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The Western Cape water supply system will only meet the expected requirements until about 2011, unless other interventions are implemented. The Western Cape reconciliation strategy provides a framework that will enable timely decisions to be made in order to meet water requirements up to 2030. The photograph shows construction on the conduit at the Berg River Dam in the Western Cape (see article on page 16)

SELECTING INTERVentions TO STUDY AND IMPLEMENT THE WESTERN CAPE RECONCILiATION STRATEGY

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Competency speaks for

‘I do not like to work with history; I’d rather shape the future.’ When Martie Janse van Rensburg came to this conclusion about her innate professional preferences, she had already reached heights in a career not normally associated with a South African woman of the 1980s, and since then it has been full steam ahead for this energetic person.

In speaking to Martie, Lorraine Fourie found that the CEO of the Trans-Caledon Tunnel Authority (TCTA) would much rather discuss her profession than her personal likes and dislikes with differentiation regarding gender and marital status. For example, a male articled clerk, junior in qualification and rank to you, but with a family to support, received a higher salary. The situation didn’t bother me too much – although at times I did raise the issue of inequity – because I wanted to be recognised for my professional skills and capabilities. I was never much of a feminist in a time when it was fashionable. I have always believed that your competency will speak for itself. When I do presentations at businesswomen’s associations I have on occasion said that you may be creating that glass ceiling yourself. I know I can be criticised for such a statement, and I fully support the efforts to create an enabling environment for women, but sometimes you may use it as an excuse for not excelling. I believe that what you set your mind to, you can achieve. If you look for obstacles you will find them – but then, I have a short memory about some things,’ she adds with an impish grin.

After graduation in 1977 she joined the small accounting firm of Viljoen, Louw, Bartel (now incorporated in PricewaterhouseCoopers) in Bloemfontein. ‘At the time, you served your articles and studied part-time for the CTA qualification – it was only offered on that basis – while in the workplace you had to contend with certain articles marked for me to read because she thought I should be up to date on current affairs.’

Initially planning to study pharmacology, she had a quick change of mind and enrolled for a BComm degree at the University of the Free State, setting her sights on a career in chartered accounting. ‘At the time there wasn’t much encouragement for women to take up a career in the financial field, but I probably have a good streak of stubbornness in me, so I persevered.’ She considers herself to have been a balanced young person who had lots of fun and enjoyed her hockey and athletics. ‘I must say I didn’t study too hard – although it did catch up with me sometimes – but I had good listening skills and I was able to internalise that to my benefit.’
the time was one of the reasons why I went into commerce.’ She also obtained her Hons BCompt (CTA) through Unisa.

The next year saw her move to Senekal as chief accountant at the agricultural co-op in the town. This was not purely a professional move. She married Derick Janse van Rensburg, who was doing his articles at a firm in Senekal. They had met at university, and at the end of 2007 they will have been married for 25 years. ‘Yes, I married relatively young and, like any relationship, it is what I call “work in progress”. If I look at the average South African male, he will not have chosen to be married to a person like me. But Derick and I share the same core value system wherever necessary. Our biggest debate sometimes is how to best share our spare moments, given our career demands and varied interests, but we create time to take part in activities that we both enjoy, like scuba diving which we started last year.’ They’ve also completed the Argus race five times on a tandem.

On talking to Derick, it’s clear that his wife’s successes do not intimidate him in the least. ‘We grant each other a lot of individual space and the ability to be separate personalities who are continuously growing and changing.’ On the subject of his doing the grocery shopping, he regards it as the most workable solution in their household. ‘Seeing that I’m particular about what goes into the kitchen cupboards, our housekeeper, who’s been with us for more than 13 years, and I are in charge of the shopping list and there’s actually no need for Martie to get involved.’ For a man who grew up in Frankfort in the Free State this is quite a statement.

Martie found the two years she spent in Senekal a useful learning curve. At age 25 the youngest employee at the co-op, she was responsible for a staff complement of 30, reporting directly to a member of the board. She also had to adjust to married life in a small-town environment. ‘What I specifically remember from that era is how much I learned about the human element in the workplace. I dealt with people from varied socio-economic backgrounds and I learned how to pick up early warning signals from people under stress. I learned how important it is to build good human relationships, because part of being a boss is to detect that “silent cry for help” and deal with a problematic situation in an empathetic way.’

Citing the ‘men are from Mars, women are from Venus’ scenario, she thinks female managers are more observant about certain issues. As for her particular sensitivities, she says: ‘You need to develop the right gut feel. This involves having a sense of reality, some intuition, the ability to make on the spot decisions and, above all, the courage to make that decision, because, sometimes, postponing it will create more challenges.’

CLIMBING TO THE TOP

In 1985 the Van Rensburgs moved to Pretoria, where Derick had to do compulsory military service and Martie joined Deloitte Haskins & Sells as senior auditor. She also resumed her chartered accountantancy studies and passed the board exam in 1987, after which she joined Unisa as senior lecturer in computer auditing and applied taxation. ‘Teaching at postgraduate level brought quite a different working environment, as well as the self-confidence to deal with larger groups of people. Up to then my interaction had been mainly on a one-on-one basis, at most one-to-four. The Department of Applied Accountancy then introduced a certificate in advanced taxation, and I was involved in developing the framework and rolling it out.’ At the same time she was doing her master’s in taxation at the University of Pretoria, but never quite found the time to complete her final dissertation, which she regrets to this day, but hopes to rectify in the foreseeable future.

The most important legacy of this period was that she realised she did not really like working with ‘the past’ and needed to work in concert with other people. ‘In a career in tax you work mostly on your own, doing research, looking at history. But I realised that I wanted to work in an environment where I could create a better future for people and that I needed the energy of a team to make that happen.’

In her four years at Unisa, Martie handled several freelance assignments for Deloitte & Touche, and towards the end of 1991 she re-joined her old employer as principal management consultant and audit manager. ‘By now I had also recognised that I was not a half-day jobber; I have to be productively and intellectually engaged full time.’ In 1993 Deloitte was contracted by TCTA to look at long-term funding models, and Martie was seconded to the state-owned entity as financial manager on a part-time basis, while being involved in the restructuring of the Human Sciences Research Council’s financial division. This led to her full-time appointment as chief financial officer to TCTA in 1994.

TCTA’s role then was the implementation of the South African portion of the Lesotho Highlands Water Project (LHWP) and the long-term funding and concomitant risk management of the water supply component of the LHWP. ‘When I joined, work was under way on the construction of the delivery tunnel north, and funding was mainly raised in the money market. In 1995 we initiated the first capital market funding for the LHWP through the issue of the WSO1 (water stock) bond by using a new treasury management model, namely by raising money through a panel of market makers [banks].’ The experience she had gained in the development of liability management frameworks and her understanding of financial markets, risk management, and large project implementation were of such standing that in this period she was advisor to the Minister and Director-General of Water Affairs and Forestry (DWAF) on the investigation into capital market activities of a water board, and a member of the advisory committee created to develop a national water pricing policy.

When TCTA’s chief executive officer...
resigned in January 1998, Martie was appointed acting CEO. Her development and strategic positioning of TCTA, also as a water sector body within SADC, made her the preferred choice for the top position. She took office as CEO in May 1998 and was appointed an executive director to the board. ‘By that time we had completed construction of our area of work on the LHWP, and we were raising funding locally and offshore through an auction process which brought much more transparency into the market. We then needed to sit down and discuss with government what it intended to do with this entity.’ Martie successfully steered the discussion processes to convince government that TCTA had a much wider-ranging role to play than merely in the LHWP, one that would add value to the broad water sector.

