the tunnel had to be 1:2000.

Because of its magnitude, the construction of the tunnel was divided into three separate contracts: an inlet section of 27,2 km, which included the construction of the inlet tower and its approach bridge; a central, or plateau section of 31,1 km; and an outlet section of 24,1 km. The latter contract included the construction of the underground control works and the outfall canal.

Seven access shafts varying in depth from 7,5 m to 378 m were sunk at intervals of about 11 km along the tunnel route, allowing tunnel construction to be carried out in opposite directions from each shaft. This provided 16 working headings.

Five types of cross-sectional tunnel profiles were specified to meet the varying conditions which could be encountered. These were normal conditions; low cover conditions; lightly fractured and unsuitable for support by rock bolts; rock heavily fractured and unsuitable for support by rock bolts; and chemically altered and swelling rock.

CONSTRUCTION

A list of 12 pre-qualified tenderers was published in December 1966. Tender documents for the inlet section were issued in March 1967 and tenders were opened on 27 June 1967. The inlet contract was awarded in January 1968, the outlet contract in July 1968, and the plateau contract in October 1968. The first tunnel excavations commenced in February 1968 while the last breakthrough, that between Shaft 7 and the outlet portal, was accomplished in May 1973. The first concrete lining began in June 1970 and the lining operations in the tunnel itself continued until December 1974.

The excavation by all three contractors was carried out by means of conventional drilling and blasting methods, using different types of equipment for excavating and transporting the material to the surface. An excellent record was achieved in the inlet

drive where a maximum length of 145 m was excavated in one week. The weekly advance averaged over the whole tunnel was some 50 m per week. Each of the three contracts achieved a concrete lining rate of more than 540 m per week. The highest quantity of concrete placed in one week was 7 490 m^3 in the outlet heading.

The works had to be completed within 48 months of starting work. In addition, the construction the intake tower had to be programmed to keep it ahead of the rising water level in the Gariep Dam reservoir when impounding started in mid-1970.

CONSTRUCTION PROBLEMS

It was always appreciated that tunnelling on this scale in confined spaces would involve appreciable risks and possible loss of life. An empirical estimate was that one life would be lost per kilometre of tunnel length. The major problems encountered in certain sections of the tunnel justified this view. The driving of the tunnel not only constituted a tremendous challenge to all concerned, but the accidents and fatalities that unfortunately did occur, underlined the grim and stark reality of the dangers and risks associated with such an undertaking.

An inrush of water, calculated to be some 2 000 m^3 per hour that occurred in the Shaft 2 south heading, emphasised the fact that water is still the biggest construction problem to be encountered in tunnelling. This inrush, caused when the tunnel intersected an abnormally high yielding fissure associated with a previously unknown regional geological faults flooded 1 750 m of tunnel to a depth of 87 m. The water reached a static level some 20 m below ground surface. This deep fault system extends from the springs at Aliwal North all the way through to a region south of Upington.

The inrush of water was stemmed by an ingenious method of drilling an aureole of boreholes from the surface down to the flooding point and injecting a cement-sand grout mixture under pressure into these boreholes. The shaft was then dewatered by powerful pumps. During the final stages of the dewatering a concrete plug was cast in the tunnel itself and cement injected through the pipes left in the plug. The result of the flooding caused a serious delay in the particular heading. After the recovery of the shaft a further 1 370 m of water-bearing ground had to be traversed under the protection of long pilot boreholes drilled ahead. Further precautions had to be taken in the rest of the tunnel with the installation of watertight bulkheads near the construction shafts, as well as drilling pilot holes ahead of the advancing headings, and an increase in the capacity of the main pumping stations used for dewatering.

Another hazard encountered was the sustained conflagration of a major issue of undetected inflammable methane gas between Shafts 4 and 5. The fire could only be extinguished by cementation procedures and oxygen starvation. This resulted in a delay of nine months.

Excavation of tunnel outlet portal

A further hazard was caused by severe rock-falls that occurred in tunnel sections of poor rock. These necessitated additional heavy roof-support measures, thus causing further delays. Although these problems could and were all overcome through the determination and team spirit of both the engineer and the contractor, they caused a substantial delay in the completion time for the tunnel as well as a considerable increase in the construction costs.

INTAKE TOWER

The intake tower was constructed adjacent to the left bank of the Gariep Dam reservoir. As the Orange River carries a sediment load of 0,75 % to 1,5 %, it is inevitable that the reservoir will be subject to heavy sedimentation over the years. The intake works were therefore designed with this in view. The aesthetic aspects of such a huge concrete structure were also taken into consideration. The tower structure has a height of 77,7 m above its foundations and an external diameter of 38 m. Seen from above it is shaped like a four-leafed clover. The leaves of the clover contain the gates which will control the level at which water is withdrawn from the dam.

The tower has intakes at six levels, so that relatively sediment-free surface water in the dam can be drawn off.

UNDERGROUND CONTROL WORKS

About 25 % of the average Orange River runoff flows through the tunnel. The diversion rate is controlled from the southern end where the control works are located to ensure that the tunnel flows full at all times. The majority of the construction shafts were left open to counteract any surging effects as well as access for maintenance purposes. The flow velocity of the water during the peak operating conditions is about 2,5 m/s or 9,1 km per hour. The maximum flow is 56 m^3/s. (This is substantially more than the quantity of water supplied to the entire Gauteng area at that time.)

The control works are located underground, adjacent to Shaft 7, that is, approximately 75 km from the tunnel intake. The whole of the huge underground complex was sited in a large, sound, dolerite intrusive body. Downstream of the control works the rock cover above the tunnel rapidly decreases. The energy dissipation created by the control works required a very expensive steel-reinforced concrete lining, which was necessary to sustain the reservoir pressure over the outlet section.

From the control works the tunnel extends for another 10 km to the south to the tunnel exit, where it discharges into the Brak River and thence to Grassridge Dam.

COMMISSIONING

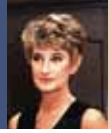
The tunnel was formally commissioned by the then prime minister, B J Vorster, on 22 August 1975, twelve years after the Department of Water Affairs' construction team set up camp on the banks of the Orange River. The cost of the tunnel was well in excess of the cost of Gariep Dam.

Contractors

The three main contractors were for the inlet section, BCA Consortium comprising Farsura-Cogifar, Italy, Batignolles, France, and African Batignolles, South Africa. The Plateau section contractors were the ORCO consortium comprising LTA, South Africa, Boart Hard Metals, South Africa, Boyles Drilling Co, USA, and Compagnie De Constructions, France. The outlet contractors were the JCI-Di Penta Consortium comprising Inpressas di Penta, Italy, and Johannesburg Consolidated Investments, South Africa. □

I was the departmental resident engineer with overall responsibility on site from the commencement of the project in 1963 through until 1969, when the project was well under way and no more policy decisions would be required. The information above is mainly from my own records plus additional statistical material provided by the consulting engineers.

To be continued in our next issue



Compiled by Lorraine Fourie
From *Reflections on the Making of Space*, edited by Justin Fox

Revel Fox – role model for South African architects

'The architect expresses his humanitarian concerns best when he has his ego under control. Self-indulgence, self-gratification, self-aggrandisement, self-enrichment, and all the other selfs that tempt us must be firmly subdued before the architect can operate effectively in the service of society. His work should answer his client's needs but it should also benefit everyone who is exposed to it. Architecture should be benign, life-enhancing, health-giving, a source of pleasure. It should not be gimmicky, fashionable, attention-seeking or vulgar.'

THIS IS HOW RENOWNED architect Revel Fox expressed himself about the profession he had been practising for 55 years, until his death in December 2004. He spent a lifetime developing an architecture appropriate to the region and trying to solve the unique needs of South Africa's built environment. His profound influence on architecture and urban design in the country stems from a design philosophy that encompassed a 'complete' architecture in which he gave close attention to all aspects of a project, through landscaping down to the smallest details of the interior finishes.

What emerges from the observations and reflections of his peers, partners and colleagues is essentially the same. They stress his overriding concern with quality, rigorous design concepts and careful attention to detail in order to achieve the deceptive simplicity of the final product. All of this seems to have been achieved in physical and mental spaces that do not tolerate superfluous objects and thoughts. His work is that of a man who steadily followed his own beat for decades, producing buildings and spaces of common sense and quality, and ignoring to a large extent fashionable styles and fads.

Revel decided to study architecture in the early years of World War II. At the age

In an extensive urban-design project on the Durban beachfront, through traffic was diverted inland and landscaped parking introduced

Revel Fox brought his influence to bear on the way many South African architects approach their profession

of 16, when he applied to the University of Cape Town, he had no idea of the nature of an architect's work, nor was his choice the result of a childhood ambition. Many of his friends were enlisting for armed service and he would have preferred to join them, but his parents insisted that he study first. He completed 18 months of fairly indifferent study before he enlisted, with the result that he travelled abroad with the benefit of a fundamental knowledge of the history of architecture implanted in his mind. The experience gave him the opportunity of visiting important sites and buildings of antiquity, following the story of civilisation from the Nile Delta through Rome to Florence and Venice. It established the basis for a life-long appreciation of the rich European architectural heritage that drew him back on many subsequent journeys of discovery.

He returned to finish his studies in 1946 and spent two years trying to make up for what was thought to have been lost time. The formal instruction he received in the 1940s came mostly from architects who had been trained at the progressive Architectural Association in London, and who were influenced by ideas emanating from the Bauhaus under the direction of Walter Gropius and his associates. Consequently, he was instructed in the tenets of the Modern Movement or the International Style, as it came to be called, during the period when it was the undisputed theoretical basis for design. What he wasn't prepared for was that much of his ensuing work would be on existing buildings, often in sensitive contexts, whether urban or natural.

The dominant influences that affected him at that time came from the leaders of the Modern Movement, such as Frank Lloyd Wright, Mies van der Rohe and Le Corbusier.

Revel graduated in 1948 during a

State of the art Convention Centre

With the completion of the Cape Town International Convention Centre an inhospitable car lot was transfomed into a location that is an asset to the city

SINCE ITS COMPLETION in 2003, the Cape Town International Convention Centre (CTICC) building has received a SAICE Regional Award (2004), the South African Institute of Steel Construction Overall National Award (2004), and was selected overall winner in the South African Property Owners Association (SAPOA) Awards for Innovative Excellence in Property Development (2004).

The design of the centre was the product of a team of consultants led by Foreshore Architects (principal architect Revel Fox, who worked closely with Anya van der Merwe Miszewski and John Ferendinos) and closely followed the bid-winning proposal submitted by the RF Project Association. The structural engineers were KFD Wilkinson, KAYP and ASCH Consulting Engineers, and the main contractors were WBHO / Rainbow Joint Venture.

The CTICC consists of a number of component parts, including a large column-free exhibition space, meeting rooms, two auditoria, an administration building, banqueting hall, and circulation space. The latter area, as well as the meeting rooms, restaurants and one of the auditoria is contained within a large conservatory structure which provides protection from the elements whilst keeping the interior visually open to the city.

Challenging construction

The first engineering challenge in its construction was the development of a foundation system which would carry the building loads on a site that, until the 1920s, was some 150 m offshore and which concealed a large buried groyne built of 6,5 t concrete blocks.

An innovative solution, proposed by Frankipile and Ross Demolition, involved excavating to uncover the groyne, and crushing on site and recycling the 6,5 t blocks to provide sub-base material for the site. Frankipiles could then be driven into the bedrock below.

Functional and aesthetic steelwork

Structural steel was used in many of the components, both as a structural material and decoratively. Much of the steelwork is visible, having been used by the architects to elegantly express and support the form and function of the building.

Looking up into the roof space of the exhibition halls, one sees the curved 'Toblerone' trusses supporting a sound-insulated roof with provision for 2,5 t hanging loads. Carrying the 'Toblerones' are a series of lattice girders spanning up to 72 m, which are able to support huge folding partition walls in a variety of positions with minimal deflection.

The conservatory structure with its striking south light takes the form of a Vierendeel portal that is braced, also using Vierendeel girders at roof level, to the concrete structures contained within this envelope. The steel sections were selected to express an interesting composition of orthogonal lines and carefully detailed junctions.

Within the conservatory space are contained slender composite steel walkways providing multilevel access routes to the many destinations in the centre. These are linked to steel staircases and glass-clad steel lift shafts.

The 1 500-seat auditorium, tucked against the downramp of the elevated freeway that bounds the northern edge of the building, presented the challenge of keeping out vehicle noise. The solution involved creating a box within a box to provide maximum acoustic insulation.

High load bearing floors

The vast expanse of floor to the four exhibition halls, which also forms the roof to the basement parking area, are reinforced concrete bridge decks spanning onto reinforced concrete columns on a 7,8 m x 9,0 m grid. The floors of two of these halls were designed to carry a superimposed live load of 1,5 t per square metre, whilst the other two can carry 3 t per square metre.

Above: BankCity built in the new-classicist style over seven city blocks in the Johannesburg CBD echoes a timeless quality

Left: Design and detailing of the Peninsula Technikon in Bellville South refer to a collegiate classicism, while the building materials used are low on maintenance and will mellow over time

depressed phase in the building industry in Cape Town and made a temporary move to what was then Rhodesia, which was experiencing a period of growth and activity.

After three years of comparative isolation in Zimbabwe he felt the need to travel and study further. The places to visit in the early fifties in Europe were countries that had not been ravaged by conflict and where development had continued in some form, such as Sweden, where he subsequently set up home with his wife, Suzanne, and small child, Grethe.

In retrospect Revel thought that the kind of building programmes South Africa had to carry out after 1994 could learn important lessons from the integrated approach to urban design, landscaping and architecture he saw in mid-century Sweden. At a time when most buildings of architectural significance were isolated pavilions, taking little account of either an urban or natural context, the Swedes placed great emphasis on the integration of buildings into their whole environment, so that the buildings' social significance, as well as their harmonious relationship with what went on around them, produced the highest level of design. During this time he also first became aware of the need for conservation to be responsibly handled at the urban scale.

After two years the Foxes returned to the home of Revel's parents, who were then living in Lourenço Marques, to await the birth of their second child. They then returned to the Cape where he started his own practice in Worcester in the early 1950s. During the four years he spent there, the painter Jean Welz, who had trained as an architect at the Bauhaus, had a considerable influence on his work. Welz encouraged Revel to look closely at the fine tradition of vernacular architecture in the Boland.

Revel's first buildings were small projects such as houses for friends. In the process he sought to adapt theoretical notions to the practical realities of building with limited funds and local technology in a taxing Karoo climate. There is also clear evidence of the influence of the Cape vernacular in those early houses.

Some of his design themes recurred throughout his sequence of work One such theme was 'the pure white flat-roofed box with horizontally banded windows' which appeared in modified forms to deal with the reigning climate and circumstances. Revel would later remark wryly that they were referred to by the locals as 'Fox boxes'.

The sixties opened a new range of experiences. The Fox family moved from Worcester to Cape Town and the challenge of surviving under very difficult circumstances began. Revel supplemented his income with teaching, which began an involvement that continued throughout his career.

During this period Revel had the opportunity to travel on a Carnegie Corporation grant to look at conservation policies in Europe and to visit and report on graduate schools of architecture in the USA. He returned to South Africa much impressed by what he had seen and inspired by the urban studies in graduate schools in North America, where the focus was on the crisis in cities. This provided him with an added incentive for further study.

In 1966 he registered for a degree in Urban and Regional Planning at UCT. His professor was Julian Beinart, who had been one of the earliest employees in Fox's Worcester office. Revel was in mid-career, and had to juggle a heavy workload and the responsibility of raising a family with an intensive period of study. But the field of study changed his approach to design and the course of his career.

His practice grew during the sixties, proceeding from the design of single houses to a commission for an apartment building in Newlands. Montebello apartments and terrace houses was the first large-scale project to come into his practice. He later bought an apartment at Montebello, and lived there until his death in 2004. Other large commissions completed in this period were the School of Ballet and the Faculty of Education at UCT, as well as the Joseph Stone Auditorium in Athlone, a complex built within a tight budget, which was commended for 'making a virtue of economic limitations'.