In 2001 TCTA was tasked to stabilise and restructure the treasury function and governance of Umgeni Water, the second largest water board in the country. ‘TCTA’s specialist knowledge of the water sector and treasury activities, specifically with regard to project financing, positioned it best to take on this mandate. My role was mainly to drive the assignment from conceptualisation to roll-out and stakeholder management. TCTA carried out an extensive analysis of business drivers, and the development and implementation of building blocks to restructure the balance sheet. I had to gain perspective of the complexities of a professional board with large stakeholder representation, and I had to learn skills to deal with what was somewhat of a conflict environment. It wasn’t easy, but it was tremendously enriching.’

Equally rewarding, on a personal level of development, was the role she played in the creation of Johannesburg Water. ‘When we started the process in 1999, I was vice-chairperson of the advisory board appointed by the city to drive the transformation of water and sanitation delivery on local government level. We had to create a platform for the merger of 13 departments from seven municipalities, setting up a ring-fenced commercially viable entity from scratch – a major operation. Mine was largely an overseeing role, but more often than not I had to actively participate in consultations, which were largely about understanding the dynamics of human relations at play when you have to move people out of their comfort zone.’ Stimulating too was negotiating the contractual aspects and structuring the business processes towards ultimately establishing the entity in 2001, which is still growing and developing. Martie resigned from the board in 2006, but reflecting on her role she says: ‘It brought me invaluable exposure to organisational transformation procedures, insight into the problems and challenges of water on the ground, and how you turn around service delivery. Throughout the process I was asking myself what difference my contributions would be making, and what kind of legacy we would be leaving behind.’

TCTA was mandated to fund and implement the Berg Water Project (BWP) in the Western Cape and the Vaal River Eastern Sub-system Augmentation Project (VRESAP) in Gauteng. ‘The fund-raising model that we developed for BWP in 2002, and which was then replicated for VRESAP in 2004, involved mobilising private sector participation through your consulting engineers, your contractors and the financial market. The easiest way to explain our role in this scenario is to compare TCTA to a marriage between
When wearing her financial hat, Martie is an active participant in the Bond Exchange of South Africa (BESA). During her term of office on the governance structures (executive committee) of BESA in 2002, the exchange refocused its strategic direction and strengthened its governance model. She still serves in a non-executive capacity on the governing committee that was subsequently established in line with the recommendations of the King II Report.

When wearing her financial hat, Martie is an active participant in the Bond Exchange of South Africa (BESA). During her term of office on the governance structures (executive committee) of BESA in 2002, the exchange refocused its strategic direction and strengthened its governance model. She still serves in a non-executive capacity on the governing committee that was subsequently established in line with the recommendations of the King II Report.

When she became CEO at TCTA, Martie purposely set out to learn the engineering side of things. ‘If I wanted to be a competent leader, I needed to know what the function entailed – what it constraints are, its opportunities, and its strategic aspects. So I moved out of the pure financial field and became what I call a Jack of all trades, master of none. But I’m enjoying the challenges of a wider involvement.’

She’s been at the helm there for the past nine years, during which time she has repositioned the entity from an implementation body to a fully fledged liability management utility with a multi-project mandate. ‘I needed to drive hard; it didn’t just land on my doorstep. It required continual pushing of the envelope to ensure that cutting-edge solutions are on the table in the fast-changing environment we’re operating in.

‘Looking back, it’s been white-water rafting most of the time, but then I cannot be satisfied with less than an excellent product at the end of the day.’

Currently she is preparing TCTA to integrate with DWAF’s water infrastructure departments through the creation of the new National Water Resource Infrastructure Agency. If there’s a role for her to play, the first question she will be asking is: Am I relevant, and can I make a difference?
Ninham Shand Consulting Services is celebrating its 75th anniversary this year. The company has come a long way since 1932, when Ninham Shand set up unassisted in his office in Cape Town and began to travel the Cape in search of commissions. In the ensuing years the practice of Ninham Shand has provided infrastructure to countless towns, supplied regional facilities throughout the country, and played a leading part in some of the most prestigious engineering projects in the subcontinent. We revisit some of the highlights in its history.

1932
Ninham Shand, a UCT graduate with overseas experience in dam construction and water supply, enters into partnership with George Stewart (who practises out of Johannesburg) and James Shannon. He travels thousands of miles in the Cape Province in search of municipal work, and obtains commissions for water supply projects in several towns. To ease the burden of travelling, he acquires his first aeroplane.

Gradually the practice diversifies from simple water supply, and in 1938 he is appointed to design a significant arch dam on the Swart River at George. He gains another major structural project in the form of the complicated Revenue Office Building in Cape Town. He is invited to research evidence for an important water court case, and thereby establishes his reputation as an expert witness which will stand him in good stead for the rest of his career.

1939
At the outbreak of war, Ninham Shand is appointed as a major in the Defence Force. He is made responsible for building coastal defence works and aerodromes, but still manages to direct some private work essential to the war effort. The drainage scheme for the reclaimed Cape Town Foreshore proceeds on an emergency basis, and is successful due to several innovative measures – such as weighbatching and truck-mixed concrete – which he introduces.

1941
The firm’s first embankment dam, the Melville Dam near Oudtshoorn, is completed.

1945
Shortly after the end of the war, the partnership with Stewart is dissolved and Ninham Shand sets up business on his own account. He has twelve qualified engineers in his employ. His first important project is the raising of Mocke’s Dam near Bloemfontein, where he installs 34 syphons to prevent upstream flooding. The job leads to the establishment of the first branch office in Bloemfontein, which is opened by Graham Walker in 1949. By 1951, work in the Eastern Cape is flourishing to such an extent that it becomes necessary for Jerry Tait to open an office in Port Elizabeth.

1953
Ninham Shand becomes interested in the water potential of Lesotho, and the seeds of the Lesotho Highlands Water Project are born. Investigations will continue over many years. The practice expands in other directions and structural and geotechnical departments as well as a soils laboratory are established.

Shand presents a preliminary report on the potential of the Orange River Scheme, and deals particularly with the proposals for the Van der Kloof Dam site. Other major dam projects include Wemmershoek and Stettynskloof dams, and a dam and hydro-electrical scheme at Ceres.

1963
Ninham Shand takes eleven of his senior engineers into partnership and the firm becomes Ninham Shand and Partners. Jan de Wet opens the Pretoria office and Shands...
becomes a member of the consortium for the design of the Orange River Project, while investigations continue in Lesotho.

The firm is appointed for major road projects in Namibia. It is also commissioned to design several major bridges, including the Swartkops River Bridge at Port Elizabeth, the Lazarus Bridge at East London and the Swakop River Bridge in Namibia.

1969


The roads department is entrusted with the design of the Garden Route freeway from Mossel Bay to George, including the Great Brak Pass and the Maalagat Bridge. Shands play a key role in reconstruction after the Boland earthquake.

The firm promotes the first pumped storage scheme in the country at Steenbras and is responsible for designing the civil components, including the upper Steenbras Dam. The project wins major SAICE and SAACE awards. Construction on other large dams, including the Mpofu Dam near Humansdorp, the Garden Route Dam near George and the raising of Stettynskloof Dam, is under way at the same time.

The partnership is formed into a company in 1976, trading as Ninham Shand Incorporated. Hans Blersch becomes chairman of the board.

1980

Further decentralisation brings the number of branch offices up to fifteen. The provision of township infrastructure becomes an important part of the consulting scene and an urban department is formed as a separate entity to the major roads division.

Interest in the Lesotho Scheme is revived and Shands is appointed to produce a feasibility report on the proposed scheme in association with three other firms.

1986

Jan de Wet becomes the third chairman. He is succeeded by Peter Thomson.

Shands becomes a member of the various consortiums formed to carry out the elements of the Lesotho Highlands Water Project, and the massive project begins to take shape.

The Palmiet Pumped Storage Scheme is designed in collaboration with two other firms. The scheme to control the Kuils River commences, and the firm is commissioned to produce an analysis of the Western Cape Water System, which eventually leads to the construction of the Berg Water Project.

1996

Democracy in South Africa gives opportunities for firms to look northward for work, and Shands becomes involved in ventures in Mozambique, Algeria, Sub-Saharan Africa and the Middle East.

The firm enters into several partnerships with emerging consultants to facilitate the transfer of knowledge. Tony Mills becomes chairman.

The Lesotho Highlands Water Project is in full swing. Shands is initially involved in the provision of access and services to the Katse Dam site, and later in aspects of the dam itself. The delivery and transfer tunnels - huge projects in their own right - are designed by the Consult 4 Consortium, in which Shands plays a leading part. Consult 4 is also responsible for the design of the Maguga Dam in Swaziland, which gains major awards.

Two large projects to augment the Bloemfontein Water Supply, the Rustfontein Water Treatment Works and the Novo Water Transfer Scheme, are carried out by the Bloemfontein office.

2002

The shareholder base is broadened to include more employees. The control of the firm’s operations is put in the hands of a board in which previously disadvantaged persons have 50% representation, and Barney Tsita becomes the fifth chairman. BEE shareholding is increased to over 30%.

The Berg Water Project gets under way, while further phases of the Lesotho Highlands Water Project commence. The emphasis for roadwork shifts to maintenance and rehabilitation.

Shands is a member of the consortium in the Vaal River Eastern Sub-system Augmentation Project.

2003

SAICE names the Lesotho Highlands Water Project ‘The Project of the Century’. At about the same time, Ninham Shand is voted ‘South African Engineer of the Century’ in a competition in a leading construction magazine.

The South African Large Telescope (SALT) receives numerous accolades and several awards.

TODAY

Ninham Shand is now a multidisciplinary organisation with a foothold in many countries. It is nevertheless essentially a part of modern South Africa, and its makeup, clientele and outlook reflect the nature of the country which is the base of its operations.

The firm has more than 500 employees and is working on some 1 300 projects worth approximately R1 billion in total. The shareholding in the company is in the hands of its employees, over 40% of whom are black, while the board of the operating company is fully compliant with empowerment objectives.

Despite the modern outlook, the philosophy of the firm’s founder is still very much part of their character. Ninham Shand believed that technical excellence was paramount and that good business was simply an outcome of good engineering. While imaginative solutions, sound development, and attention to detail were the cornerstones of his professional approach, they went hand in hand with integrity, reliability and designs which were appropriate to the needs of the client.
Tony Murray recently lent me his copy of The Snape papers. I was fascinated to read these and to perceive the breadth of vision of Alfred Snape. He was prophetic in his address before the Engineers’ Club in Manchester, more than 80 years ago, when he said: ‘Having these large natural resources we confidently expect the development of large chemical industries with coal at the base.’ At the same lecture he foreshadowed the steel industry and a unified electricity supplier. As an immigrant to South Africa myself, I was particularly struck by his words, ‘My home is now South Africa, and my interests are now inseparably wrapped up with that beautiful land.’ That is also the case with me.

I consequently consider it a great honour to follow a list of eminent engineers paying tribute to Snape by recounting of some of my experiences during a long career in the field of water engineering.

Most young engineers working for the Department of Water Affairs in my time wanted to be on construction. We were given major responsibilities at an early age and did the most interesting work imaginable following the drudgery of study. In 1964, after seven years at the Ebenezer Dam in the then Northern Transvaal and at the Stormdrift Dam near Oudtshoorn, I was appointed RE for the Krugersdriift Dam on the Modder River near Bloemfontein, but had to first come to head office in Pretoria to undertake the design under Roby Myburgh and Eric Chunnett, at the same time starting with the construction of the advance infrastructure. One day, Mr Myburgh called me to his office and said that the French government had issued an invitation for a young engineer to attend a four-month ‘stage’ in France. (A ‘stage’ is a mixture of a study course and a kind of apprenticeship.) He knew that I spoke French, and thus would not have to attend a French course. Of course, I was interested, but there was one condition: I had to apply to join his staff in the design office, which meant the end of my treasured construction career!

I was lucky to work at a time when huge projects were the order of the day – new harbours at Saldanha and Richards Bay, with the associated major railways; huge new coal-fired power stations by Eskom, with their attendant infrastructure such as mines, roads and water supply; the uranium enrichment plant at Pelindaba; the Orange River Project with its major dams and tunnels; the Pongola River development; the two new oil-from-coal plants of Sasol at Secunda; the new Iscor plant at Newcastle; toll roads, etc.

In the early seventies, I was in charge of the preliminary design of the proposed Java Dam on the Elands River near Kestell in the Free State, which was required for storing the water pumped from the Spioenkop Dam on the Tugela River in Natal for use in the Vaal catchment. When the white paper on that project was tabled in Parliament, the then Department of Bantu Administration – or whatever it was called in those days – nearly got a fit. The dam would have flooded a large part of their proposed QwaQwa homeland, which nobody at Water Affairs had heard of!

This led to my involvement in the complete replanning of the Tugela-Vaal water transfer scheme. This project was required to supplement the over-extended resources of the Vaal River, the main source of water to the economic heartland of South Africa. It was rather fortunate that we had to replan the project, because in the process we found a much better site for the storage dam at Sterkfontein, on an insignificant spruit called the Nuwejaarspruit. Although very close to the watershed between the catchments of the Tugela and the Vaal, the reservoir could store more water than the Vaal Dam, with only 20% of its area subject to evaporation. The necessary water transfer infrastructure could also be substantially reduced in length, and a major tunnel saved. It also opened up the possibility of introducing the 1 000 MW Drakensberg Project, together with Eskom.

I had become familiar with pumped storage projects during my studies in France and had noticed the suitability of the terrain, both concerning sites for the upper and lower reservoirs, and their relative proximity. Combining water transfer with electricity generation resulted in major savings for both organisations. The transfer water could be pumped off the peak, at only the incremental cost of the coal burned. I became involved in the negotiations for determining how this benefit could be divided...
between the two. For this purpose future
cost streams had to be discounted. When I
approached the Department of Finance and
the Reserve Bank, it became clear that the
state did not have a policy on what is gener-
ally called the social time value discount
rate, where future expenditure is compared
to the present one. It seems as if I was the
first person to ask the question, with the
result that I was told to serve on a committee
making recommendations in this regard.
Because Water Affairs' savings were going
to accrue over the next fifty years or so, it
was an important question to be answered.
Fortunately, neither Eskom nor Water Affairs
took a parochial view. Both realised that
water and electricity users were one and the
same, and we could come to a speedy agree-
ment on the division of costs and benefits.
I found these negotiations most stimu-
lating and rewarding. I am of the view that
engineers in general, and civil engineers in
particular, should familiarise themselves
with the basics of economic and financial
analysis, which I personally have had to use
frequently in my career.

After the proposed Drakensberg Project
had been put before the then Minister of
Water Affairs (Fanie Botha) and the Eskom
Board and approved, the former, being a
politician, immediately wanted to make a
grand announcement and meet the press on
site. I frantically tried to stop him, because
we were still investigating the feasibility
of opening up a 16 m wide cavern in the
relatively weak rocks at the site, which was
a condition sine qua non for the feasibility
of the whole project. But he would not listen
and went ahead. Fortunately this proved to
be possible, and the rest is history!