The influences of the seventies were quite unlike the years that preceded them, with the environment and its ecology becoming major public issues. For Revel there was a distinct shift in emphasis from individual buildings to designing on an urban scale, and the focus moved from single family houses to group housing, bringing with it the attendant concerns with political and social issues. Egyptian architect Hassan Fathy influenced Revel with his building methods that made good, appropriate and economical housing for the poor. He was also inspired by the Luxembourg academic Rob Krier, who in examining the erosion of urban space, called for a new attitude toward the design of cities which rejected much of the accepted planning theory of the day. The growing obsolescence of streets and squares as the life-giving elements of cities became a particular concern.

Revel's practice at that time undertook work that correlated with the issues of the time, such as a school for botanical studies at Kirstenbosch and significant conservation projects. It was also a period of participation in housing projects, ranging from self-help schemes for the very poor to prototypes for Mitchells Plain and the Marina da Gama at Muizenberg, which involved careful environmental planning. In addition, there were buildings for education, including two community learning centres, a project for a lay training centre at Lovedale, the Federal Theological Seminary at Imbali in KwaZulu-Natal, which was partially destroyed as a result of the political unrest in the early 1990s, and the extensions to St George's Cathedral in Cape Town.

Although the practice was offered few commercial projects at the time, the ones it did were large and visible, such as the BP Centre in Cape Town, which, some 30 years later, has not dated and still is one of the most prominent buildings in the city.

The new design for the campus of the University of the North, east of Polekwane, provided for an inner core of academic activity with the students' residences beyond

It was an unlikely appointment for a small and inexperienced practice, but Revel and his people seized the opportunity to address the problems of high-rise office buildings. Together with the head office building for the Cullinan Group in Olifantsfontein, Gauteng, it was one of the first projects in which they experimented with the external fabric of the building as part of its climate control. The basic structural elements were used to model, shape and articulate the façade to create depth and interest, as well as meeting the practical requirements of reducing the sun load and preventing heat gain.

The seventies ended for them in an unexpected confrontation. Revel had always maintained an apolitical stance. He chose to work in areas which he believed were of benefit to all communities, or which he thought were innocuous and uncontroversial. However, a serious conflict arose when the Council of the Cape Town Technikon indicated a wish to build their new campus in District Six. He regarded that as a poor choice on planning grounds, as well as on account of the sensitivity surrounding the site. As leader of the consortium of architects commissioned to design the campus, he first attempted to persuade them to choose an alternative location, and when he failed to do so, he resigned. It was regarded as a political statement and it was to have a lasting effect on attitudes towards his practice.

The start of the eighties brought significant influences from Christopher Alexander at the Centre for Environmental Structure at the University of California at Berkeley. Revel's practice followed the academic debate on the definition of community, discussing the process of design from the scale of the region right down to the smaller components of dwellings, and he said that the publication *The Timeless Way of Building* introduced a new vocabulary into the language of architecture. Another perceptible influence was Charles Jencks' work *The New Classicism in Art and Architecture*.

For Revel it was a period of vivid new impressions, many of them associated with travel. There were nine work-related journeys abroad, one involving a half semester of teaching at the University of Pennsylvania, and one as a member of the internal South African delegation who met representatives of the ANC at the Dakar Conference.

His work was now characterised by a greater preoccupation with urban issues, involving consultancies to Cape Town, Simon's Town, Mossel Bay, Port Elizabeth and East London. The longest and most satisfactory was in Durban, which encompassed major changes to the beachfront and parts of the central city. It was the largest urban-design project in South Africa at the time, and among other things, entailed the rejuvenation of the historical centre around the city hall and post office. The beachfront design was one of his most challenging exercises in trying to reorganise the traffic flow in and through cities. Apart from reducing traffic movement, the Durban beachfront intervention involved landscaping, intensive greening and sand-pumping to reinstate beaches that had been eroded.

Two examples of his ongoing involvement with conservation were the restoration of Bertram House, a satellite of the South African Cultural History Museum in Cape Town, and the preparation of a comprehensive conservation plan for Groot Constantia Estate.

In a period when the official policy on the provision of housing was softening, Revel's office increased their involvement in the delivery of all kinds of dwellings,

Award-winning works

- Montebello Apartments, Newlands, Cape Town – Bronze Medal, Cape Provincial Institute of Architects, 1968
- Eoan Group Cultural Centre and Joseph Stone Auditorium, Athlone, Cape Town – Bronze Medal, Cape Provincial Institute of Architects, 1969
- BP Centre, Cape Town – Cape Province Institute of Architects Medal for best example of architecture in Cape Province, 1973
- Federal Theological Seminary, Imbali, Natal – Institute of SA Architects Award of Merit for best example of architecture in Natal, 1981
- Cape Provincial Administration Building, Cape Town – Concrete Society of Southern Africa's Fulton Award for excellence in the use of concrete, 1983, and Institute of SA Architects Award of Merit for best example of architecture in Cape Province, 1985
- Consultancy to the Beach and City Steering Committee of the City of Durban – Durban City Council's illuminated address, recording their appreciation of his outstanding contribution, 1988
- Peninsula Technikon Central Buildings, Bellville South – Clay Brick Association's National Award for quality brick masonry, 1990
- First National Bank Headquarters (BankCity), Johannesburg – SA Property Owners Association's Building Merit Award, to Architects in Association, principal architect Revel Fox, 1992
- Steenberg Golf Estate – FIABCI (International Real Estate Federation) Rural Properties Prix d'Excellence, 1998
- Vineyard Hotel Conference Centre Conference Venues Award for the best conference centre in the category 'City Venue with Accommodation', 2000
- Morgenster Winery – Institute of SA Architects Award of Commendation, 2003
- Cape Town International Convention Centre – See box on page 11

Personal awards

- Institute of SA Architects Gold Medal for outstanding contribution to architecture in South Africa, 1977
- Cape Times Centenary Medal for outstanding achievements in field of conservation of Cape buildings, historic precincts or natural environment, 1983
- Cape Tercentenary Foundation's Award of Merit for outstanding services to architecture in the Cape, 1987
- SA National Monuments Council's Gold Medal for contribution to conservation in South Africa, 1994
- Sophia Gray Memorial Lecturer, 1977
- DArch (honoris causa), University of Natal, 1993, and University of Cape Town, 2001, for lifelong contribution to excellence in architectural practice, education and professional affairs, and the advancement of architecture in South Africa
- National Order of the Grand Counsellor of the Baobab, for a lifetime contribution to the advancement of architecture in South Africa, conferred posthumously, 2005

including self-help projects for the squatter community at Crossroads and affordable homes for Garden Cities at other income levels. There was also an early-learning centre in Guguletu, a general purposes building for the University of the Western Cape, and the planning of a new campus for the Peninsula Technikon at Bellville South.

Revel redefined contemporary collegiate architecture in the making of this campus. Although his initial appointment was for the design of the central buildings, his firm also undertook the redesign of the campus. The result was a formal cross-axial layout, with separate faculty pavilions linked by a colonnaded arcade around a central space. Because the formality of the plan and the character of its architecture are assumed to be classical, it aroused some discussion within the profession, and attempts were made to classify the buildings within a variety of styles or 'isms'. In fact, an important influence was the layout of the University of Virginia in Charlottesville by Thomas Jefferson.

He also worked on additions to the Houses of Parliament, with a comprehensive redesign of Stalplein and the Tuynhuys precinct. The latter was completed by another firm of architects when the commission was withdrawn. It has been suggested that Revel's dismissal coincided with the release of Breyten Breytenbach from Pollsmoor Prison into his house.

During the early nineties much of his time was spent away from Cape Town on the design of BankCity, the headquarters of First National Bank in central Johannesburg. It was the largest project in the CBD since the construction of the Carlton Centre, consisting of six buildings spread over seven city blocks. The development sought to transform and revitalise a dilapidated part of the city, and the planning of the group of buildings involved the creation of two new public squares which became the venue for important civic events and celebrations.

BankCity's architectural style can best be described as new-classicism, complementing the style of the best of old Johannesburg. The buildings are elegant and timeless, the type of buildings people identify as being those of an established financial institution. The design at the time was the subject of a lively debate and was criticised by several commentators. Revel hoped that the structures would in due course be re-evaluated in a broader context, with the benefit of having been observed over time.

Another challenging assignment in this period was the Victoria and Alfred (V&A) Waterfront mixed-use redevelopment project, involving work on several Waterfront buildings and adapting the old Breakwater Prison on Portswood Ridge above the docks for use as the UCT's Graduate School of Business. The cloister design of the original prison, characterised by dominant wall architecture with minimal openings, offered plenty of accommodation around the central courtyard and was preserved intact, with the addition of an inner ring for offices, lecture rooms and a library. Two buildings of a modest, unadorned design were added, flanking the main prison, to accommodate visitors, conferences and other activities.

The V&A Waterfront project also included a residential component. The value of the location and the high cost of its infrastructure resulted in high-income, high-density urban housing. Wherever possible, apartments are dual aspect, achieving both sea and mountain views. Because of this, vertical access cores rather than conventional access galleries have been used. The basic masonry armature of the buildings refers to the maritime tradition of the waterfront, but the character is wholly a product of its time. The surfaces of the buildings are carefully articulated by means of fully glazed deeply recessed 'outdoor rooms' or balconies, contrasted with large French doors behind Marseilles-type balconies shaded by sliding louvred shutters. Pergolas, awnings, screens

and lattices further enliven the facades whilst providing sun control and visual privacy. Detailed attention to landscaping includes a continuous pedestrian promenade at the water's edge.

Work in conservation included the restoration of several buildings on the Groot Constantia and Alphen estates in the Constantia Valley, as well as at Morgenster farm near Somerset West. All these projects presented the challenge to adapt existing historically significant buildings to new uses, in some cases adding new buildings into highly sensitive architectural contexts. Unique issues were also faced in the incorporation of a residential golf estate and clubhouse on the Steenberg wine farm. Elements new and old, rural and urban, natural and cultivated, were integrated to create a harmonious impression between the new structures, the beautiful landscape and the existing vernacular buildings.

As a member of the Board of the Freedom Park Trust, which is responsible for the development of Freedom Park at Salvokop in Pretoria, Revel was instrumental in guiding the architectural and planning components of the park to stand as a leading national and international icon for humanity and freedom.

Revel believed that a design is successful only if everyone associated with it – architect, client and user – is satisfied. He leaves behind a legacy of houses which are elegant and understated, office buildings that are harmonious places of work, and urban designs which generate pleasant city precincts and traffic-free places. These structures and spaces are expressed in a design language that is simple, accessible and strong, often uplifting the viewer.

Overlooking the Victoria and Alfred Basins on the Cape Town Waterfront, one of the restored buildings on Portswood Ridge displays a dominant veranda architecture

The restoration of Meerlust near Faure in the Western Cape was initially a learning process for both Revel Fox and its owner, but the final results were most rewarding

'What then,' asked Revel at the conclusion of the Sophia Gray Memorial Lecture which he delivered in 1997, 'are the lessons to be learned from experience in a world of fallible theories and ephemeral structures? The lesson for me is the need to strive to do the best job one can, with the data one has, under the given circumstances. If the endeavour is sincere and the pursuit of the most effective outcome is unremitting, the results will justify the effort and will stand the test of time.'

Revel remained fully engaged in all aspects of the work of his office until three weeks before his death. His surviving partners, Peter Puttick, Lorna Hansen, Tertius Kruger, Mark Meyer, Lisa Scott and Robert Wouters, know that the best memorial they can create to this remarkable man is for them to build on the principles upon which he founded the firm, and they have re-affirmed their commitment to making a lasting and valuable contribution to the built environment in South Africa. □

Franki solves it in Bedfordview

FRANKI AFRICA HAS AGAIN shown its ability to produce cost-effective geotechnical solutions in contracts that require decisions 'on the move', as it were. This time it has been for the foundation and lateral support work at the new Bedfordview Mall shopping centre, yet another successful development by Abrosie Brothers in Bedfordview.

The development comprises low-rise residential, high-rise residential, commercial and shopping as well as an upmarket hotel. Franki Africa, who has traditionally done all the geotechnical work for Raymond and Budwa Abrosie, negotiated this large and prestigious contract with them.

The site, which was originally part of the Geldenhuys mine tailings dump, is directly to the east of Bedford Gardens shopping complex. The tailings were removed for reprocessing and the site terracing was completed before any of the foundation work began.

The terracing exposed naturally occurring soils, which comprised residual and Andasitic lavas with the bedrock at highly variable depths below original ground levels.

The presence of highly variable weathering, together with core stone (boulders) development, posed a significant challenge for the foundation works, which was exacerbated by the presence of a variable and perched water table.

Franki directors Gavin Byrne and Ian Oliver, who were instrumental in negotiating the contract and deciding on the most cost-effective solutions, were cognisant that the phased development required piling for a wide range of column loading with light piles required under the low-rise residential developments and heavy capacity piles for the commercial and hotel portions.

Their solution was augered cast-in-situ piles in conjunction with pre-drilled enlarged base piles. This accommodated the variability in rock depth and allowed Franki to found piles on enlarged bases, rather than bedrock, in areas where bedrock exceeded 10 m in depth. The enlarged base solution was also adopted in areas where significant core stone development was evident.

Mike Taitz, Franki director in charge of the project, says the completion of the earthworks with the terracing, before

finalisation of the development plan, necessitated innovation for the formation of deep basement excavation lateral support structures.

'Changes in planning the position of the required final basement structure, necessitated a combination of permanent soil nail and gunite support in areas of cut and reinforced earth in areas of fill,' explained Taitz.

He added that Franki, because of its close working relationship with Reinforced Earth, was able to invite that company to work with Franki in the solution of the problem thus providing the client with a robust and cost-effective solution, which, ultimately, required retaining structures up to 9 m in height.

Taitz says that negotiating a contract directly with a client has many advantages, not the least of which is the ability to take responsibility for any challenge that may arise.

'Our decision to call in Reinforced Earth is a case in point. We had negotiated to supply the client with the best possible solution and this is what we were able to do,' concluded Taitz.

The contract includes:

- the installation of 463 No auger and pre-drilled enlarged base piles to depths ranging from 2,5 m to 9,0 m in a full range of diameters from 450 mm to 1 200 mm
- the construction of 150 mm of permanent gunite wall reinforced with two layers of ref 395 galvanised mesh, together with five rows of 20 mm diameter inclined and galvanised soil nails up to 9,0 m long for the lateral support on the western face
- 1 800 m^2 of Reinforced Earth backfill on the southern face to complete the lower basement groundwork
- auger piling for the apartment blocks and at the higher level on the southern side of the site

The contract was awarded on 28 April 2005, work commenced on 9 May and completion is expected before the end of July 2005.

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Unprecedented number of entries for Steel Awards

The office precinct on the DTI Campus in Pretoria

THERE HAS BEEN an unprecedented response from the industry to the 2005 Steel Awards. According to Reneé Pretorius, communications manager of the South African Institute of Steel Construction (SAISC), a record number of entries has been received.

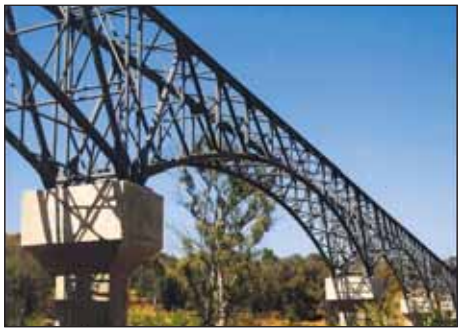
'We are not only pleased about the quantum of entries but also the high standard of some of the projects. It is testimony to the excellent work currently being done in steel in South Africa,' says Pretorius.

One of the excellent entries is the *DTI office precinct*, part of the DTI Campus in Pretoria.

Galvanised steelwork was used extensively throughout the project with the galvanised finish blending in with the African rustic appeal of the surrounding buildings. Owing to the fast-track nature of the project, together with the requirement to galvanise and achieve a quality level befitting the prestigious office development, it took an unusual effort from the project team, contractor and steelwork subcontractor to design and detail these steel structures and balustrades. The net result is an outstanding aesthetic structure that was created within very tight programming constraints.

Another entry, submitted by Arup SA, is the *Leeuwkop Relief Outfalls* sewer pipe bridge in Sandton.

Here, a creative and innovative solution was required as a result of the high rate of development in the residential and commercial areas north of Johannesburg.