One day, while I was chief engineer
planning of the department, a delegation
from Sasol came to see me, wanting to
know where they could construct a dam to
supply water to their proposed new plant
at Secunda. To their dismay, I said that I
had other clients to look after in the area,
and that their demand would be met in a
project or projects serving all requirements
in the area. At the time we were heavily
involved in inter-basin transfer projects for
supply to the eastern Highveld of Transvaal,
mainly the very large coal-fired power sta-
tions of Eskom. We were already supplying
existing stations from the Komati River
and from the Usutu. These supplies, which
often depended on long pipelines and single
dams, were rather precarious. The new de-
mand, together with those of proposed new
Eskom stations, opened up the possibility
of some backing up of supplies. This lead
to the Usutu-Vaal link project, linking the
resources of the Komati, the Usutu, and the
Vaal River.

The wisdom of this was proved when a
prolonged drought struck in the late seven-
ties and early eighties. In the autumn of
1983 an economic catastrophe stared the
country in the face – the projected demand
of most of the country's power stations and
of Sasol II and III showed that by September,
before the normal onset of the rainy season
in that area, the five dams on the Komati
and the Usutu, as well as the Grootdraai
Dam on the Vaal, would run dry. This was
unthinkable, as the whole country, including
the mines, which rely on electric pumps,
would come to a grinding halt! Although
the Vaal Dam itself was also virtually empty,
we had the water that was pumped from
the Tugela into Sterkfontein in reserve. This
could be let out by gravity to the Vaal Dam,
but how to get it from the vicinity of Villiers
to the Grootdraai Dam near Standerton,
from where it could be distributed via the
Usutu-Vaal link project?

Within twenty weeks we had to imple-
ment a project to transport some 1 million
cubic metres per day, or about 12 m³/s, over
a distance of 90 km, at its shortest. A con-
tventional pipeline of some 2 m in diameter
and pumping station would not be feasible
in such a short time. The only solution was
the one that was subsequently adopted,
namely constructing a chain of seven tem-
porary weirs in the Vaal River, each with
a pumping station at its downstream toe.
This amounted to putting the Vaal River
in reverse.

Constructing seven weirs each equipped
with a spillway, with large-capacity pumps
overcoming a static height difference of some
60 m, and within such a short time, was no
mean task. Eskom supplied power at each
of the sites and flew in submersible pumps
from Sweden. We managed finish on time.

As it happened, the pumps were not re-
quired for a long time, because shortly after
the onset of the rainy season, heavy rains
restored dam levels to normal and some of
the weirs were damaged by the resulting
floods. This was the most adrenaline-pro-
ducing project I was lucky enough to be in-
volved with, and would certainly have been
the most important, if early heavy spring
rains had not fallen. I understand that a
permanent pipeline to fulfil that function is
now under construction.

When I was transferred from the design
division of Water Affairs to the planning
division, I was made responsible for water
resource planning for the eastern half of
the country, which included the present
Gauteng, by far the country's largest water
use area. This province lies astride the
continental watershed, with the result that
there are no major rivers near the centre of
demand. The nearest source, the Vaal River,
was more or less fully utilised, and elements
of the inter-basin transfer scheme from the
Tugela were already under construction. At
the time, consulting engineers for Lesotho
had just completed a report on a proposed
project, called Pelaneng, to transfer water
from the Upper-Orange in Lesotho to the
Vaal basin, along the lines first proposed by
the great Ninham Shand for supply to the new Free State gold fields. The World Bank supervised these consultants.

Advised by the bank, Lesotho wanted South Africa not only to pay the full cost of the project, but also an 8% per annum return on their investment. (Not a bad business deal!) I was asked to compare the cost of the water with that of a possible extension of the Tugela-Vaal scheme. Because provision had been made for these extensions in the design, the latter proved to be substantially cheaper, and it was decided to proceed with the second phase of the Tugela-Vaal project.

While preparing my report on this issue, I had to study the so-called Binnie Report and realised that some time after 1992 we would need the Orange River water as well. I therefore allocated a member of my staff to the study of a much larger project, because by the time it would be needed, the water demand would have grown at an exponential rate. This proved to be a blessing, and ultimately led to the Lesotho Highlands Water Project, of which phases 1A and 1B are now fully operational.

When the time was ripe, the then Minister of Water Affairs, Braam Raubenheimer, arranged to meet the Lesotho government, proposing a joint study. I was asked to accompany him and the then Secretary for Water Affairs, Jacques Kriel. We were greeted at the border by the Lesotho Deputy Prime Minister and conducted to our hotel. That evening, there was a function where everybody who was somebody in Maseru had been invited: ministers, permanent secretaries, ambassadors, bishops, you name it. The next morning, the Deputy Prime Minister pitched up at our hotel, requesting us politely to return immediately to South Africa, because the Lesotho government under Chief Leobowa Jonathan was going to issue a strong anti-South African statement that day, which would be embarrassing for us!

It was the day after the Soweto riots of 16 June 1976. Meetings were resumed only in 1978 and a study of our preliminary proposals was initiated under the direction of a joint technical committee. I was appointed study supervisor on behalf of South Africa, while TAMS, an American firm of consulting engineers, fulfilled that role for Lesotho. Later I became the RSA’s chief delegate on the JTC. Each government appointed its own consulting engineers, who were instructed to produce a joint preliminary feasibility report. Lesotho insisted that a hydroelectric component had to be included, and that no dams could be proposed on the Caledon River, which forms the border between the two countries. Lesotho argued that this would amount to recognising that border, while they maintained a claim on parts of the eastern Free State, which they consider ‘conquered territory’.

In May 1979, after a positive report by the JTC, it was decided to proceed with a final feasibility study, each country paying half the costs. When Lesotho finally obtained the necessary funding – from the European Development Fund – conditions imposed by the fund led to the most extraordinary arrangements. None of their funds would be allowed to be paid to a South African firm. The investigations had to be divided in two physical parts, with each country’s consultants dealing with its own part while reviewing the work of the other, eventually producing a joint report! Managing these clumsy arrangements was far from easy. Nevertheless, at the end of 1983, a joint report was produced, recommending a particular phased layout.

I was not satisfied that the optimal layout had been identified, and recalling that in the past the cause of the two governments failing to reach agreement had been the amount of royalties to be paid to Lesotho, I insisted that further work be done on this issue. Accordingly, a study was undertaken to determine the cost of a project entirely within South Africa that could fulfil the same function. This was called the Orange-Vaal Transfer Scheme and it would be used as a yardstick for the benefits of the LHWP, which could be divided between the two countries. These benefits proved to be vast indeed, especially when compared to the GDP of Lesotho!

Originally, the consultants came up with a proposal that included a hydrostation, the tailrace tunnel of which issued on South African territory. Although it was the cheaper solution, the Lesotho government insisted that the tailrace should discharge in a balancing reservoir on Lesotho soil. This made our side very suspicious indeed,
because it would allow Lesotho to cut off the water, while maintaining hydropower output.

With the securocrats, and especially the then State President, P W Botha, becoming involved in the issue, the project came close to be called off. But in April 1986 the final report appeared, consisting of 19 volumes of text and 8 albums of drawings, altogether 62 cm thick and weighing 33 kg. The treaty documents form an almost equally impressive stack!

On 24 October 1986, the treaty was signed in Maseru by the respective Foreign Ministers. As is usual, the places on the dais were taken by diplomats from Foreign Affairs, top brass from the Army, Navy and Air Force, and all sorts of other people who had had nothing to do with the project, while we, the responsible engineers, were relegated to a place somewhere among the journalists … One of these later referred to Pik Botha as the chief architect of the project!

The signing of the treaty set in motion the design phase. We had made it a condition that South African firms would do at least half of the engineering and construction. Lesotho interpreted this ‘at least’ as ‘at most’. I called in all South African consulting firms with experience in dam and tunnel engineering and suggest they form a consortium, which they rather reluctantly did. In the end this arrangement proved to be so successful that they continued operating as such in the rest of Africa.

I remained involved in the project as chief South African delegate of the Joint Permanent Technical Commission until all tenders had been awarded and the advance infrastructure had been completed. This
In the early sixties, South Africa became a member country of the International Commission on Large Dams (ICOLD), which has its head office in Paris. Possibly because of my knowledge of French, I was roped in as assistant to the first secretary of the national committee, Jacques Kriel, was not an easy job. At one stage, the South African Defence Force invaded Maseru to target ANC cadres stationed there. I was told to stop all work. If I had obeyed, it is doubtful whether the project would have got off the ground again. Instead, I instructed the consultants to continue working without venturing into Lesotho and left my representative, Hans Pettenburger, and his staff in their office in Maseru. Hans, who died recently in Somerset West, was a most courageous individual and was prepared to run the risk.

Originally we wanted to create a bi-national company to construct and run the project, but because of the size of the project and its cost relative to the Lesotho economy, this arrangement was not acceptable to Lesotho. Consequently, the treaty made provision for the Lesotho Highlands Development Authority to fulfil that function, with the JPTC overseeing and approving.

This arrangement was far from ideal and caused me many headaches. One day, after the tenders for the main works had been received and were being evaluated, then Foreign Minister Pik Botha called me to his office and told me that an American firm of contractors, Morrison Knudsen, in consortium with a Japanese firm, wanted an opportunity to re-tender, after they had lost because of their exorbitant price. Apparently, Laurence Eagleburger, the American Deputy Secretary of State, had intervened on their behalf. He had already convinced Lesotho to reopen the process. I told Mr Botha that we could not do such a thing, that we would loose all credibility in the eyes of the rest of the world, and that I would not be prepared to continue leading the project if that request were to be met. I never heard of it again!

Becoming involved in the financial arrangements of the project and the drafting of the treaty was most interesting indeed. Standard Chartered Merchant Bank, funded by the World Bank, had been appointed to advise the project authorities. They were paid a rather large amount of dollars for their trouble. I was astonished to observe how easily they earned that money and how little true expertise was involved, especially when compared to the input of the consulting engineers.

I could write a book on all the ups and downs of that project, but in the end, I can contemplate, with great satisfaction, the 30 m/s crystal clear water issuing from the tunnel near Clarens in the Free State. I believe that the Nuwejaarspruit is now a white-water rafting venue, an unexpected additional benefit from the project.

In the early sixties, South Africa became a member country of the International Commission on Large Dams (ICOLD), which has its head office in Paris. Possibly because of my knowledge of French, I was roped in as assistant to the first secretary of the national committee, Jacques Kriel. As I rose through the ranks of Water Affairs, I became secretary of ICOLD, and then chairman. The commission has an annual meeting somewhere in the world every year, and a congress every three years. We were not welcome in some of the countries organising these meetings. Nevertheless, I was fortunate to have attended quite a number of them, starting in Athens in 1974. There was always a study tour before or after these meetings, which gave one the opportunity to observe how things were done in other member countries. In 1991, the year after President F W de Klerk delivered his famous speech in Parliament and the year I was promoted to Director General of Public Works, SANCOLD (the South African national committee of ICOLD) issued an invitation to hold the next congress in 1994 in Durban. This invitation was accepted. You can imagine how anxious we were about the outcome of the negotiations then being conducted at Codesa! We had to spend a lot of money in advance, without the certainty that it would be possible to receive some 4 000 people, with the climate of violence as it then was.

Shortly after Mr Nelson Mandela had been inaugurated as President, I had to show him his new residence – the Presidency in Brynterion. As chairman of the organising committee, I made use of this opportunity to ask him whether he was prepared to open this important international congress. I presume that his diary was not yet as full at the time as it would later become, because he graciously accepted. You can imagine what a coup that was! I even had the privilege of drafting his speech, which was well received by his audience. That, and a very successful congress, no doubt contributed largely to me being elected president of ICOLD for the next three years.

Looking back over my career, I can tell those of you who are still at the start of your careers that it is extremely important to inform yourselves of issues beyond the purely technical. You need to know enough about these to know when to call in the experts. Only then will you be in a position to lead major projects. Now that the accent is once again on infrastructure development, I can assure you that you could experience an equally challenging time as civil engineers.

THEO P C VAN ROBBROECK

THEO VAN ROBBROECK was born and grew up in Belgium (1931). He completed his schooling at the Scheppers Institute in Mechelen (Mechlin), summa cum laude. In 1952 he immigrated to South Africa, where he started his studies in civil engineering at the University of Stellenbosch. In 1956 he graduated with a BSc BEng.

Theo started his career in water engineering with the Department of Water Affairs, where he worked for 32 years in the divisions of construction, civil design and planning. He later became Deputy Director-General of the department, where he was responsible for water resource development, that is, the planning, design and construction of major water schemes all over South Africa. Among these was the Lesotho Highlands Water Project, one of the largest of its kind in the world.

From 1991 until his retirement from the civil service, he was Director-General of Public Works. After this, he worked part-time for another two years for Sir Alexander Gibb and Partners of the UK.

Theo was active in the affairs of the South African Institution of Civil Engineering, where he rose to the position of deputy president and president-elect. Owing to his promotion to Director General of Public Works, he was not in a position to take up the presidency. He is also a past chairman of the Water Engineering Division of SAICE, and received the Water Engineering Award in 1992.

He was involved with the International Commission on Large Dams from the time South Africa became a member of this organisation. He was elected vice-president of ICOLD for the zone Africa-Australasia and in 1994 became president of ICOLD for the three-year term ending in 1997. He currently is honorary president.

During his term of office, Theo took part in the Gland initiative from the World Bank and the IUCN which led to the establishment of the World Commission on Dams, and served as a member of the forum until the commission delivered its report.

In recognition of his achievements, the University of Stellenbosch awarded him an honorary doctorate in engineering. For the same reason he was awarded the Alfred Lewis Gold Medal by the Department of Water Affairs.

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Selecting interventions to study and implement the Western Cape Reconciliation Strategy

THE WESTERN CAPE WATER Supply System is situated in a winter rainfall area. It serves more than 3 million people in the Greater Cape Town, Boland and West Coast areas, as well as a large irrigated area.

The maximum total historical water use of 499 million m³/annum, which occurred in 2000/01, exceeded the existing supply from all dams of 475 million m³/annum. Following recent water restrictions, the current total unrestricted water use is estimated at 510 million m³/annum. The Berg Water Project, which will be completed during 2007, will augment the available supply by an additional 81 million m³/annum.

The Department of Water Affairs and Forestry (DWAF) and the City of Cape Town (CTT) tabled the draft reconciliation strategy for the system in February 2007. This strategy provides a decision support framework that will enable timely decisions to be made on water resource studies and interventions to meet future water requirements up to 2030.

The water requirements of the system are expected to grow and, even with the Berg Water Project, the system will only meet the expected requirements until about 2011, taking cognizance of current water conservation and demand management measures, unless other interventions are implemented.

DEVELOPMENT OF THE STRATEGY AND IMPLEMENTATION PLAN

Aims and objectives of the strategy
The main objective of the strategy is to provide a sound basis for planning the reconciliation of future water requirements with the supply from the system. It will put in place a programme of studies and other investigations to ensure that the necessary interventions are investigated timeously and at the appropriate level of detail.

The involvement of the public and key stakeholders is integral to the strategy and regular review of future water requirement scenarios and reconciliation options to meet these requirements will be necessary.