Leeuwkop Relief Outfalls sewer pipe bridge

Arup was awarded the project based on its solution, which consisted of concrete piers supporting a steel arch bridge structure with a concrete deck to support the sewer pipe.

Originally it was expected that the bridge be constructed in concrete, which is the norm for most bridges in South Africa due to the perceived low cost of concrete relative to steel. However, Arup looked at both a concrete and steel solution and chose steel for cost and aesthetic reasons.

The entry states that the 'aesthetic appeal of steel and the advantages of maximum prefabrication and therefore minimum construction time' were deciding factors for using the steel design, which entailed a tubular steelwork arch that provided an exceptionally pleasing aesthetic look to the Jukskei River crossing.

Roodepoort's *Clearwater Mall's* retractable roof is yet another high-profile entry in this year's Steel Awards.

The roof, the first of its kind in South Africa, was designed to facilitate an all-weather space that is open to fresh air in good weather yet can be closed in inclement conditions. It opens and closes automatically at selected times of the day, but has sensors for it to respond to rainy and windy conditions. It also has an override for manual operation if required.

The roof is a superb achievement in steel and is an example of today's multi-disciplinary integrated technology.

The winners of the Steel Awards will be announced on 11 August 2005 at the SAISC's annual awards ceremony to be held concurrently in Midrand, Cape Town and Durban, and linked via a two-way satellite link.

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Rotary Interchange *first for South Africa*

THE LIBERTY MIDLANDS MALL is proving to be the catalyst for a series of new developments in Pietermaritzburg and an innovative traffic feature could make the wheels of commerce turn even more smoothly.

The location of the shopping centre is ideal, with two interchanges on the N3 in very close proximity. But a very confined site required innovative thinking to provide an efficient traffic system and stay within budget. The shopping centre has the capability to generate significant volumes of traffic which otherwise would not be present on the localised street system and this, along with the fact that adjacent land is being developed as well, meant that the existing road infrastructure would have to be upgraded to accommodate the increased traffic associated with the development activity.

BCP Engineers were commissioned to develop proposals for resolving the problem. Stan Walden and Derek McGuigan turned to overseas experience and the final solution was a large diameter traffic circle utilising two freeway bridges. The proposal required the widening of Armitage and Sanctuary roads and the construction of a new bridge in order to accommodate a rotary interchange above the N3.

Although this type of interchange has been used extensively overseas, this was the first time it would be used in South Africa. It was scrutinised by many experts and even sent to the CSIR for testing and comment. The verdict was that it was an appropriate and clever solution to a tricky problem. The project recently received the Pietermaritzburg Branch Award for technical excellence.

The new bridge over the freeway was constructed with minimum disruption to traffic on the N3. All other construction took place in very confined conditions whilst maintaining traffic flows on the road system. The construction was undertaken by Group 5 KZN and completed in a tight programme of ten months.

For traffic coming from the north – Hilton, Howick and beyond – a new off-ramp was constructed from the existing Chatterton Road Interchange, giving access directly to the local road system and hence into the shopping centre. The frontage of the shopping centre will be widened to four lanes and will offer three points of access.

This section of the N3 has now been subjected to even more scrutiny by the SA National Roads Agency, who appointed BCP to undertake a study of the N3 Pietermaritzburg bypass. This road carries the highest volume of goods traffic in Africa as well as high volumes of light vehicle traffic, which peak dramatically at certain times of the year with the additional tourist traffic.

This is further complicated as it passes through Pietermaritzburg, where it also acts as a commuter route. On this project, Stan Walden and Zamisile Mkhize ran a series of computer models examining every alternative. Mkhize says she no longer struggles to get to sleep at night. ‘Thirty seconds dreaming about cars, and insomnia is a thing of the past!’ □

Left: Rotary Interchange at Liberty Midlands Mall; above: Construction in progress

Facts and figures

- **Construction time** ..... 11 months
- **Construction costs** ..... R55 million
- **Fill required** ..... 324 000 m³
- **Waste removed** ..... 112 000 m³
- **Layerworks** ..... 36 400 m³
- **Retaining walls** ..... 1 700 m²

- **Owner** Gautrans
- **Financing** Attfund Ltd
- **Consulting engineers** BKS
- **Contractor** WBHO
- **Subcontractors** Diesel Power, Ndivela, VSL, DSC Zendon

Huge traffic problem alleviated

NEXT TO THE Clearwater Mall site in Roodepoort, Gauteng, WBHO Roads & Earthworks has constructed a R55 million quarter-link interchange at the intersection of Hendrik Potgieter and Christiaan de Wet roads to facilitate access to the shopping centre.

The Clearwater Interchange replaced the existing at-grade intersection between the two roads. The purpose of the interchange was to alleviate the traffic congestion at the intersection and to make provision for the additional traffic in the Strubens Valley urban area generated by the shopping centre, as well as other future developments.

'The interchange was originally designed as a conventional diamond interchange and land was expropriated for this purpose,' says the project leader, Cas Pretorius of consulting engineers BKS.

'With the original diamond interchange design the shopping centre site was not accessible from Hendrik Potgieter and Christiaan de Wet roads. By opting for the quarter-link design access could be provided from these provincial roads,' says Cas.

Fanus Lundt of BKS, who was responsible for the design, explains:

'The project called for the construction of an overpass comprising two new bridges across Hendrik Potgieter, all associated ramps and slip lanes as well as two new entrances to Clearwater Mall.

'Christiaan de Wet Drive is taken over Hendrik Potgieter Road by means of two bridges. The two roads are linked by means of a link road in the north eastern quadrant of the intersection. This link road forms T-junctions with both Christiaan de Wet Drive and Hendrik Potgieter Road. In addition to the link road a ramp is provided in the southeastern quadrant for westbound traffic on Hendrik Potgieter turning south onto Christiaan de Wet. Another ramp in the northwestern quadrant accommodates eastbound traffic on Hendrik Potgieter turning north onto Christiaan de Wet.'

An interesting challenge associated with the project was the construction of a section of the link road through the Panorama landfill. The landfill consists mainly of domestic waste and is situated on the site of an old quarry. The quarry is approximately 11 m deep and the landfill approximately 9 m high. Waste approximately 20 m (seven storeys) high had to be removed and replaced with fill material to create a stable

Above left: Completed Clearwater Interchange with Panorama landfill to the right and attenuation area inside the quarter link clearly visible

Above: The Clearwater quarter-link interchange during construction, with Clearwater Mall in the background

foundation for the link road. During the removal of the waste the emission of gases had to be monitored closely and special precautions were taken to protect the construction workers from these gases. When the concentration of these gases reached certain levels, construction work had to be stopped until the concentration returned to safe levels.

Construction of the bridge decks also required special techniques. It was a prerequisite that continuous traffic flow on Hendrik Potgieter be maintained during construction of the bridges. To achieve this, the decks were constructed approximately 800 mm above their final positions. After the decks were completed they were lowered to their final positions. It took approximately five days to lower one deck.

Fanus explains that the interchange not only alleviates traffic congestion, it also has an important function in stormwater management. Stormwater runoff due to the development of the shopping centre has increased by 85 % from what it was before. The higher flood peaks are attenuated (stored and released at a lower flow rate) in an 'attenuation pond' in the area between Christiaan de Wet, Hendrik Potgieter and the link road (namely the quarter link). The higher flood peaks enter the quarter link via a system of large box and pipe culverts and is released back into the existing drainage system downstream via a smaller pipe culvert that regulates the maximum allowable outflow. The excess stormwater (about 8 000 m^3) is stored temporarily in the quarter link.

'This ensures that the post-development (after the shopping centre development) flood peak runoff is not higher than the pre-development (before the shopping centre development) flood peak runoff,' says Cas.

Although Clearwater Mall traffic is only using 30 % of the capacity of the intersection, the developers, Attfund Ltd, have financed the entire upgrade of the intersection. □

Shopping under *the open skies*

FOR THE FIRST TIME South Africa's splendid climate has been incorporated in the design of a shopping centre. Sporting a retractable roof, the Clearwater Mall in Strubens Valley, Roodepoort, brings the Highveld sun right into the retail area.

The roof, the first of its kind in the country, sits atop an oval-shaped atrium some 60 m across, and can be opened to take advantage of sunny weather, similar to that of a sports stadium.

ROOF ON ROLLERS

'A highly innovative design,' is how Rob Bray, director of Bentel Associates International and design architect for the Clearwater project, describes the triangular centre with the atrium located in the centre of the triangle. Its most prominent feature, the roof, was designed to facilitate an all-weather space that is open to the skies in good weather, yet can be closed in inclement conditions. It opens and closes automatically at selected times of the day, but has sensors allowing it to respond to rain and wind. It also has an override for manual operation, if required.

The roof, which has been entered for the South African Institute of Steel Construction's 2005 Steel Awards, is described as 'a superb achievement in steel and is an example of today's multidisciplinary integrated technology'.

The vast amount of steelwork, including the installation of the retractable roof, was undertaken by subcontractors Cadcon, A-LEITA and Burger Projects, who also installed the decorative angular structural steel tendons, varying from 8 mm to 24 mm in width, in the atrium roof.

To achieve a lightweight structure, the roof was designed to rest in its closed position on a specially designed I-beam support system, which forms the parallel rails that support the wheels of the movable steel structure. They are in turn each supported by two V-shaped columns constructed from laminated saligna beams, connected at their lower ends to single concrete columns with specially shaped steel connecting plates on either side and bolted right through the laminated timber. The roof itself has been covered with galvanised steel roll KingKlip 0,58 mm industrial sheeting, as is the rest of the building, by subcontractor Tate & Nicholson.

INDOOR-OUTDOOR THEME

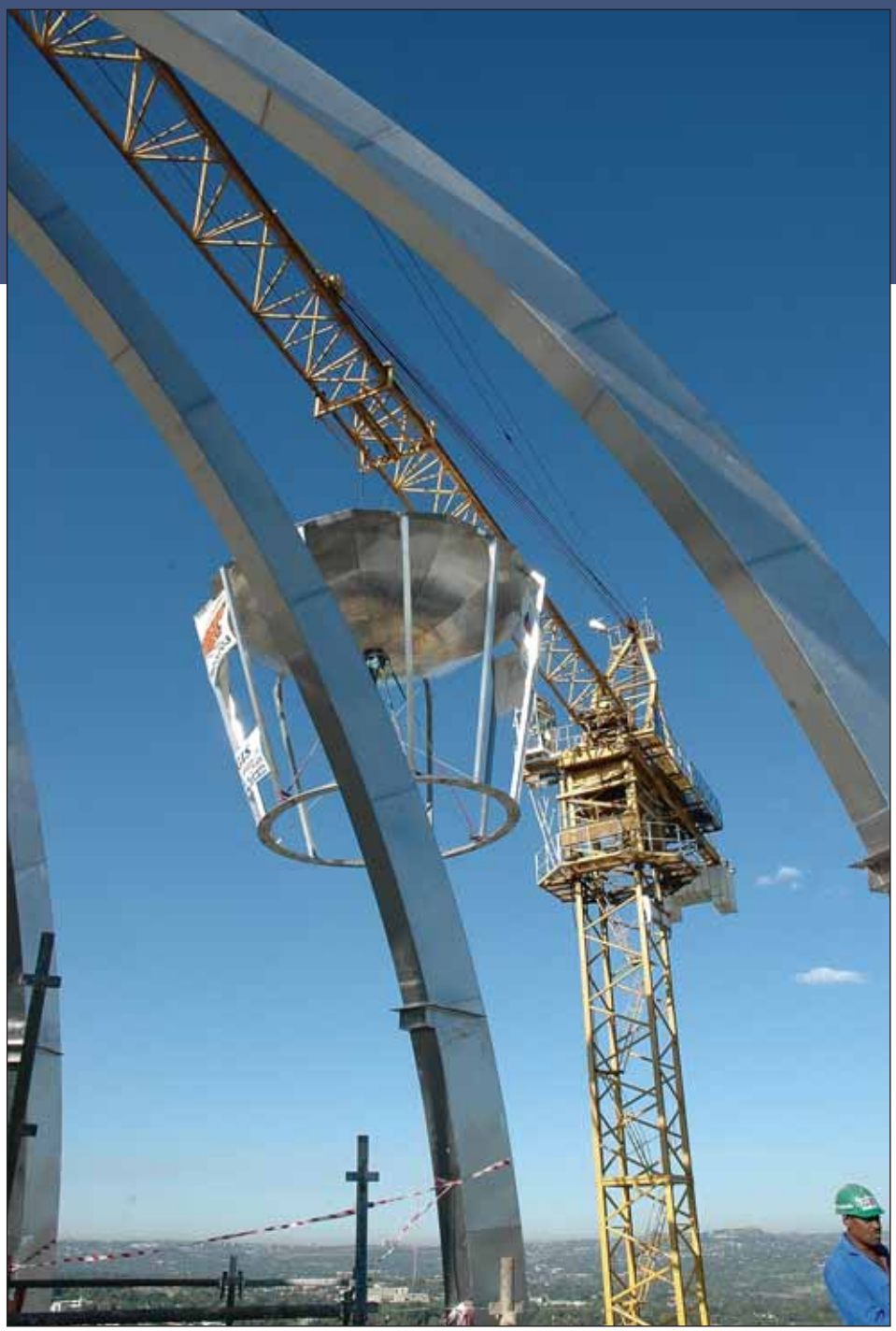
Apart from steel, the design of Clearwater made extensive use of other natural materials such as stone, glass and aluminium, with the five entrances featuring sandstone coloured brick and glass curtain wall façades. The feeling of airiness is enhanced by the 6 m high ceilings, which is higher than normal, and the 4 m glass-fronted shop fronts, bringing the outdoors indoors. Since at least 30 % of the overhead structure is static glass, light will stream in even when the roof is closed.

The main structure is concrete, while the premises for two of the main anchor tenants, Pick 'n Pay and Woolworths, consist of steel structures filled in with brickwork. Altogether 30 000 m^3 of concrete and eight million bricks were used. A coffered slab was used for construction of the first-floor deck, post-tensioned for economy and to save time. A major challenge which WBHO Construction faced was the pouring of concrete off-shutter on the top level of the atrium to form the perfectly curved egg-shaped shelf sloping from 3,6 m to 1,5 m. Following a fast-track programme, WBHO completed the R280 million contract within approximately 15 months.

The Clearwater project has been included in the construction industry's honours list for 2005. It has received a commendation from the Concrete Society of Southern Africa in the category Building Projects.

Located on the junction of Hendrik Potgieter and Christiaan de Wet roads, the 65 000 m^2 mall was developed by Attfund & Belcanto to meet the shopping needs of Roodepoort residents who previously had to travel to Westgate, Cresta and Northgate. □

To achieve a lightweight structure, the roof was designed to rest in its closed position on a specially designed I-beam support system



Project info

- **Developer** Legacy Group Holdings
- **Building contractors** Group Five/Stocks Building Africa
- **Architects** Bentel Associates International
- **Structural engineers** Ritchie Midgley
- **Quantity surveyors** C P de Leeuw
- **Mechanical and wet services engineers** WSP Consulting Engineers
- **Electrical contractors**: Claasen Auret
- **Fire consultants**: Specialised Fire Technology
- **Interior designers**: Stephen Falke and Lionel Levin
- **Financiers**: Nedbank BoE

Domed tower stands tall in Sandton

CONSTRUCTION ON THE R750-million, 34-storey Michelangelo Towers in the Sandton CBD, north of Johannesburg, is nearing completion. The two retail levels have already been handed over to the developer, Legacy Group Holdings, and work such as cladding and finishing on the tower complex is progressing at speed.

Designed by architects Bentel Associates International, the building's appearance falls in the classical mould, but it is in all aspects a modern building incorporating the latest building and materials technology. The contract is being carried out by a joint venture between Group Five and Stocks Building Africa (SBA).

Left: Placing the crowning section of the dome, bringing the structure to 153 m

PINNACLE OF ELEGANCE

Comprising a basement, podium and tower block, Michelangelo Towers is a mixed-use development. The basement and podium are formed by four below and four above ground levels of parking, two retail/commercial levels linking through to Sandton Square, and three levels of apartments. The tower – which starts on the eighth floor – is entirely devoted to luxury residential accommodation comprising 13 levels of apartments, four levels of penthouse suite apartments, two levels of king penthouse suites and two levels of sky suites, offering their occupants some of the best views of Johannesburg. According to Legacy Group Holdings chairman Bart Dorrestein, most of the apartments, ranging in size from 75 m^3 to the 800 m^3 king suite, have already been sold.