Water requirement scenarios
A model was developed to estimate the future water requirements of the system, which depend mainly on economic and population growth. Population growth rates declined between 1972 and 2001 as a result of HIV/AIDS, the out-migration of working-age residents and a decline in fertility rates, whereas the economic growth from 1996 to 2006 was higher than the national average, but lower than that of other South African metropolitan areas.

The biggest contributor to the growth of the economy in the Greater Cape Town Area was the services industry, and in particular, the financial services industry.

Two future water requirement scenarios were developed. For the high water requirement scenario, with high economic and population growth, the total system requirements would grow from 502 million m³/annum in 2006, to 935 million m³/annum in 2030, and for the low water requirement scenario from 465 million m³/annum in 2006 to 670 million m³/annum. These scenarios did not take into account any future water conservation and demand management interventions.

The high and low water requirement scenario curves for the CCT (without the additional use by agriculture and Boland and West Coast towns), as developed for the strategy, are shown in figure 1. The City’s actual historic water usage is also shown, as well as the previous unconstrained curve, which was developed in 2000, prior to the implementation of the City’s current water conservation measures. The low water demand curve represents the City’s commitment to the DWAF with regard to water conservation and demand management, as contained in the raw water supply agreement between the DWAF and the City. The curve represents the CTC’s current commitment to the implementation of water conservation and demand management.
SCENARIO PLANNING FOR THE RECONCILIATION OF SUPPLY AND REQUIREMENTS

Selection, screening and public review of interventions

The objective of the strategy’s selection process for studies and interventions is to identify the most favourable interventions to meet future water requirements when these exceed the available supply. It also takes account of the time to implement interventions, which can take up to ten years or more, from feasibility study to the completion of large projects.

All interventions were initially evaluated in terms of cost, socio-economic and environmental criteria to a common base of information. Public input was obtained on additional interventions and the proposed list was amended accordingly. A representative multi-stakeholder group screened 66 interventions, by ranking each intervention in terms of the criteria, and agreed to eliminate 19 non-starters. Further refinement of the list of interventions was undertaken in the following months, by integrating new information and input from the extensive public process.

Scenario planning process

This scenario planning process identified, evaluated and assessed alternative groupings and phasing of interventions to determine the possible combinations of interventions for reconciling the water supply with the requirements up to 2030. The objective was not to select one ‘favourable scenario’, but to identify which interventions should be studied by specific dates, so as to provide sufficient information for the decision-makers to select the most appropriate interventions.

The reconciliation planning support tool (RPST) was developed and used to evaluate 56 interventions and 11 scenarios. The RPST also facilitated the assessment of the following aspects:

- The benefits of implementing water conservation and demand management
- The reconciliation and supply implications of implementing the ecological reserve for existing water resources
- The reconciliation and supply implications that may arise from climate change

Scenarios were mainly evaluated against the high water requirement scenario without
any water conservation and demand management as this gives the most conservative intervention implementation start dates. All water conservation and demand management interventions were considered as reductions in the requirement curves, whereas water resource projects were assumed to augment the yield of the system.

**THE RECONCILIATION PLANNING SUPPORT TOOL**

The RPST is used to facilitate the selection process by comparing potential interventions with one another for one or more selected future water requirement scenarios. Information is imbedded in the tool, including various water requirement scenarios, the current system yield, intervention programmes, yields and financial parameters.

The tool is run in Excel, with Visual Basic macro-programmes. It is interactive, and the user can adjust all input data. The tool graphically shows when decisions regarding investigations for selected interventions need to be taken to achieve a water balance. It can also show the time-related implementation programmes for the selected interventions, the effects of water conservation and demand management in reducing requirements and the increases in system yield provided by projects. A table indicates the required study start dates for the various interventions of a selected suite comprising a scenario.

A basic multi-criteria decision-making function is included to assist the user in the selection process. This enables the user to alter the weightings of the criteria and to alter the criteria themselves. Five different variables can be compared on this basis. The remainder of the criteria can be utilised for a more qualitative assessment. A set of filters is included for all the criteria so that interventions can be analysed in various ways.

The RPST also displays financial parameters, namely unit reference values, operating costs, capital costs and the unit cost of water per intervention selected. The tool can also give the net present values and expected cash flows for a selected suite of interventions.

Figure 3 contains a graphic illustration of water balance sheet output.

**FINDINGS**

The findings highlighted the following:

- The importance of the City’s eight-year water conservation and demand management plan, as well as additional or following water conservation and demand management initiatives.
- Many proposed groundwater interventions form an integral part of the strategy and need to be thoroughly investigated.
- Reuse of effluent is a very important future source.
- Desalination, although still expensive, would need to be implemented in the future. It is therefore necessary to start with investigations now.
- The implementation of the ecological reserve could have significant socio-economic implications, and has to be properly coordinated and monitored.
- Climate change could have serious implications which need to be properly coordinated and monitored.

**RECOMMENDATIONS**

The following recommendations were made in the draft strategy:

- A strategy committee should be formed to make recommendations on an annual basis, on long-term planning activities required to ensure reconciliation of requirements and available supplies.
- The City’s current eight-year water conservation and demand management strategy should be implemented and a feasibility study initiated to determine the potential of the additional long-term water conservation and demand management interventions, as shown in Table 1.
- Studies of all the supply-side interventions listed in Table 2 should be undertaken at an appropriate level of detail in order to plan the reconciliation of supply and requirements.
- The City’s Table Mountain Group (TMG) aquifer feasibility study and pilot project should proceed, as this has been identified as a potentially significant water source. The strategy committee should

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**Table 1 Recommended starting dates for water conservation and demand management intervention studies**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Date study required</th>
<th>Study level required</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCT eight-year strategy and programme</td>
<td>2007</td>
<td>To be implemented</td>
<td>The City</td>
</tr>
<tr>
<td>Adjustment of water tariffs, metering and credit control</td>
<td>2007</td>
<td>Feasibility</td>
<td>The City</td>
</tr>
<tr>
<td>Eliminate auto-flush urinals</td>
<td>2007</td>
<td>Feasibility</td>
<td>The City</td>
</tr>
<tr>
<td>Leakage detection and repair</td>
<td>2007</td>
<td>Feasibility</td>
<td>The City</td>
</tr>
<tr>
<td>Promotion of private boreholes and wells</td>
<td>2007</td>
<td>Feasibility</td>
<td>The City</td>
</tr>
<tr>
<td>Use of water-efficient fittings</td>
<td>2007</td>
<td>Feasibility</td>
<td>The City</td>
</tr>
<tr>
<td>User education</td>
<td>2007</td>
<td>Feasibility</td>
<td>The City</td>
</tr>
</tbody>
</table>