State-of-the-art technology controls the security and comfort levels demanded of the building. Says WSP's Gavin Pereira, design

Comprising a basement, podium and tower block, Michelangelo Towers is a mixed-use development

technician responsible for the plumbing and drainage design of the Manhattan-style apartment complex: 'The domestic water created the most interesting challenges, requiring engineering solutions to design a pressurised plumbing system that could operate between two and four bar in such a high-rise building.'

The structure is in concrete whilst the envelope includes GRC mouldings, curtain wall systems, fold-away aluminium and glass doors and windows to the apartments, glazed balustrades and marble, granite and plaster cladding. The tower block is capped by an imposing stainless steel dome, which towers 153 m above the Sandton skyline.

The dome was erected in two phases, the first being the installation of twelve curved supporting sections, which were then topped with a 7 m x 5 m structure supporting the inverted dome.

FAST-TRACK PROJECT

According to Jacques Robbertze, contracts director for Group Five/SBA, the greatest challenges the project presented since they moved on to site in April 2003 have been the speed of construction and the demanding site logistics. Fronting on busy Maud Street and with customers frequenting the already opened shopping mall in the Towers as well as shopping areas and restaurants flanking the complex, the space on site is very tight. 'But having refined all our systems for handling the flow of materials we are well on top of the logistics of the operation,' he says. □

Two Fulton Awards for Mohale Dam

The 145 m Mohale Dam is the highest concrete faced rockfill dam on the continent

MOHALE DAM in the Lesotho Highlands has won two of the prestigious Fulton Awards for excellence in the use of concrete.

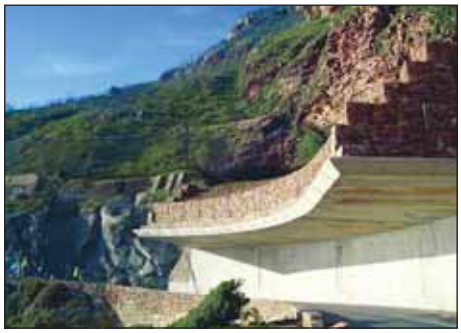
The awards – South Africa's premier construction industry accolades – were presented at a banquet at the Emperor's Palace on Friday, June 24. They are presented every second year by the Concrete Society of Southern Africa. The Cement & Concrete Institute was anchor sponsor this year.

The winners of the 2005 Fulton Awards are:

- *Civil engineering projects category:* Mohale Dam, Lesotho Highlands. The entry was submitted by consulting engineers Mohale Consultants Group. The contractors for the project, owned by the Lesotho Highlands Development Authority, were Mohale Dam Contractors.
- *Building projects category:* Constitutional Court, Hillbrow (owner: Johannesburg Development Agency). The entry was submitted by WBHO, the firm who handled the contract in a joint venture with Rainbow Construction. The architects were OMM Design Workshop and Urban Solutions. Other companies involved in the contract were Ital Concrete Design and ARUP.

Concrete has been used with great skill in the Constitutional Court

- *Design aspects category:* Chapman's Peak rockfall protection. The Chapman's Peak Engineering Group and Entilini Concession were the entrants for this project handled by contractors Chapman's Peak Construction JV. Consulting engineers were Zietsman Lloyd & Hemsted and the late Prof Rolf Kratz. Other firms involved were OvP Associates (landscaping) and Louis Melis & du Plessis (geotechnical engineers).



The reopening of Chapman's Peak Drive required substantial rockfall protection measures. Concrete canopies were selected as the solution in two gullies where the greatest probability of high energy rockfalls and landslides exists

- *Aesthetic appeal category:* Nelson Mandela Bridge, linking Newtown and Braamfontein. Grinaker-LTA Civil Engineering submitted the entry. The consulting engineers were Nelson Mandela Bridge Consultants Consortium and the contractors Grinaker-LTA-BCW Joint Venture. Other firms involved on the project (owned by the Johannesburg Roads Agency) were Goba Moahloli Keeve Steyn and Holcim.

Innovative design and construction techniques were used to create an aesthetically appealing structure for Nelson Mandela Bridge, with concrete playing an important role

- *Construction techniques category:* Mohale Dam.
- *Special category:* Nova Vida housing development, Luanda, Angola. Contractors Group Five Construction International submitted the entry for this project for which Africon were the civil engineers and client's representatives. The architects were Group Five Design and Planning, and other firms involved were Group Five Civil Engineering, and Group Five Roads & Earthworks.

Bringing new life to a city in dire need of housing, the Nova Vida housing project has provided new homes for 30 000 people in a period of only 41 months

The following commendations were made:

- *Civil engineering category:* Ngqura Harbour and Zambezi River Bridge
- *Building projects:* Clearwater Mall and Bowman Gilfillan head office
- *Design aspects:* Constitutional Court, Nestlé warehouse and LG warehouse
- *Aesthetic appeal:* Plumpjack Wine Estate and Constitutional Court
- *Construction techniques:* Isibonelo Bunker and Zambezi River Bridge

Judges for the 2005 Fulton Awards were the presidents of the Concrete Society of Southern Africa, Venance da Silva; the South African Institution of Civil Engineering, Mike Deeks; and the South African Institute of Architects, Trish Emmett.

In total, 29 projects entered for this year's Fulton Awards, named after internationally renowned concrete technologist the late Dr Sandy Fulton, a former executive director of the Portland Cement Institute (now Cement & Concrete Institute). □

Text **Hendrik Markram**
Associate **Deneys Reitz**

Despite the various problems associated with the practical implementation of the new construction regulations, they do form a good basis for refining and developing a much needed (and absolutely necessary) set of health and safety requirements for the construction industry.

This is the view of Hendrik Markram, an associate in the Construction and Engineering Law unit at leading commercial law firm Deneys Reitz. He says that the intentions of the regulations, which were promulgated under the Occupational Health and Safety Act of 1993, are generally good but they

New

WITH THE PROMULGATION OF the new construction regulations under the Occupational Health and Safety Act, 1993 on 18 July 2003, the legislature created significant and far-reaching responsibilities for members of the construction industry.

WHO IS AFFECTED?

Before dealing with some specific regulations, it is important to understand the mechanism employed by the legislature.

Regulation 2(1) states that: '*These Regulations shall apply to any persons involved in construction work*'.

The underlying principle behind the regulations is that every party involved in construction works will be policed by another party higher up in the construction chain. Legal liability for the actions of parties lower down are transferred to parties higher up. The duties and responsibilities imposed by the regulations are therefore now not only applicable to designers, the principal contractor and any other appointed contractors, but also the owner of the works, who is the person for whom construction work is performed. Ultimately, everyone involved, including the client, can be held liable.

The responsibilities of a party cannot be avoided by exclusion from the construction process. A client who performs construction work without the assistance of a principal contractor can be used as an example. The client will assume the position of the principal contractor in terms of the regulations with all the inevitable responsibilities of, not only the client, but also that of the principal contractor.

REGULATION 3: NOTIFICATIONS

Regulation 3 deals with the notification of construction work in the following manner:

(1) A principal contractor who intends to carry out any construction work shall –

- *(a) before carrying out that work, notify the provincial director in writing of the construction work if it includes –*
  - *(i) the demolition of a structure exceeding a height of 3 metres; or*
  - *(ii) the use of explosives to perform construction work; or*
  - *(iii) the dismantling of fixed plant at a height greater than 3 metres;*
- *(b) before carrying out that work, notify the provincial director in writing when the construction work –*
  - *(i) exceeds 30 days or will involve more than 300 person days of construction work; and*
  - *(ii) includes excavation work deeper than 1 metre; or*
  - *(iii) includes work at a height greater than 3 metres above ground or a landing.*

Notifications are not applications to perform work, but notification is required before any work of the above nature can be proceeded with.

The requirement for notification of demolition of structures in excess of 3 m is surprising, however; the previous requirement was 6 m.

Regulation 3(1)(a)(ii) is important, but should be read with the explosives regulations, which impose more strict requirements.

Notifications required under Regulation 3(1)(a)(iii) will be problematic for persons involved in maintenance (even if routine) of plant as the definition of *construction work* includes: *'any work in connection with ... (b) the installation, erection, dismantling or maintenance of a fixed plant where such work includes the risk of a person falling'*.

To put the notification requirements of Regulation 3(1)(b) into practical perspective, one could use an example of a construction worker performing his duties on a site that qualifies for inclusion under this regulation. The worker needs to perform work at a height in excess of 3 m above ground level. The principal contractor must first notify the provincial director of the Department of Labour that this work is to be carried out. However, the client, its agents, designers, the principal contractor and the contractor who employs the worker cannot allow the worker to proceed before the notification is in place. Should the actions of the worker result in an incident, any liability can legally be transferred to all parties involved.

Exactly the same problem arises where an excavation of more than 1 m deep is to be performed. The regulation deals only with

impose some far-reaching responsibilities on all members of the building industry.

'The underlying principle behind the regulations is that every party involved in construction works – from the designers right through to the person for whom the building work is being carried out – will be policed by another party higher up in the construction chain. This means that the duties and responsibilities imposed by the regulations are applicable to every party in the construction chain, without exception,' says Markram.

Here, Markram discusses some of the implications of the regulations.

construction regulations

How practical are they?

the depth of the excavation and not the volume or other dimensions. If a construction worker performs an excavation for purposes of planting a tree and the depth of the excavation exceeds 1 m, the principal contractor has to notify the Department of Labour before such work can be proceeded with. Copies of all notifications are to be kept on site and must be available for inspection.

It is clear that the implementation of these regulations is very difficult from a practical perspective. A further problem that will inevitably arise is that the Department of Labour will be flooded with notifications and resources will be allocated to construction sites where the health and safety risks are minimal and within acceptable normal levels.

REGULATION 9: STRUCTURES

Regulation 9(4) reads:

(4) Any owner of a structure shall ensure that inspections of that structure upon completion are carried out periodically by competent persons in order to render the structure safe for continued use: Provided that the inspections are carried out at least once every six months for the first two years and thereafter yearly and records of such inspections are kept and made available to an inspector upon request.

A *competent person*, as defined in Regulation 1, means:

... any person having the knowledge, training, experience and qualifications specific to the work or task being performed: Provided that where appropriate qualifications and training are registered in terms of the provisions of the South African Qualifications Authority Act, 1995 (Act No 58 of 1995), these qualifications and training shall be deemed to be the required qualifications and training.

This responsibility on owners of structures appears to be unrealistic. Any structure where the progress to the works had not exceeded 50 % at the time of promulgation of these regulations (18 July 2003) would be affected by this particular regulation. Not only will it have significant cost implications for owners of structures during the first two years after completion, but also for the remainder of the life of the structure. The responsibility to have inspections carried out is conferred on owners of both commercial and residential properties. Also, no distinction is made between single- and multi-storey buildings in this regulation.

This responsibility attaches to the structure and is not affected by changes in ownership of a particular property. This regulation may have a significant impact on the property industry from the point of view of prospective investors in property as well as the marketing strategies of property developers.

It is also questionable why inspections would be necessary on a yearly basis subsequent to the initial two-year period. Any undue risks of collapse of a structure as well as structural defects should have been identified during the initial period, thereby limiting the health and safety risks to the occupants of such structures to an acceptable level.

THE CONTRIBUTION OF THE CONSTRUCTION REGULATIONS

Although various practical problems with the regulations are pointed out above, the intention of a legislature is good. The regulations do create renewed general awareness of the health and safety of all persons involved in construction work, and form a good basis for refining and developing health and safety requirements in the construction industry.

Deneys Reitz Inc
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Text **Rob Morson and Matthew Bonner**
Corporate Department: Construction and Engineering Practice Area, Bowman Gilfillan

Construction Industry Development Regulations another brick in the regulatory wall

THE RECENT IMPLEMENTATION of the Construction Industry Development Regulations, 2004 promises to place a further administrative burden on the increasingly regulated South African construction industry.

The Construction Industry Development Board Act, No 38 of 2000 established the Construction Industry Development Board (CIDB) to provide leadership to stakeholders in the industry and to implement an integrated strategy to stimulate sustainable growth, reform and improvement of the construction sector. The CIDB, which is responsible to the Minister of Public Works, comprises private and public sector individuals appointed by the minister on the basis of their individual knowledge and expertise.

In addition to establishing the CIDB, the Act provided for the future establishment of registers of construction contractors and construction projects. The regulations, which were first published on 9 June 2004, take the first step towards the establishment of these registers and with effect from 16 May 2005 require all private sector construction projects with a value in excess of R3 million to be registered with the CIDB. The registration fee is R750 per project.

The registration requirements also currently apply to certain public sector construction contracts with a project value in excess of R3 million inasmuch as the regulations came into effect, during various periods between October 2004 and May 2005, in relation to construction projects of the Limpopo Provincial Department of Public Works, the eThekwini Metropolitan Council, the National Department of Public Works, and the Gauteng Department of Transport, Roads and Public Works. The current public sector registration requirements will extend to all construction projects of all other organs of state with effect from 15 August 2005 and then to all other local councils as from 14 November 2005, from which date the project value threshold for registration of public sector contracts with the CIDB decreases from R3 million to R300 000.

The private sector should take note that the R3 million project value threshold decreases with effect from 14 November 2007, from which date all private sector projects with a value in excess of R300 000 will have to be registered with the CIDB against payment of the required R750 registration fee. In what will no doubt come as a relief to many private individuals, the registration requirements do not apply to construction works in respect of the construction of homes as contemplated in the Housing Consumer Protection Measures Act, 1998.

REGISTRATION OF CONSTRUCTION PROJECTS

The regulations require an employer to apply to the CIDB for the registration of a construction project within two working days from the date that the contractor's offer to perform the construction work is accepted by the employer.

The application will have to include details of the following:

- whether the project being registered relates to a project that consists of a series of contracts, or whether the project being registered relates to a series of projects aimed at a predefined outcome
- whether the project relates to a public-private partnership, and
- whether the employer is acting on behalf of a client

The registration fee will have to be paid by the client who initiated the project on the date of registration of the project or in advance if the registration relates to a number of projects that are to be registered by that client for a period agreed on with the CIDB.

Once the project is registered, the regulations require an employer to submit various project-related status reports to the CIDB and to notify the CIDB of any arbitration or litigation initiated in relation to the construction works in question.

Any person or organ of state who fails to register a construction project in terms of the regulations is guilty of an offence and is liable to a fine not exceeding R100 000.

REGISTRATION OF CONTRACTORS

The regulations further provide that contractors must register with a national register of contractors which categorises contractors in a manner that facilitates public sector procurement and promotes contractor development. A contractor may be registered in more than one class of works. Annual fees payable for such registration range from R200 to R40 000.

The regulations specifically exclude the need for a contractor who is registered as a homebuilder in terms of the Housing Consumer Protection Measures Act, 1998, to register in terms of the regulations, but only in relation to the construction of homes as referred to above.

The categories of registration are determined by

- a contractor grading designation contemplated in the regulations which is determined by evaluating the financial and works capability of the contractor by means of formulas set out in the regulations
- the status of a contractor as a potentially emerging enterprise
- from a date determined by the minister, recognition in terms of a best practice recognition scheme, and
- from a date determined by the minister, the status of recognition of the progress of a contractor in terms of any black economic empowerment programme

The aim of the register of contractors is to

- indicate the size and distribution of contractors operating within the construction industry
- indicate the volume, nature and performance of contractors and target groups, and
- enable access by the private sector and thus facilitate private sector procurement

WHAT HAPPENS IF CONTRACTORS DO NOT REGISTER WITH THE CIDB?

It is vital that contractors register in terms of the regulations, as every organ of state must, subject to the policy on procurement, apply the register of contractors to its procurement process.

The Act provides that no contractor may undertake, carry out or complete any construction works for public sector contracts, awarded in terms of competitive tender or quotation, unless he or she is registered with the CIDB and holds a valid registration certificate issued by the CIDB. Should a contractor do so, he or she will be guilty of an offence and liable to pay a fine of up to 10 % of the value of the contract in question.

It should also be noted that a failure to comply with the regulations is an offence which carries the possibility of a fine of up R100 000.

BEST PRACTICE ASSESSMENT SCHEME

Both the Act and regulations make provision, at a later stage, for the implementation of a Best Practice Assessment Scheme, which is aimed at enabling organs of state to manage risk on complex contracting strategies and promote contractor development in relation to best practice standards and guidelines developed by the CIDB.

CONCLUSION

In keeping with the stated intention of the Act, the creation of the project and contractor registers is aimed at stimulating sustainable growth, reform and improvement of the construction sector. The additional administrative burden and the payment of registration fees has and will no doubt continue to be met with apprehension by the private sector in particular. The key to the successful implementation of the regulations lies not in its policing but rather in the CIDB's ability to thereby demonstrably increase value and service delivery to the benefit of employers, contractors and all other stakeholders. □

Bullish outlook for civil industry

ACCORDING TO SAFCEC's State of the Civil Industry Report for the 2nd quarter of 2005, the civil engineering industry is looking forward to substantial growth over the medium term. Although the industry contracted in 2004, it is expected that moderate growth will materialise in 2005, which will become more bullish during 2006 with positive spin-offs for employment creation.

And outside our borders, there has been a slight recovery in the first quarter of 2005 with confidence in the SADC region just penetrating the 50-level. Activity seems to have been the most prevalent in Botswana, Swaziland and Mozambique.

ECONOMIC BACKGROUND

The South African economy is enjoying a period of low interest rates, low inflation, higher disposable income and a stronger currency. On a quarter-to-quarter basis the annualised rate of real gross domestic product accelerated for five consecutive quarters to 5,5 % in the third quarter of 2003. A slight deceleration followed in the final quarter to 4 %, mainly due to weaker performances of the mining and manufacturing sectors on the back of the strong currency. Expectations are that GDP will grow in the region of 4 % during 2005.

The underlying expectation is that the South African economy will be subject to a prolonged period of relative currency strength, low inflation and stable interest rates.

Total construction increased 12,72 % in real terms for the year to December 2004. This high level of growth was supported by sustained growth in the residential (22,48 %) and non-residential (9,84 %) construction sector on the back of low interest rates. South African Reserve Bank (SARB) figures indicate growth of 8,18 % in construction works in 2004, but the civil engineering market was subdued with lower levels of activity culminating in a real contraction of 5 % in 2004.

The residential building seems to be cooling of somewhat; however, there is much expectation that non-residential activity will pick up as capacity constraints arise. Construction works are not expected to do much better in 2005 than the recorded SARB growth rate for 2004.

POSITION OF THE INDUSTRY

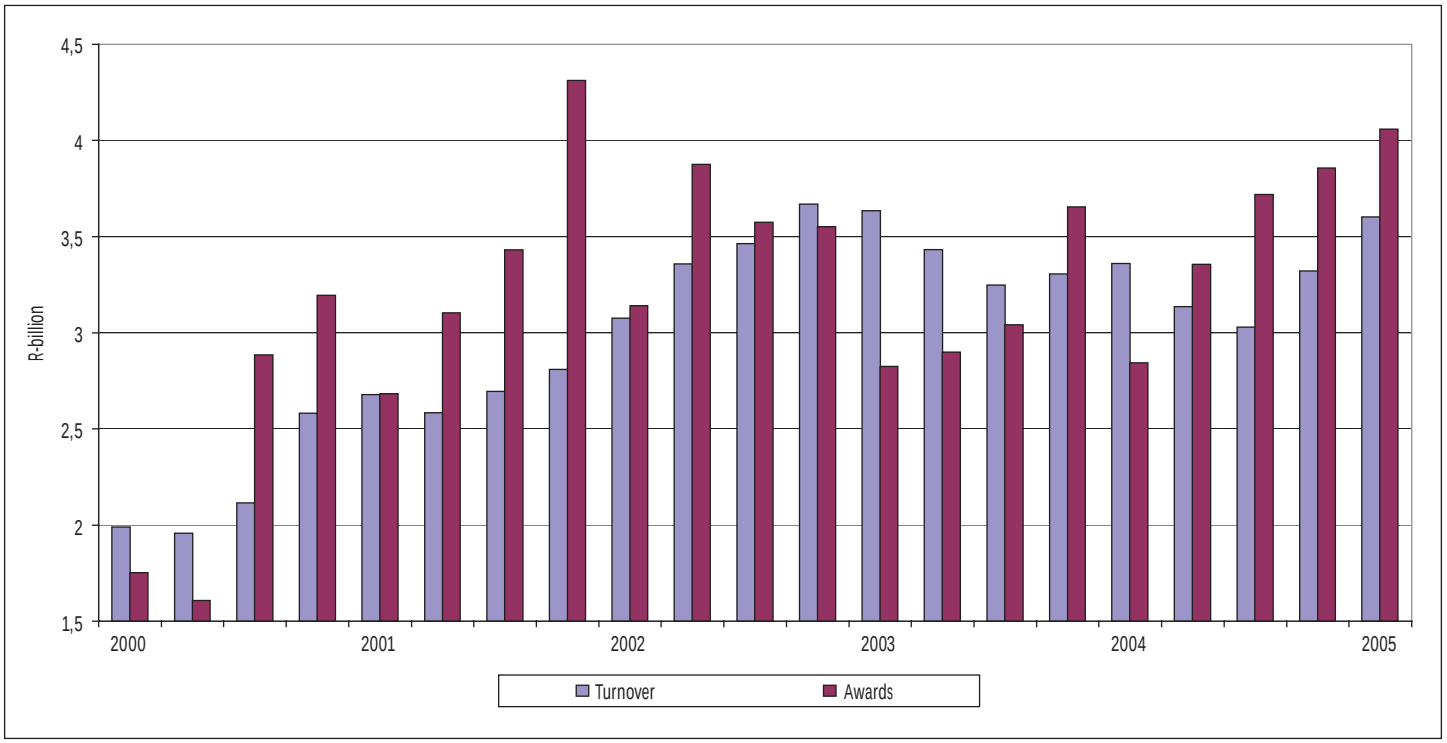
Civil engineering activity seems to be on the road to recovery in 2005. The following indicators, based on figures compiled over the 12-month period ending in March 2005, seem to bear this out.

Main indicators

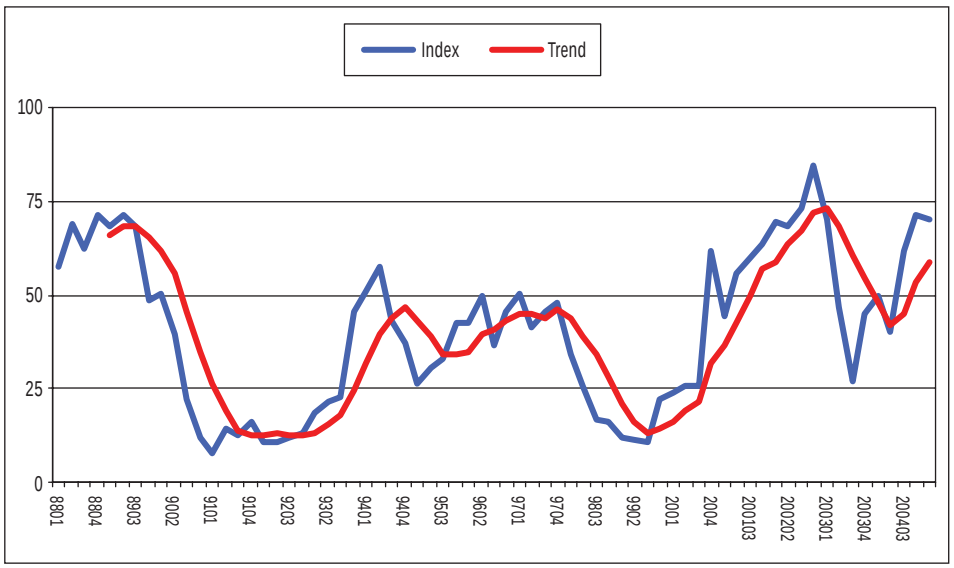
- *Confidence levels* moved more or less sideways in the second quarter of 2005. The annual rise in confidence of 44,5 % to the first quarter is based on renewed optimism for increased infrastructure spending over the medium term.
- The cumulative number of *tenders* declined by 7,6 % over the 12-month period to the first quarter of 2005 compared to the same period in 2004.
- The value of *contract awards* increased by 20,5 % during the 12 months leading to the first quarter of 2005 compared to the same period ending in the first quarter of 2004.
- Average annual *employment* levels declined 8,2 % to the first quarter of 2005.
- The civil engineering industry has experienced an increase in activity from 2000 to the beginning of 2003. Since then, awards and turnover have declined. There seems to be a recovery in the *turnover* activity, with a six-month growth of 3,85 % on the back of increased award activity.

PROSPECTS FOR 2005

Leading indicators are used to compile a short-term outlook for the industry. These



Graph 1 Civil engineering activity (2000=100)



Graph 2 Civil engineering confidence index

indicators are compiled from surveys conducted among SAFCEC members as well as from the tender data base.:

Confidence index

The confidence index relates to the general business outlook amongst the companies within the industry. Levels below the 50-mark indicate pessimism, 0 equals total negativity, and 100 indicates absolute optimism. This is a weighted index; hence the larger contractors impact more on the overall figures. The trend line represents a five quarter smoothed average, removing short-term volatility and distortions.

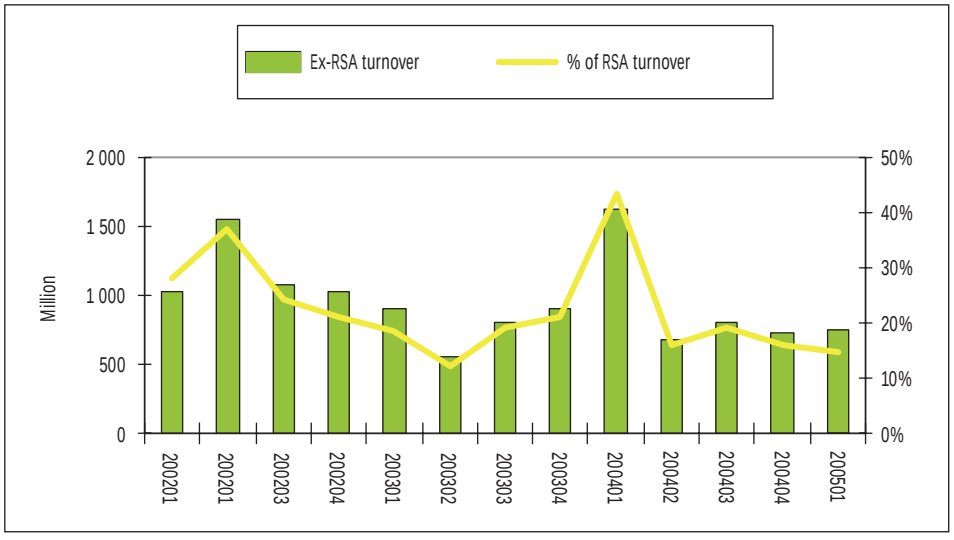
The recovery in confidence during the final quarter of 2004 came on the back of the award of the Bergriver Dam project, the prospects of Gautrain, the 2010 World Cup Soccer, as well as several announcements of major infrastructure investments to address the growing capacity constraints related to the provision of transport and electricity. The level of optimism has been sustained mostly by the larger and medium-sized contractors. The confidence levels amongst the small contractors captured in the sample is somewhat erratic and declined during the first quarter of 2005.

The first quarter of 2005 has seen a decline in contracts across all categories up to R10 million, correlating with the decline in optimism amongst the small contractors. Though the contribution of contracts above R20 million declined in the first quarter, the promise of substantial infrastructure investments in the near future sustained the confidence amongst the large contractors.

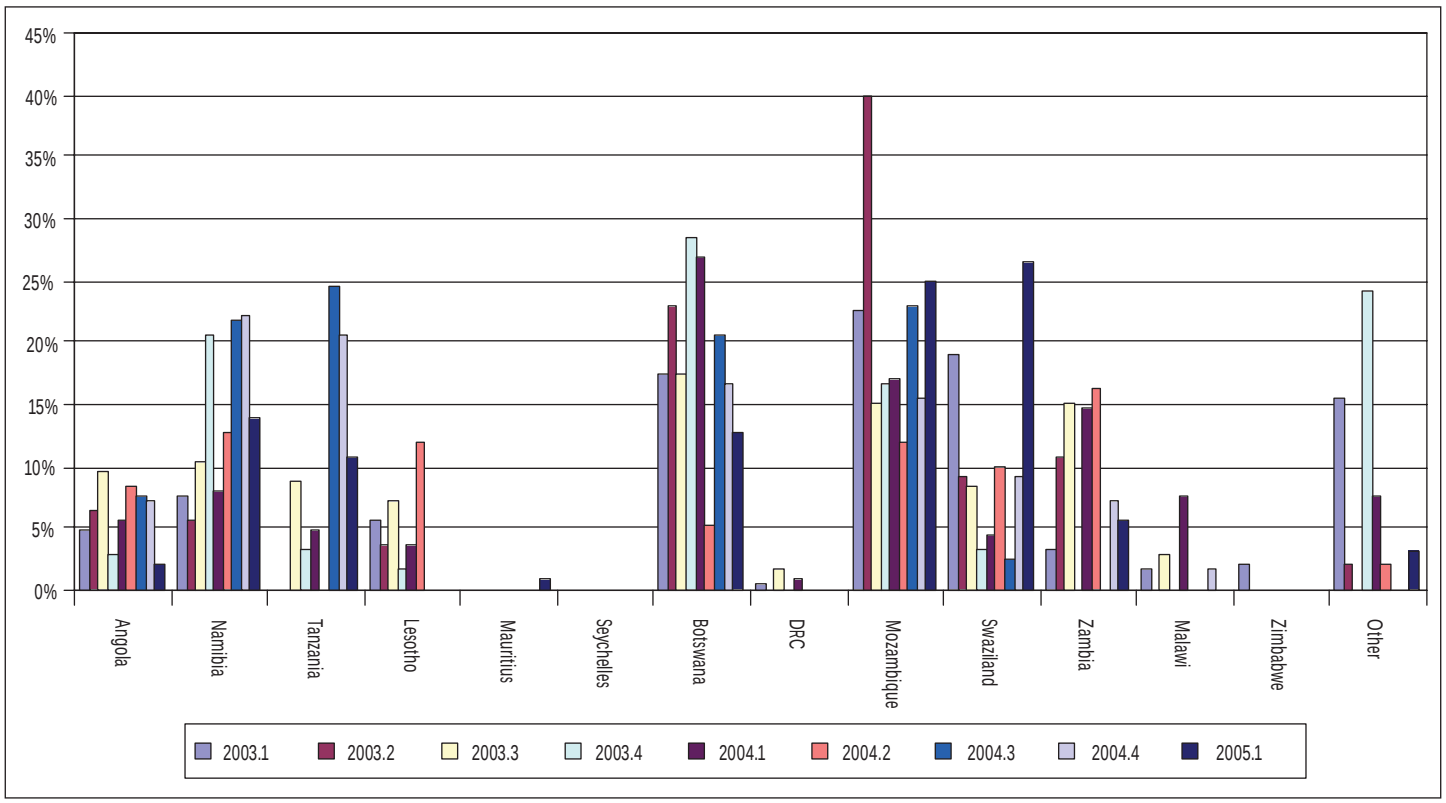
Tender activity and contract awards

In the SAFCEC opinion survey some indication is given about the volume of tender invitations during the first quarter of 2005. This qualitative trend, combined with the tender information gathered from the project database, provides an indication of what has been happening to tenders.

That tender activity in the first quarter was not very high is evident from both the opinion survey and the tender database. Contract awards did increase, but it would appear that activity picked up in the R10 million to R20 million categories at the cost of contracts above R20 million.



Graph 3 Nominal ex-RSA turnover (quarterly 2002–2003)



Graph 4 Ex-RSA operating areas

The opinion survey does not correlate with the awards database, where a 5,2 % real increase in the amount of contract awards has been registered in the first quarter of 2005.