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**Table 2 Summary of supply intervention study start dates**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Date study required</th>
<th>Study level required</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EXISTING FEASIBILITY STUDIES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TMG aquifer feasibility study</td>
<td>Ongoing</td>
<td>Feasibility</td>
<td>The City</td>
</tr>
<tr>
<td>Pilot desalination plant</td>
<td>Ongoing</td>
<td>Feasibility</td>
<td>The City</td>
</tr>
<tr>
<td>TMG regional monitoring</td>
<td>Ongoing</td>
<td>Monitoring</td>
<td>DWAF</td>
</tr>
<tr>
<td><strong>PLANNED FUTURE STUDIES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voelvlei Phase 1</td>
<td>2007</td>
<td>Update feasibility</td>
<td>DWAF</td>
</tr>
<tr>
<td>Michell’s Pass diversion</td>
<td>2007</td>
<td>Pre-feasibility</td>
<td>DWAF</td>
</tr>
<tr>
<td>Newlands aquifer</td>
<td>2007</td>
<td>Pre feasibility</td>
<td>The City</td>
</tr>
<tr>
<td>Cape Flats aquifer</td>
<td>2007</td>
<td>Feasibility</td>
<td>The City</td>
</tr>
<tr>
<td>West Coast aquifers</td>
<td>2007</td>
<td>Pre feasibility</td>
<td>DWAF</td>
</tr>
<tr>
<td>Upper Wit River diversion</td>
<td>2007</td>
<td>Pre-feasibility</td>
<td>DWAF</td>
</tr>
<tr>
<td>Raising Steenbras Lower Dam</td>
<td>2007</td>
<td>Pre-feasibility</td>
<td>DWAF/ the City</td>
</tr>
<tr>
<td>Lourens River diversion scheme</td>
<td>2007</td>
<td>Update pre-feasibility (as linked to raising Steenbras Lower Dam)</td>
<td>DWAF/ the City</td>
</tr>
<tr>
<td>Upper Molenaars diversion</td>
<td>2007</td>
<td>Pre-feasibility</td>
<td>DWAF</td>
</tr>
<tr>
<td>Effluent re-use (policy, treated effluent re-use to potable standards, treated effluent re-use for irrigation/industry)</td>
<td>2007</td>
<td>Pre-feasibility</td>
<td>The City and all water services authorities</td>
</tr>
<tr>
<td>WCVSS effluent re-use study</td>
<td>2007</td>
<td>Pre-feasibility</td>
<td>DWAF</td>
</tr>
</tbody>
</table>
monitor progress to decide whether to implement a full feasibility study.

- The City should proceed with its proposed pilot seawater desalination plant in order to learn lessons for the implementation of large-scale desalination.

- The City and other water service authorities should collaborate to develop integrated effluent re-use policies and also initiate feasibility studies to determine the full potential of effluent re-use.

- DWAF should initiate an integrated system effluent re-use study, which should include interventions such as the exchange of Berg River irrigation water.

- A further 12 interventions comprising groundwater schemes, interventions that would maximise existing infrastructure or WCWSS yield, and some other interventions for which there is uncertainty about yield and cost, should be studied at reconnaissance level as soon as possible, so that comparative evaluations can be made.

- A study should be undertaken by DWAF to assess the implications and costs of implementing the ecological reserve at existing schemes.

- The City should assess the capacity of the Voëlvlei pipeline, as this could impact on the viability of implementing either the Voëlvlei Phase 1 or the Michell's Pass diversion schemes. The cost implications of an additional pipeline from Voëlvlei to the City should also be assessed.

- DWAF should initiate a study to assess the potential impacts of climate change on the reconciliation of supply and requirements.

- The strategy committee must ensure that adequate monitoring is undertaken to provide reliable information for planning the reconciliation of supply and requirements over the longer term.

- The scenario planning process must be updated on a regular basis.
DURING AUGUST 2006 floods devastated the coastal town of Glentana, 35 km east of Mosselbay and 20 km south-west of George. At the end of July and the beginning of August 2006 continuous rain had saturated the catchment areas in the southern Cape. On 2 August 2006 the rainfall intensity increased resulting in an increase in peak flows equal to the 1:18 year storm events. The major storm water infrastructure was unable to cope with the increased flow and one section of the storm water infrastructure, which had to transfer the runoff upstream from the caravan park through the road fill, was insufficient and extensive damming occurred that inundated the caravan park. Failure of the structures occurred quickly due to the cohesionless material supporting the structures. MVD Consulting Engineers (South Cape) (Pty) Ltd were appointed to analyse and design the entire storm water system and it was apparent from the start that there were areas with complex three-dimensional flows. It was subsequently decided to evaluate the stormwater components by means of hydrological and hydraulic modelling and to construct physical models for the intricate sections. Sinotech CC was subcontracted by MVD to perform the physical modelling.

The Glentana storm water system consists of three contributing runoff areas which are diagrammatically illustrated in figure 1. A schematic layout is given in figure 2.

Two areas where there were excessive damage were just downstream of the main road on the Hoogekraal system (point A) (figure 3) and the area where all three runoff areas join at the restaurant (point B) (figure 4).

The two physical model studies that have been completed are referred to as the Hoogekraal energy dissipating structure model (point A) and the Seekat Road and Oudeweg culvert system model (point B), shown in figure 1.

PHYSICAL MODELLING

The stormwater upgrade and reinstatement and improvements of the available infrastructure entailed a number of structures where the flow direction will have to change and where excessive energy needs to be dissipated. The flow regime in the rivers tends to be supercritical which required special assessment of the system components.

Appropriate uniformities for model studies include the Froude number, Reynolds number and the Weber number. Experience \(^1\) \& \(^2\) has indicated that Froude uniformity can be used to investigate...
surface vortices, if the Weber number is in excess of 120 and the Radial Reynolds number is greater than $3 \times 10^4$. In the models the values of the Weber number and Radial Reynolds number are more than the suggested criteria and hence Froude uniformity was used in the models.

The objective of any model study is to ensure that the model accurately represents the behaviour of the prototype. This requires that amongst other similarities, the flow regime behaviour should be represented by the flow in the model. While varying the geometric parameters by the same scale factor, the hydraulic values have to be converted by the appropriate dimensionless parameters. The driving force in any free surface model is gravitation using Froude uniformity, which represents the ratio of inertial and gravitational forces.

**MODELLING OF THE HOOGEKRAAL ENERGY DISSIPATING STRUCTURE**

It is believed that piping was the reason why the storm water system failed at Hoogekraal. The system was flowing under pressurised flow conditions as shown in figure 5 and water was forced through the joints (figure 6) liquefying the supporting soil and created piping which eroded the surrounding material. The stormwater pipe segments were washed out from the downstream side.

A storm water system was designed for Hoogekraal. The new design incorporates an internal HDPE liner which will be installed in the reinstated two storm water pipes permitting pressurised flow with the 21.5 m high energy dissipating structure at the outlet to dissipate the energy and direct the water (figure 7). The design flow capacities for the Hoogekraal energy dissipating structure was determined as $Q_{50} = 16.9 \text{ m}^3/\text{s}$ and $Q_{100} = 22.9 \text{ m}^3/\text{s}$ from a hydrological analysis of the catchment area. Froude uniformity requires that the Froude numbers in prototype and model must be equal, hence:

$$\frac{V_{\text{Prototype}}}{\sqrt{gD_{\text{Prototype}}}} = \frac{V_{\text{Model}}}{\sqrt{gD_{\text{Model}}}}$$

A scale of 1:24.8 was selected for the modelling of the Hoogekraal energy dissipating structure. From the assumed Froude uniformity the other scale relationships could be determined. The 1:50 and 1:100 year model flow rates were determined as 5.53 ℓ/s and 7.49 ℓ/s respectively.

The observations that were made of the preliminary designed layout reflected the following:

- At low flows the water will drop onto the floor slab just upstream from the second wall, that is, missing the baffle wall and designed plunge pool (figure 8)
- At high flow rates most of the flow is streamlined along the right wall with the creation of a backflow on the left side of the structure
The model study highlighted the importance of providing sufficient aeration at the top of the structure especially during the high flow rates and to create resistance downstream for the deflection of flow across the downstream natural channel. This was accomplished by introducing the following alterations:

- The angle of the left wall relative to the structure was changed, and
- The end wall was raised

### MODELLING OF THE SEEKAT ROAD AND OUEDWEG CULVERT SYSTEM

The Seekat Road and Oudeweg culvert system is a large complex system. The Seekat Road and Oudeweg run-off areas join just upstream of Seekat Road from where the flow have to be transported in a 2.4 m x 2.4 m culvert underneath the road and parking area, turning just after the restaurant through ninety degrees (left) towards the sea channel (figures 2 and 10). At the sea energy dissipating structure the run-off from the Hoogekraal area flowing through a 2.4 m x 2.4 m culvert merges with the flow from the Seekat Road and Oudeweg run-off areas.