Turnover

In the 12 months to March 2005 the civil engineering industry contracted around 2 % in real terms. On the back of increased award activity in the latter part of 2004, which continued into the first quarter of 2005, the industry is poised for a comeback. The projection for growth in turnover during 2005 are based on contract award activity, seasonally adjusted annualised growth based on 2005 first quarter activity, and the current levels of optimism.

The boosted confidence in the industry is based on major government projects that were announced. However, these are macro infrastructure projects and the potential for delays due to political processes is high. Hence it is quite possible that some of a projected growth in 2005 of between 10 % and 13 % will spill over to 2006 and therefore a growth rate of 8 % in 2005 is seen as more appropriate.

There are, however, strong indications that central government initiatives and interventions to boost the efficiency and ability of the industry to deliver on infrastructure projects are nearing fruition. These include

- the BBBEE Act and Industry Charter
- the Public Finance Management Act
- the Municipal Finance Management Act
- the Construction Industry Development Board's Registration of Contractors, and
- the Supply Chain Management Procurement System

In addition, the Expanded Public Works Programme is expected to be implemented in earnest and will contribute to a general rise of the skills level of the labour pool available to the industry.

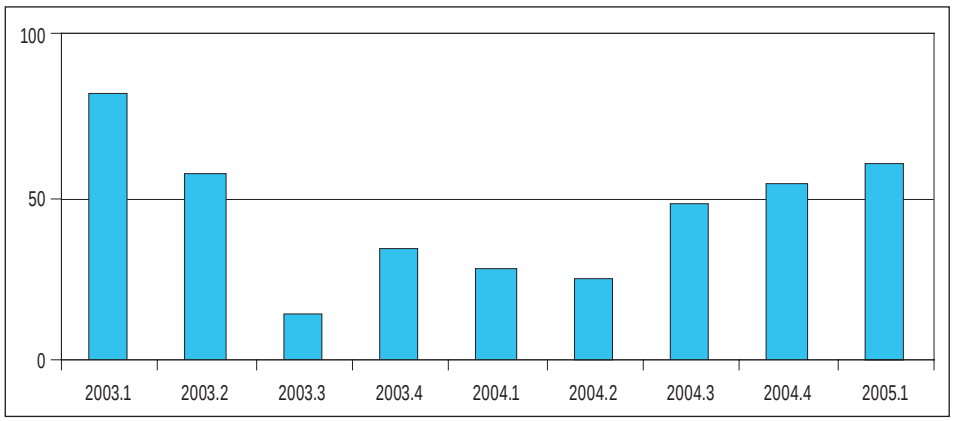
The successful implementation of these initiatives will remove many of the obstacles that are currently retarding infrastructure development and the realisation of the job creation potential of the industry.

Constraints

With the prospects of increased activity it is expected that serious stresses will be placed on the skills available to the sector. This is not limited to direct employment, but includes the availability of high-quality subcontractors. The scarcity of skilled people relevant to the construction sector may lead to increases in the cost of these skills on the back of increased demand. It is also feared that material costs will escalate substantially as local supply capacity is stretched.

CIVIL ENGINEERING PRICE MOVEMENTS

The Baxter contract price adjustment formula (CPAF) reflects an inflation of just over



Graph 5 SADC confidence index

7 % in the composite price index during March 2005.

The main contributors to the indices are the stronger rand affecting imported goods, as well as much lower inflation affecting the escalation in living costs. Forecasts are based on the following benchmark assumptions:

- R/$ will average R6,40 in 2005 and R6,80 in the first six months of 2006.
- The crude oil price will remain average around 48US$ in 2005 and 50US$ in 2006.
- CPI inflation will average 3,3 % in 2005 and 3,5 % in the first six months of 2006.
- PPI inflation will average 2,7 % in 2005 and 3,8 % in the first six months of 2006.

EX-RSA

South African companies are stretching their reach beyond the borders of South Africa. Developing countries in the Southern African Development Community (SADC) region (excluding South Africa in this section) hold great promise of growth in infrastructure development. It is therefore becoming increasingly important to understand the activities and opportunities in the SADC region.

General

According to the reaction from our survey respondents, civil engineering turnover generated across our border is in the region of 20 % of locally generated turnover (graph 3). To understand the nature of the work and how the export members feel about the various countries in the SADC region, SAFCEC did a survey to gauge these aspects among some of its export members.

According to the weighted responses it would seem that road and bridges are the most significant type of work being done across our borders. No other category takes any form of precedence after roads (graph 4).

The survey is designed to record where activity is taking place in SADC as well as other cross-border areas. It is therefore possible not only to see which regions within SADC provides opportunities, but also how SADC compares with other cross-border areas. In the last quarter Botswana, Swaziland and Mozambique ranked the highest among the SADC countries.

The SADC confidence index (graph 5) is compiled in the same way that confidence is measured within South Africa. There has been a slight recovery in the first quarter of 2005 with confidence in the SADC region just penetrating the 50-level.

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IT'S BOMBELA!

'The Gautrain Project is an important and necessary project. Gautrain is a project that will make Gauteng, and indeed, South Africa, proud,' said Gauteng Premier Mbhazima Shilowa on 2 July in announcing that the Bombela Consortium was appointed as the preferred bidder for the Gautrain Rapid Rail Link.

The project will be implemented as a Public Private Partnership (PPP) and includes the design, construction, operation and maintenance as well as financing of the complete system. Gautrain will be transferred back to the Gauteng Provincial Government at the end of a concession period. The concession period consists of a 4,5-year construction period followed by a 15-year operating period.

The Gautrain Project is one of the largest and probably most exciting transportation projects in South Africa today. The project is expedted to play an important role in stimulating economic growth, in relieving traffic congestion, in promoting public transport, tourism and public-private partnerships, and in changing the culture of public transport usage in South Africa. It will be responsible for creating 148 000 jobs.

THE BOMBELA CONSORTIUM

The Bombela Consortium is a partnership between Bombardier Transportation, Bouygues Travaux Publics, Murray & Roberts, Loliwe and RATP Développement. Bombela is 50 % owned by its international partners and 50 % by Murray & Roberts and Loliwe of South Africa.

The civil works will be undertaken by Bouygues Construction, Murray & Roberts and Loliwe Rail Contractors and will take 4,5 years. It will include construction of ten stations (three of which are underground), 20 km of tunnel section, 9 km of viaducts and bridges, and 10 million m^3 of earthworks. Bombardier Transportation and Loliwe Rail Express will be responsible for delivering the rolling stock with final assembly in South Africa. Operation and maintenance of the system will be carried out for 15 years by RATP Développement in association with their South African partners, through a local operating company.

WAY FORWARD

The final route proclamation process will commence with the publishing of the land required for the project in a preliminary design report, followed by the actual proclamation. During this process the final surveying and valuation of the land will be done, so that the expropriation can commence after the proclamation.

The announcement of the preferred bidder is only a milestone towards financial closure – it does not conclude the procurement process. The tender process for a PPP project comprises a Request for Pre-Qualification, Request for Proposal I and II, a Best-and-Final-Offer (BAFO) phase and then negotiations for financial closure and the final signing of the concession contract.

After the concession contract has been finalised, construction will commence. The construction period allowed for is 54 months, which means that the project will be completed a few months before the FIFA Soccer World Cup in 2010.

NIGHT-TIME REHABILITATION OF THE SOUTHERN FREEWAY (M4), DURBAN

The Southern Freeway (M4) is an urban six-lane double carriageway road which was constructed between 1967 and 1978. It extends from the Victoria Embankment and Smith Street in the north to Durban International Airport in the south, and plays a vital role in the economy of Durban and its greater surrounds, as well as serving the many suburbs in the south.

Over the many years of high traffic usage the pavement was in dire need of rehabilitation. eThekwini Municipality appointed Vela VKE Consulting Engineers in a joint venture with Eyethu Engineers as the engineering consultant to undertake the necessary investigations and design of the pavement rehabilitation of the M4.

The detailed assessment included a comprehensive visual assessment of the pavement, non-destructive falling weight deflectometer (FWD) measurements, rut measurements, riding quality and skid resistance testing; selective coring of asphalt layers and laboratory testing to ascertain the asphalt condition and thickness over bridges and other structures, as well as a visual inspection of the bridge joints. After investigation of the traffic patterns, it was noted that rehabilitation would have to take place at night in order to minimise traffic disruptions.

The investigations confirmed that

- the surfacing needed to be replaced to improve the skid resistance

Typical peak traffic

Paving the asphalt base at night

SMA surfacing on fast and middle lanes

The completed roadway

- the structure of the pavement as a whole was sound and no substantially deep repairs were necessary
- the existing asphalt was fatigued and oxidised and needed to be replaced as deep as was practically possible, within the constraints of full traffic usage during day time

For the purposes of scheduling the work, the M4 rehabilitation was separated into three semi-equal sections. The middle section, which was in the worst condition, was completed first. This contract ran from April to December 2003 and was valued at R19,58 million. The second section, nearest to the airport, was completed in six months from June 2004 to January 2005 and was worth R14,9 million. The last section of the contract commenced in April 2005 and will continue until January 2006. The contract value of this last section is R39 million.

Working at night had its limitations and difficulties. In the first phase contract, low night time temperature created problems during the paving of the thin 25 mm stone mastic asphalt (SMA). The solution adopted included using two paving teams to pave the SMA on Sundays, during the day.

In the second phase contract, Sasobit was used to modify the binder to assist with compaction of the asphalt at lower ambient temperatures. The window period for the compaction was thus extended and all the paving was possible at night.

A further difficulty encountered when working at night was adequate warning of oncoming rain. To overcome this, the weather bureau at Durban International Airport provided valuable weather forecast information and with this information, the contractor and the resident engineer decided each afternoon whether or not to proceed with night work.

Despite the challenges and limitations of working at night the advantages of no disruption to heavy day time traffic, and the opportunity to work under low traffic volume conditions outweigh the night time limitations and result in a preferred environmentally friendly rehabilitation approach on urban freeways.

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QUALITY STREET / M4 INTERCHANGE UPGRADE

eThekwini Municipality's Economic Development Department was the driving force behind proposals for renewal of the so-called 'Southern Industrial Basin' comprising the areas of Jacobs and Mobeni in Durban. Access to this area is provided from the M4 Southern Freeway at Quality Street Interchange. This interchange has capacity problems and to relieve the congestion a cost-effective, easily constructable and aesthetically pleasing solution was required.

Vela VKE assisted the city from the initial concept and preliminary design stage. This focused attention on and clarified the role of the interchange improvement on economic regeneration spin-offs and as a stimulus to other development opportunities.

Vela VKE was appointed in 2003 to carry out the detailed design and tender stage of the project and in August 2004 construction commenced on site.

The work entailed the construction of an 11 m bridge widening over the M4 and the adjacent service road, and widening and rehabilitation of roads. Technical challenges included the use of soil nail lateral supports, precast piles to support new foundations, and accommodating traffic by constructing the deck above clearance level and then jacking it back down into its final position.

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INFRASET WINS JOHANNESBURG CONCRETE POLE CONTRACT

Infraset Infrastructure Products has won the contract to manufacture and supply Johannesburg's electricity service company, City Power, with 300 fully prestressed concrete poles for the Fairland Powerline Upgrade project.

Commencing at the beginning of May and due for completion at the end of July, the project entails the installation of 200x9 m 7 kN and 100x9,3 m 17,5 kN poles in Fairland, a north-western Johannesburg suburb. Tshepang Electrical has been sub-contracted by City Power to do the installation work.

The 9 m poles are designed to take a maximum load of 7 kN, although the working load in this installation will not exceed 2,8 kN. Loads are taken up at 300 mm from the top of the poles.

The 9,3 m poles can handle a maximum load 17,5 kN, whereas their actual working load on this project is not expected to exceed 7,0 kN.

Sizwe Mkhize, product manager of Infraset's Concrete Pole Division, says that the design life of the poles is 50 years.

'Because of its durability and longevity, concrete is by far the most cost-effective pole material. Historical records show that South Africa's first prestressed concrete poles were planted in 1933 and, some 70 years on, they show very little sign of wear. According to Eskom, an 88 kV line which runs between Witbank and Bethal has been supported by concrete poles for about 55 years – with little or no maintenance.

'Research conducted by Eskom demonstrates that when all factors are taken into consideration, such as life expectancy and maintenance costs, concrete poles are the least expensive pole option by a substantial margin.

'Although initial capital outlay is higher than, say, with timber poles, it takes only 16 years for any additional amount to be amortised. Thereafter, with every passing year, the cost of a concrete pole becomes progressively lower. By contrast, timber poles have high maintenance costs and a much shorter life span,' notes Mkhize.

Concrete poles are prestressed with steel rods to give them much greater strength and load bearing capability. Thus the inherent resilience of prestressed poles enables them to withstand overloading much more readily than any other structural material. They are also thin, making them very easy to handle and install. Some of their other advantages are that they are rot and termite proof, fireproof, maintenance free, vandal and theft proof, and corrosion resistant, besides their obvious longevity.

Infraset's has been producing concrete poles since 1992 for Eskom, and more recently, for Spoornet's electrification masts.

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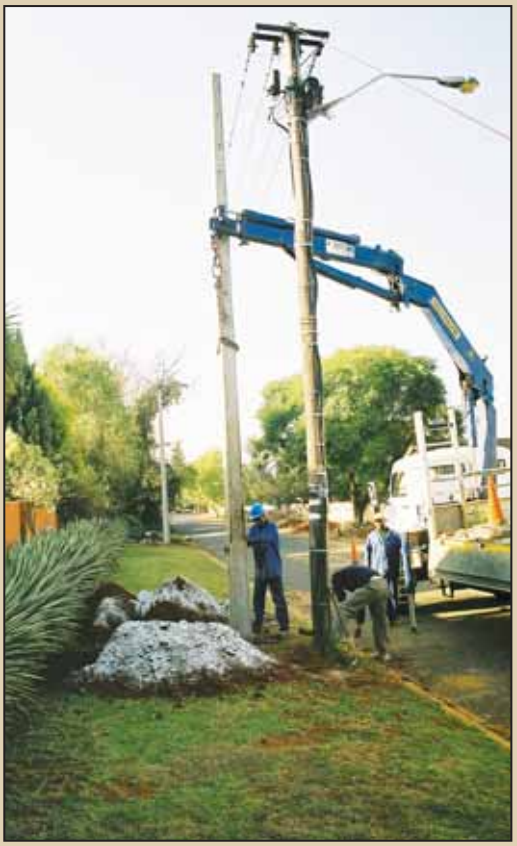

One of 300 prestressed concrete poles supplied by Infraset for a powerline upgrade project in Fairland, north-west Johannesburg, is planted next to the timber pole it is replacing

An example of Formpave storm water control system at a recently constructed leisure centre (sporting complex) in Port Solent, England. The car park is situated over a sub-base reservoir system which is used to store rain water absorbed by the paved surface

SUSTAINABLE URBAN DRAINAGE – A BOON FOR SOUTHERN AFRICA

Southern Africa is on the threshold of a breakthrough in the conservation of the world's most precious resource. Sustainable urban drainage system (SUDS), a rainwater collection and purification system based on permeable paving technology, will enable the annual conservation and redeployment of millions of litres of clean rain water.

A licence agreement has been concluded between two concrete block paving manufacturers, CMA member Inca Cape, from the Western Cape, and Formpave Limited, a UK-based company which first developed a sustainable urban drainage system some ten years ago. The agreement gives Inca the green light to produce and market the Aquaflow block, a permeable concrete block paver. Under the agreement Inca also have the right to sub-licence other producers to use the system.

Various types and colours of Aquaflow blocks will be used in the patented Formpave SUDS system, which is based on retaining water in a sub-base reservoir. Aquaflow blocks allow water through the surface at a rate of approximately 4 500 mm/hr and one square metre will allow 4,5 m^3 through the surface every hour.

Aquaflow blocks are bedded on a laying course of 5–6 mm crushed stone underlain by an Inbitex geotextile membrane. The membrane separates the laying course from the sub-base stone which is carefully sized to create a 30 % reservoir capacity.

The membrane traps silts, oils and heavy metals and promotes the growth of microbes which digest the oils and some heavy metals.

Purified by filtration and microbial action the water in the system can be harvested and re-used. It is released in a controlled manner into sewers or streams or if conditions are right infiltrated back into the ground to recharge base flows.

CMA director John Cairns says the long-term benefits to the region are immense.

'The arrival of sustainable urban drainage is none too soon. Growing demands are being placed on local water resources through ongoing urban development and low rainfall across much of the SADC region, and water conservation systems such as this deserve immediate attention from landscape architects, urban designers, engineers, quantity surveyors, property developers, as well as local, provincial and national authorities.'

Formpave's South African debut was announced during a sustainable development seminar 'Breaking the Mould / Exposing the Future' which was staged at the beginning of June by ILASA (Institute of Landscape Architects of South Africa) and sponsored by the CMA, Inca Cape and Concor Technicrete.

Presenters examined the critical role of landscape architecture in ecologically responsible development and focused on methods of counteracting the global degradation of environments and ecosystems through effective bio-regional planning and design. The Formpave storm water source control system was covered at the seminar by Peter Hart, MD of Formpave Limited.

Hart observed that burgeoning urbanisation and rapid run-off have placed increasing strain on conventional storm water drainage systems and this has led to the contamination of streams, rivers, sewers and culverts, all of which are subject to overloading during bouts of heavy rain.

He also noted how heavy metals, hydrocarbons, rubber dust, and silts are deposited on impermeable surfaces during dry weather conditions. These are washed off during heavy downpours and end up in expensive water treatment works. Alternatively they are deposited in rivers or streams where they cause severe environmental damage.

Hart claims that the total construction costs of a Formpave SUDS system are lower than conventionally drained surfaces.

CDs containing the full seminar are available from ILASA at R120 each.

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TIME TO PAY FOR POOR CONCRETE DESIGNS FROM THE LAST 'BOOM'

Many concrete structures in the aggressive marine environment of the KwaZulu-Natal coastal belt are showing signs of deterioration – and will cost huge sums of money to be restored to their original condition, says Jim Horton, a partner in Contest Concrete Technology Services, the Durban-based concrete training and consulting practice.

'These buildings were constructed between the mid-1970s to mid-1980s during the last building "boom". Structural designers and constructors then did not have access to the concrete technology currently available and now many of the shortcomings in specification and construction are becoming evident. Contest has been inundated with requests to investigate the extent of deterioration on such structures and to make recommendations, write specifications and supervise the repairs.

'When these deteriorating structures were built, the technology of concrete that could counteract the adverse effects of salt and carbon dioxide was not available, and what we are seeing now is the result of poor construction methods and material selection.'

Horton said the most serious concern expressed by property owners was that a piece of concrete, falling from the structure, could injure a pedestrian or motor vehicle at street level.

Concrete spalling on the KwaZulu-Natal coast – a legacy of poor planning. Too few designers of concrete structures are ensuring that the current building boom does not lead to history repeating itself, says Contest in Durban

Another concern was the drop in value of the individual units in the building if it could be clearly seen that expensive repairs would be necessary in the near future. Furthermore, many coastal flats are owned by retired people without the finance for special restoration levies. 'These factors collectively place a major moral responsibility on engineers to ensure durability in their concrete designs. But once spalling of concrete sets in, it spreads rapidly and the sooner a repair is carried out the less expensive it is likely to be.'

Bruce Raath, Horton's partner at Contest (who heads the company's training division), said Contest had formulated a one-day course covering the specification and implementation of concrete to provide a long, low-maintenance life span. The course was written around the use of the durability testing of concrete, which was devised about 15 years ago in South Africa, and represented international, cutting-edge technology. The course had been offered only once so far in 2005, and had been very well attended.

'Generally, however, far too few designers of concrete structures are incorporating the principles of good design and workmanship into their specifications. There is no doubt that the incidence of concrete deterioration is alarmingly high. The lack of attention in the current building boom to technology that now is there for the taking is such that history may well repeat itself 25 years from now,' Raath added.

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A WINNER – AGAIN

Kaytech's popular Multi-Cell cellular system has again been successfully installed in the construction of a road where access to normal construction materials is non-existent or restricted. This time the product has been used extensively in the building of a concrete access road in the Kosi Bay section of the Greater St Lucia Wetland Park.

The area is remote – Kosi Bay is situated just inside the KwaZulu-Natal/Mozambique border – and consultants SNA (Pty) Ltd prescribed the easy-to-install and durable Kaytech product. It is hugely effective and is laid using the most basic, at hand materials.

'The consultants chose our Multi-Cell when a 3,5 m wide access road had to be built in the Kosi Bay area,' says Julian Maastrecht, Kaytech's technical marketing engineer. 'The road is now effectively a cast in-situ concrete block thoroughfare and contractors Rincal Construction used 500 m^2 of our Multi-Cell 100 with its patented tension frame on the project.'

View of the completed road showing the 'concrete block' access, the gravel-filled shoulder, and the SoilSaver-covered side slope section

The product was placed over an in-situ G7 material compacted to 90 % MOD AASHTO density and the cells were filled with 25 MPa concrete. The Multi-Cell panel included a gravel-filled, 1 m wide shoulder section and also extended to the base of the fill embankment where it was tied into a 300 x 300 mm anchor trench.

'The Multi-Cell acts as an erosion protection system on the 1:2 to 1:1 side-fill embankments, says Julian Maastrecht. 'This protection system included a layer of our biodegradable SoilSaver which ensured that no washout of the topsoil in the cells occurred.'

Kaytech's Multi-Cell has been successfully used both nationally and internationally in a wide variety of applications. These include:

- road, rail and freeway embankments
- stabilisation of river banks and canals
- low traffic volume roads and pedestrian pathways
- topsoil retention in landscape projects

The product is lightweight, flexible, rot-proof, easy to install and has high tensile strength and tear resistance. Multi-Cell is manufactured by alternate linking of strips of a select geotextile. The strips are stitched together to form square cells and are filled with either soil, gravel or concrete.

Multi-Cell was also used successfully in the multi-million rand upgrading of the Amadiba Road in the Eastern Cape, a 40 km gravel link between the Bizana road and the Mtentu river mouth on the coast. The product was prescribed by CSIR Transportek who managed the project on behalf of their client, the South African National Road Agency Limited.

Says CSIR Transportek's Rob Little: 'We decided to use the Multi-Cell system as opposed to the pipe culvert system. Using the Kaytech product cost R10 000 to rehabilitate each drift. To lay a pipe culvert would have cost double that. The product was easy to install and easily managed to accommodate the varying contours of each individual drift.'

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TRADITIONAL BUILDING METHODS CANNOT MEET DEMAND

'Our age of anxiety is, in great part, the result of trying to do today's jobs with yesterday's tools,' says Hennie Botes of Moladi, designers and builders of low-cost housing units.

'Traditionally bricks or blocks are manufactured in a small mould and then laboriously laid by an artisan, sandwiched with mortar. The walls are then chased to position the water and electrical pipes and later plastered by an artisan to fill and rectify the damaged wall to conceal the imperfections.

'We simply cast a whole house in a day, employing unskilled labour, reducing time, waste and cost. Eliminating chasing for plumbing and electrical pipe work, plastering and beam filling results in a wall stronger than brick,' says Hennie.

Top: Casting of the walls. The aerated, thermal, waterproof mortar can either be pumped or bucket filled

Moladi has developed into a construction technology that addresses six key challenges embodied in the housing shortage facing developing countries:

- lack of resources
- shortage of skills
- constraint of time
- controlled work flow
- waste
- insufficient funds

'This is a cost-effective, holistic design and build technology that far outweighs poorly designed costly concrete-block and masonry structures,' claims Hennie.

'Foundations and superstructures are designed and certified by independent professional engineers. The walls have passed tests by the South African Bureau of Standards (SABS) and have been issued with an Agrément Certificate by the Council for Scientific and Industrial Research (CSIR), endorsing the physical and thermal properties.'

Moladi homes are already standing in Mexico and Suriname and an order has been received from the United States and Panama after hurricane damage in November. Moladi is currently used in Angola, Botswana and Kenya and negotiations are being finalised with Nigeria, Zimbabwe, Ghana, Sudan, Algeria, India, Indonesia, Sri Lanka, Venezuela, Costa Rica, Guatemala and Ecuador.

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SPORTING A NEW LOOK

When it comes to sports complexes, there are many complications attached to the allocation of land and D G Naidoo & Associates is only too familiar with all the restrictions. This Durban-based company looks at the entire layout for complexes, from sports fields, soccer fields and combo courts, to change rooms and public facilities. They also act as advisors to the Department of Sport and Recreation and evaluate projects to see that facilities are practical, viable and suited to the needs of the community.

'On average, I travel about 10 000 km per month to assess the existing and potential sports facilities in deep rural areas,' says Dees Naidoo, owner of D G Naidoo & Associates. Dees is largely involved in the infrastructural development of underprivileged communities, particularly the road works and the allocation of sports facilities in KwaZulu-Natal.

According to Dees, there are many complications attached to the allocation of land. The 'Inkosis' or big chiefs own the land in rural areas and they are very reluctant to part with it. So when the community submits their request to the local municipality for a sports complex, priority projects give rise to the 'permission to occupy' (PTO) agreement. In this agreement, the ground is leased to the local municipality for a set period of time, so the 'Inkosis' get to keep ownership of the land, creating a win-win situation.

Once land has been identified, the viability for sports use is tested and various factors are taken into account. These factors include road access, the availability of drinking water, sanitation and sufficient water facilities. If there are no services planned for the area, a feasibility test is conducted for future installation. These cost figures are then included in the budget.

Labour components on the project are very specific and are strictly controlled by the Monitoring Management Information System (MMIS). 'It is almost impossible to outsmart the MMIS and penalties are levied to contractors who do not conform to requirements,' says Dees. The program specifies that 30% of the construction cost be given to local contractors and labour. In addition, 50 % of the workforce must be female, 30 % must consist of youth members between the ages of 18 and 35, and 1,5 % must be physically challenged. In a project of between R1 million and 2 million, the total labour force employed on a rotational basis range between 50 and 80 people for a period of five to nine months.

'We use an interactive design package called Civil Designer to plan the landfill sites and also to design the access roads. I am very happy with the program. I even lectured Civil Designer for two years at Mangosothu Technikon and have been using the program since the early days of Stardust,' says Naidoo.

Sports complexes that have been completed by D G Naidoo & Associates include Manguzi, Bambanana and Sundumbili.

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Text **Verlene de Koker**
Acknowledgements Ben Pauw, Danie Paulsen

Last meeting of the SAICE Board of Technicians and Technologists

On 13 April 2005 SAICE's Board of Technicians and Technologists (BTT) held its last meeting. In accordance with the amended SAICE constitution, as approved by the SAICE Council in October 2004, BTT was to be disbanded and SAICE membership categories would no longer differentiate between professionally registered engineers, technicians and technologists. It was fitting that the last meeting coincided with the inauguration of SAICE's own building in Thornhill Office Park in Midrand later the same day, heralding a new future for all SAICE members.

The last BTT meeting brought to a satisfactory end the long and dedicated road travelled by civil engineering technicians and technologists to gain due recognition and establishment within the civil engineering fraternity. During the sixties and seventies, and before that, the role and status of civil engineering technicians, as well as the content and quality of their academic and practical training, were ill defined. There was a need for a body that would address these issues, would study the implications of eventual legal registration, and would develop and adopt a professional code of conduct. The South African Institute of Civil Engineering Technicians (SAICET) was therefore formed on 12 November 1974 with the encouragement and assistance of SAICE. From August 1988 SAICET also included civil engineering technologists.

SAICET witnessed and/or participated in a number of the historic changes that took place within the engineering profession in the late seventies, eighties and early nineties. Not the least of these was establishing an appropriate definition of a technician, especially in the light of misconceptions at the time. SAICET was consequently actively engaged in obtaining the official seal of professional recognition through registration under the Proposed Amendment of the Professional Engineer Act 81 of 1968. Without this amendment, Act 81 only provided for the registration of Professional Engineers and Engineers-in-Training. On 3 March 1978 notification of the proposed Amendment Bill was published in the *Government Gazette*. SAICET also participated in the formation of multi-disciplinary vocational societies representing engineering technicians and technologists, such as the Association of Societies Representing Engineering Technicians (ASRET) and the South African Association of Registrable Engineers and Technologists (SAARET), as well as the respective Boards of Control for Registered Technicians and Technologists. SAICET furthermore witnessed the replacement of the South African Council of Professional Engineers (SACPE) and its three Boards of Control by the Engineering Council of South Africa (ECSA), through the Engineering Profession of South Africa Act 114 of 1990, as the sole controlling registering body for engineering.

At the last meeting of the SAICE Board of Technicians and Technologists

Through the years there had always existed friendly relations between SAICET and SAICE. Around 1988 the two institutions began negotiating about possible formal affiliation. At the time SAICET members were invited to become involved in the activities of the SAICE Technical Divisions. This mutual recognition eventually culminated in a formal merger between the two institutions in January 1994, thereby creating a single powerful body and home for all members of the civil engineering profession. SAICE appropriately changed its name to reflect that fact, becoming the South African Institution of Civil Engineering.

The SAICE Board of Technicians and Technologists (BTT) safeguarded the interests of this group within the SAICE structure. BTT continued administering the various annual Best Student Awards and overseeing the administration of the bursary scheme, SPEBS, started by SAICET in March 1992. BTT members also began serving on SAICE standing committees and gradually became part of the fibre of the Institution, to the extent that in 2003 Faried Allie became the first technologist member to serve as president of SAICE.

Unfortunately, despite the goodwill created by the merger, the different membership categories for engineers, technicians and technologists still caused a feeling of being discriminated against, and many discussions over the years focused on this issue. The unhappiness was eventually effectively addressed through the October 2004 amendment to the SAICE constitution, which led to the logical disbandment of BTT during its last meeting in April this year.

At that historic last meeting, it was decided that a small informal panel would continue looking after the interests of technicians and technologists. It was also decided that BTT members currently serving on ECSA accreditation panels would ensure that appropriate technician and technologist appointments be made to these panels as and when required. It was furthermore agreed that the Best Student Awards would in future be handled by the SAICE Education and Training Department, while the administration of SPEBS would be taken over by Marthelene Buckle, who works for SAICE on a contract basis.

Mike Deeks, SAICE 2005 president, thanked BTT for its valued contribution towards the unifying of the civil engineering profession and congratulated the board on the measure of transformation that it had attained. During the opening of SAICE's new building later that day, the ribbon was fittingly cut by Mike Deeks as SAICE president and Brian Holdridge as last chairman of the now nostalgically historic BTT. □

102nd AGM held in Midrand

THE 102ND ANNUAL GENERAL MEETING was held on 14 April at SAICE National Office in Midrand.

REVIEW OF PAST YEAR

At the meeting, Mike Deeks, SAICE's current president, read a review by Ron Watermeyer (president 2004) of his term of office:

A SAICE president has the privilege of meeting and interacting with many members, engineers, built environment and other professionals, academics, decision-makers, visiting dignitaries and politicians. I certainly had my share during 2004. I thoroughly enjoyed meeting our members at the various branches and interacting with participants at the Construction Procurement Workshops, which I conducted together with Malcolm Pautz in 15 centres. I also had the opportunities to rub shoulders with members of the international community on their visits to South Africa and on my travels to Atlanta, Baltimore, Jaipur, and Geneva. Let me share with you some insights that I gained during my period of office.

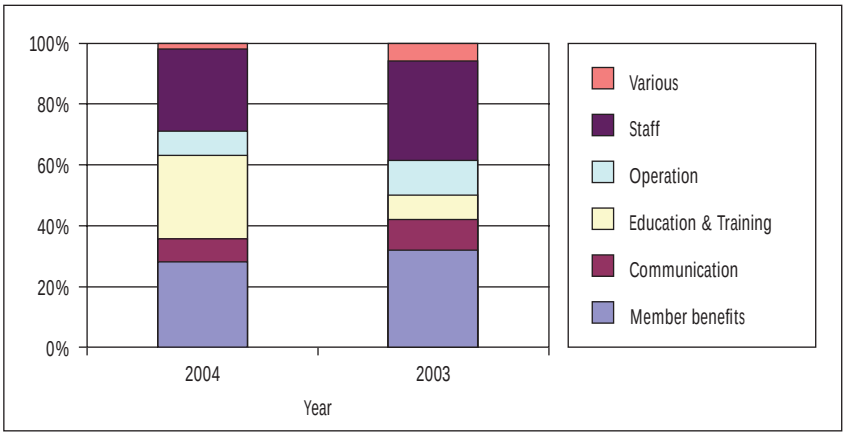
Civil engineering is not just about people's health and safety. It is also just as much about people's welfare. It is all about the application of science and technology in the control and use of forces and materials of nature in order to secure a better life for all. Civil engineers need to take a leadership role in society and to locate their work beyond their discipline if projects are to deliver the best possible societal outcomes. Civil engineers need to understand the relationship not only between their work and the environment but also with communities and the economy.

Civil engineers are by nature 'earth shapers' and as such need to respond to global, national, regional and local issues. This requires strong international networks. Politicians and lawmakers can capture the desires of the world's population. Engineers and other built environment professionals are, however, required to transform words into reality. Civil engineers stand challenged to make the difference.

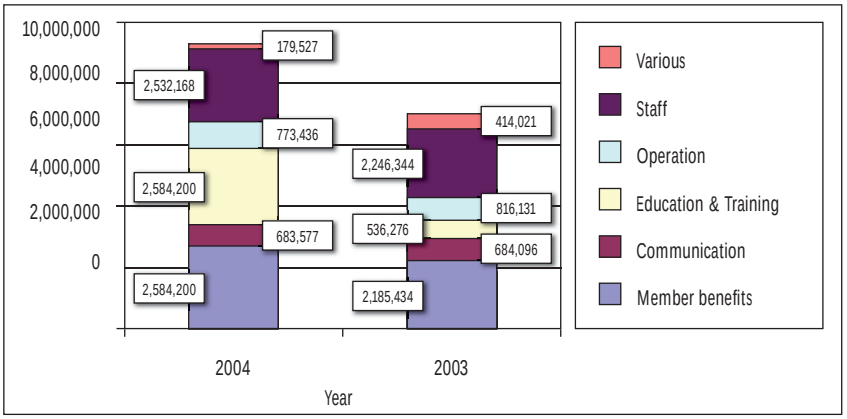
2003 was all about celebrating SAICE's centenary and looking back on a century of civil engineering achievements. 2004 was all about securing a sustainable future for SAICE. Some of the highlights of 2004 in this regard were:

- The adoption of a revised constitution which transfers responsibility for managing and administering the affairs of the Institution to an Executive Board, disbands the Board for Technologists and Technicians, reduces the number of membership categories from eight to five and broadens the corporate membership base.
- The purchasing of a permanent home for SAICE in the Thornhill Office Park complex in Midrand.
- The establishment of a Section 21 (SAICE – Professional Development and Projects) company to build capacity, enhance understanding and decision-making, and accelerate delivery in civil engineering.
- The deepening and strengthening of our relationships with our international sister organisations such as ASCE, ICE and the African Engineers Forum.

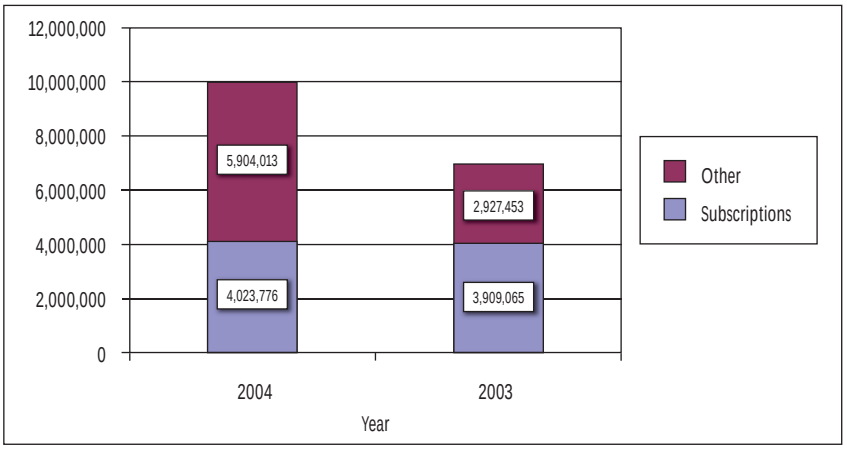
To conclude, Ron expressed his thanks to the Executive Board, Council, the Executive Director and National Office Staff for their support and dedication to the tasks at hand.



Expenditure as % of total



Expenditure



Income

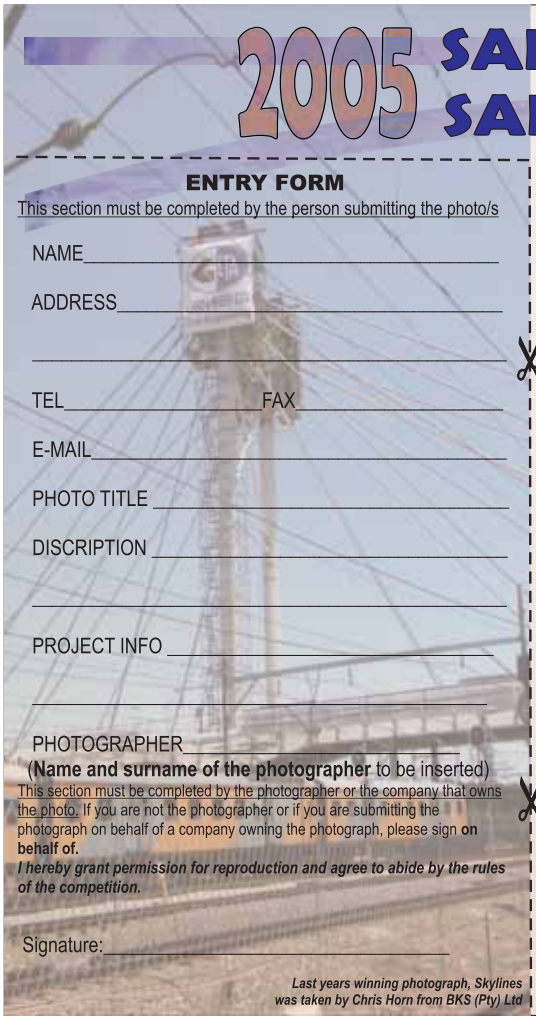
FINANCIAL STATEMENTS 2004

Dr Martin van Veelen submitted the 2004 financial statements, some of which are given in the graphs and speak for themselves.

Pricewaterhouse Coopers Inc was again appointed as the Institution's auditors for 2005, Bowman Gilfillan as legal advisors, and NMG-Labour as labour relations advisors.

The President's Award was presented to John Lane for meritorious service to SAICE and for significant ongoing contributions to the civil engineering profession (2004). □

2005 SAICE PHOTO COMPETITION
SAISI FOTOKOMPETISIE



ENTRY FORM

This section must be completed by the person submitting the photo/s

NAME_____

ADDRESS_____

_____

TEL_____FAX_____

E-MAIL_____

PHOTO TITLE _____

DISCRIPTION _____

_____

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:_____

Last years winning photograph, Skylines was taken by Chris Horn from BKS (Pty) Ltd

KOMPETISIEREËLS:

1. Die kompetisie is oop vir die algemene publiek om foto's in te skryf.
2. Foto's moet mense en/of projekte in siviele ingenieurswese uitbeeld.
3. Foto's sal slegs in EEN algemene kategorie beoordeel word.
4. Inskrywings moet kleurafdrukke en A4 grootte wees. Slegs goeie kwaliteit foto's word aanvaar. Voorsien ook asseblief kopieë van die foto/s in jpeg formaat, 300 dpi.
5. Voltooi asb 'n inskrywingsvorm vir elke inskrywing en voorsien 'n gepaste titel en kort beskrywing vir elke projek. Baie belangerik - voorsien asseblief die fotograaf se naam saam met die foto!
6. Verskaf asb besonderhede van die kliënt, konsultant en kontrakteur betrokke by die projek.
7. U is self verantwoordelik vir die verkryging van toestemming vir gebruik van die foto en fotomateriaal van die betrokke owerheid of projekbestuurspan.
8. Inskrywings vanaf maatskappye moet skriftelike toestemming van die fotograaf insluit.
9. Toestemming vir die reproduksie van foto's vir publisiteit of uitstallings word aangeneem, behalwe wanneer anders gespesifiseer. Erkenning sal aan die fotograaf gegee word.
10. Geen verantwoordelikheid word aanvaar vir verlies of skade aan foto's nie.
11. Sluitingsdatum: 12 Augustus 2005
12. Beoordeling: September 2005 - SAISI Nasionale Kantoor - Midrand

NB: Die naam, adres en titel (wat moet ooreenstem met dié op die inskrywingsvorm) moet op die agterkant van die foto verskyn.*

* Alle deelnemers sal skriftelik in kennis gestel word van die resultate.

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 print/s 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: 12 August 2005
12. Adjudication: September 2005 - 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

Important GCC 2004 seminar!

SAICE SEMINAR ON THE GENERAL CONDITIONS OF CONTRACT FOR CONSTRUCTION WORKS, FIRST EDITION, 2004

Technical problems with GCC 2004 project info

Various errors crept in during production of the first edition of GCC, 2004. The committee considered issuing a second edition, but concluded that none of the errors had contractual consequences and were rather of a grammatical nature or pertained to incorrect references.

Everybody on our database who has purchased the document received a notification to this effect, but since some of our sales were in bulk to other suppliers of the document, it transpired that the notification had not reached all users.

There has been several initiatives by other organisations to discuss the new GCC 2004, but SAICE will now also host a national roadshow with the theme 'GCC 2004: Complying with new requirements'. This roadshow will commence at the end of July and will be relevant to contractors, employers and consulting engineers involved in construction works. Copies of the fourth printing of GCC 2004 will be made available to all delegates. If you are unable to attend the seminar, we will gladly replace your copy. Please contact Elsje Kruger or Angelene Aylward at SAICE National Office at aaylward@saice.org.za.

Why the GCC 2004 seminar?

The Government's Standard for Uniformity in Construction Procurement will have a profound effect on the construction industry, as after 15 November 2005, all contract documentation for organs of state must comply with its requirements.

The General Conditions of Contract for Construction Works, First Edition, 2004 (GCC 2004) (issued and published by SAICE), which differs markedly and replaces GCC 1990 and COLTO 1998, satisfies the Standard for Uniformity in Construction Procurement as a standard conditions of contract.

The seminar will present a systematic overview of GCC 2004 by Willie Claassen, who drafted it on behalf of SAICE. By the end of each session participants will have explored new conditions in GCC 2004 and identified ways of dealing with it adequately. Participants will be able to understand the basic philosophy underpinning GCC 2004 and be able to utilise it to ensure the best performance by each party involved in the construction contract.

Theme

GCC 2004: Complying with new requirements

Sub-themes

- Overview of the development and statutory requirements for GCC 2004
- Understanding the equity and administration requirements of GCC 2004
- Handling disputes and the various dispute resolution methods available in GCC 2004

Who should attend?

The seminar will be relevant to all contractors, employers and consulting engineers involved in construction works. □

Course dates for 2005

Date	Venue
26 July	George
28 July	Bloemfontein
29 July	Kimberley
1 August	Polokwane
2 August	Nelspruit
3 August	Secunda
4 August	Midrand
5 August	Mmabatho
16 August	Pietermaritzburg
17 August	Durban
18 August	Richards Bay
23 August	Cape Town
30 August	Umtata
31 August	East London
1 September	Port Elizabeth

Obituary: S J P (Montie) Ellis 1938–2005

On 11 May 2005 Montie Ellis sadly passed away after a short illness. Montie graduated as an agricultural engineer from the University of Pretoria in 1961 and in 1972 obtained his honours degree in water utilisation. He and his family lived in various parts of South Africa as he developed his career and his prominent profile in engineering circles. He made numerous friends along the way with his professional approach to work, leadership and his willingness to help others. His integrity was an example for all. As an avid pilot, he provided his services to the Defence Force until 2003, flying politicians and officials to various destinations in southern Africa. He also enjoyed and actively participated in the social side of life, initially playing tennis and later golf. Their holiday house on the Cape south coast gave him and his family great pleasure and they often shared it with their many friends. One of his favourite maxims was 'We pass this way but once', and he lived accordingly.

Montie started his professional career at the Department of Agricultural Technical Services and thereafter served with a number of government departments and institutions. He joined the then Geustyn Forsyth & Joubert Inc (GFJ) in 1981 as an associate and became a director in 1983. He took charge of the Pretoria office in 1986 and followed this as chairman of the board of GFJ from 1987 to 1995. He also served as a director on the boards of several of GFJ's subsidiaries, including a term as chairman of the board of Waterlab. Montie retired in 2003 but continued as a part-time consultant to GFJ and later P D Naidoo & Associates (Pty) Ltd (PDNA), after the GFJ merger. Montie was the author of a number of publications and played an active role within SAACE. He was also a Fellow of WISA, SAICE and SAIAE. Montie leaves his wife, Marie, and four children.

Nuwe Genoot: Eddie Otte

Eddie Otte matrikuleer in 1962 aan die Hoërskool Gimnasium op Potchefstroom en voltooi sy BSc (Ing) aan Tukkies in 1966. Na twee jaar praktiese opleiding by BKS begin hy by Padnavorsing aan die WNNR. Hy studeer verder in Berkeley, Kalifornië, en behaal 'n DSc (Ing) aan Tukkies. In 1977 sluit hy aan by Van Wyk en Louw (Africon). Na 'n ruk in Pretoria word hy verplaas na Limpopo en bestuur die firma se besigheid daar vanaf 1982 tot 2000. Hierna volg drie jaar by Connel Wagner in Australië. Sedert April 2004 is hy werksaam by Vela VKE in Rustenburg.

Event	Date	Deadline for submission of papers	Venue	Contact
Technical Report Writing	11–12 August		Durban	Lungelwa Lamani*
Business Finances for Built Environment Professionals Wolf Weidemann	22–23 July 2005		East London Venue to advised	Lungelwa Lamani*
Assertiveness and Conflict Resolution for Managers	2–3 August 2005		Midrand	Lungelwa Lamani*
Handling Projects in a Consulting Engineer's Practice Wolf Weidemann	4–5 August 2005		SAICE National Office (New Building), Midrand	Lungelwa Lamani*
Managing Contractor Health and Safety (H&S)	2 August		Port Elizabeth	Prof John Smallwood T/F 041-368-2492 createjs@yahoo.co.uk
X-Pert Proactive Management and Planning	15–18 August 2005		Centurion	Lungelwa Lamani*
SAICE Wits/Pretoria Afternoon Lecture Series	3–31 August 2005 7–28 September 2005	Topics to be sent by e-mail	SAICE National Office	Lungelwa Lamani*
Negotiation Skills	25–26 August 2005		University of Stellenbosch	Lungelwa Lamani*
Short Course on Coastal Engineering	5–9 September		Contest Concrete Technology Services, Durban	Marechia Jacobs T 021-808-4352 F 021-808-4351 msjacobs@sun.ac.za
Catchment Management: Rules of Engagement Conference on Public Participation in Developing Catchment Management Strategies	18–20 September 2005	Deadline for abstracts 20 July 2005	Misty Hills Country Hotel Muldersdrift, Krugersdorp	Carla de Jager T 011-805-5947 F 011- 805-5971 cdejager@saice.org.za
Landfill 2005 Conference	20–21 October 2005		Greensleeves Castle, Hillcrest, Durban	Lia Russell T 031-717-2300 F 031-702-0435 ktechptn@kaymac.co.za
Environmental Applications of Geochemical Modelling	21–23 November 2005		University of Witwatersrand, Johannesburg	Lesley Stephenson T 011-717-7031 stephensonl@ebe.wits.ac.za
4th International Conference on Unsaturated Soils	2–5 April 2006	Abstracts 13 May 2005 Draft papers 15 Aug 2005	Carefree Resort & Villas Carefree, Arizona	Robert Silverstein T 703-295-6234 rsilverstein@asce.org Gerald (Jerry) Miller gamiller@ou.edu

Lungelwa Lamani's details: T 011-805-5947, F 011-805-5971, llamani@saice.org.za