The flow path between Seekat Road and the position where the flow direction needs to be changed is steep, resulting in water flowing supercritical (Fr > 1). One option was to install two 2.4 m x 2.4 m culverts in parallel at lesser slopes between the confluence of the Seekat Road and Oudeweg run-off areas to the Restaurant where the direction of flow needs to be changed. The flow regime could be sub-critical and that the positional energy could have been dissipated through a vertical drop and energy dissipating structure at the end of the culvert section. This would have required excessive backfill as well as the additional culvert segments.

The alternative, which was adopted, was to utilize the current slope which will result in supercritical flow and require only a single 2.4 m x 2.4 m culvert. An energy dissipating structure was then designed at the Restaurant to create a hydraulic jump which facilitates the ninety degree directional change. The section downstream from the energy dissipater at the Restaurant to the energy dissipation structure at the end of the system (Sea outlet) will flow supercritical. At the Sea outlet energy dissipater, the culvert system combines the flow with that from the Hoogekraal system, and this energy dissipating structure was designed to accommodate this total flow and release it into the sea.

The scales were selected as 1/20 for an undistorted Froude uniformity model, adhering to the criteria that the influence of surface tension and laminar flow could be discarded.

Figure 11 reflects a general layout of the Seekat Road and Oudeweg culvert system.
while figures 12 and 13 provide a close-up view of the two components.

The model indicated high turbulence at the entrance to the downstream culvert, reducing the capacity to below the required 1:50 year flow rate and that the circulation in the structure could be reduced by the change in the width of the structure. The optimum width was obtained as well as improving the inlet conditions by the provision of a deflector beam.

Figure 14 reflects the final layout of the structure which proved that the 1:50 year flood could be accommodated in the system and that the energy sufficiently dissipated at the sea outlet structure to have minimal effect on the sea channel stability.

**SUMMARY**

Physical modelling of the Glentana stormwater system confirmed the value of modelling to optimised dimensional layout and provides confirmation of functional capacity to handle the flow rate. The modelling also provides valuable insight into the behaviour of the flow through the storm water network and highlighted the potential problem areas.

**References**


Useful water websites

Marco van Dijk set up the following list of links to some useful water-related websites

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Each of the sites listed also have its own list of relevant links.
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CIVIL ENGINEERS • TOWN PLANNERS • SURVEYORS • CONTRACTORS • ENVIRONMENTAL CONSULTANTS
Bloem Water proactively saving water on the Caledon–Bloemfontein pipeline

BLOEM WATER – A WATER board established in terms of the Water Services Act is responsible for water supply to various towns in the southern Free State.

A pre-stressed concrete pipeline (PCP) forms the main supply vessel of potable water to Bloemfontein, Edenburg, Reddersburg, Dewetsdorp and Wepener and supplements water supply to Thaba ‘Nchu, Botsabela and Excelsior. Bloem Water resolved to proactively minimise and quantify the risks involved ensuring a continuous and sustainable water supply service.

The first phase of the investigation involved appointing a contractor for undertaking precise pipeline leak detection and location inspection services on the ageing pipeline infrastructure.

Because of the strategic importance of the pipeline, Bloem Water required that the pipeline be accurately inspected under operating conditions without shutting it down. In addition, they wanted the exact location of each leak and the approximate leak size in order to prioritise repairs.

PIPELINE DESCRIPTION

The 110 km long 1 170 mm ID pipeline will be inspected in three phases. Phase I involved scanning a 35 km long section of the pipeline terminating at the Brandkop Reservoir in Pellissier, Bloemfontein. This pipeline had surpassed its design life and needed investigation.

SSIS Sahara (Pty) Ltd was appointed in September 2006 to undertake the pipeline leak detection and location inspections utilising the revolutionary in-line and real-time Sahara® inspection technology. The inspections commenced on 11 December 2006.

INSPECTION PROCEDURE

Since Sahara is an in-line inspection technology, access into the pipeline was easily obtained at existing air valves which are frequently spaced along the pipeline. The under-pressure insertion was achieved by removing the air valve and fitting a specially fabricated flange and an insertion tube on top of the gate valve. The Sahara sensor head, inspection cable and parachute were then deployed under-pressure through the insertion tube into the pipeline while the pipeline remained in service. The flow of water opens the parachute and pulls the sensor and cable behind it.

The speed and direction of the sensor were controlled by a hydraulically operated cable drum and winch fitted inside the inspection vehicle allowing the operator to scan backwards and forwards in order to pin-point any leak. At each insertion point, both the pressure and the flow rate in the pipeline were measured. The flow rate was measured with an insertion-style flow metre allowing the Sahara operator to select the required parachute size as a function of pipe diameter, flow velocity and survey distance. Daily measured pipeline pressures and flow rates are useful information for any pipeline operator.

INSPECTION RESULTS

A total of five medium to large leaks (1 000+ litres/hour) were located on the pipeline. Four of the leaks appear to be at previous pipe repairs, while one leak was detected inside a valve chamber. Of interest was that only two of the leaks showed up on the ground surface as standing water, including the leak inside the chamber. Previous attempts to locate the one visible leak had been unsuccessful as a result of the high water table, making the excavations very difficult. The actual leak was located about 30 m away from the excavated trial holes with the whole area being under water.

The remaining three leaks showed no visible signs of a leak such as wet soil conditions and standing water, nor were they audible from the surface. It is therefore understandable that these leaks have been missed.

Owing to the sensitivity of the inspection equipment, some of the leaks were easily detected 200 m to 500 m away from...
the actual leak already. In addition, the equipment allowed the Sahara operator to accurately detect and locate even air pockets and their movement in the pipeline.

**SAHARA® INSPECTION TECHNOLOGY**

Sahara® is a proven system that has been used worldwide to accurately pinpoint the location and estimate the magnitude of leaks in water pipelines of any material type. Because leaks in pipelines are directly associated with the structural integrity of the pipe wall, the joints or steel welds, Sahara® is an ideal non-destructive, real-time pipeline condition assessment tool. It is deployed while the pipeline is in service allowing for uninterrupted water service delivery to customers while the condition of the pipeline is accurately assessed. It is capable of detecting leaks as small as 1 litre per hour allowing for ‘leak-free’ certifications.

Based on the success of the recent inspections, Bloem Water is now able to reduce unaccounted for water, selectively rehabilitate individual sections of pipe, and avoid the unnecessary cost of excavating good sections of pipe. Lastly, Bloem Water now has actual proof that the remaining portion of the scanned pipe is ‘leak free’.
MONDI BUSINESS PAPER’S Richards Bay mill required a secondary treatment process facility to be able to treat effluent for the purposes of re-use or for discharging back into the natural environment, improving the environmental performance for the mill in line with European Union (EU) ‘paper profile’ parameters. These parameters comply with the best available technology in the pulp and paper industry and compliance is essential for paper products marketed in the EU.

This project was unique by virtue of the size and capacity of the tank required to meet the client’s needs. It was undertaken by a design construct consortium comprising Grinaker-LTA Civil Engineering (GLTA) and a construction team made up of the following:

- Aquatan (Pty) Ltd – design and installation of the membrane liner to the floor and wall/floor joint
- PDNA – structural engineers on the main tank, measuring well and cooling tower supporting structure
- Semane – structural engineers on the surrounding infrastructure and technical building
- ARQ – geotechnical investigation and design of the secondary tank founding structure

NEW SECONDARY EFFLUENT TREATMENT TANK

The 123.3 m diameter outer tank and 72 m diameter inner tank with support infrastructure directing flow in and out of the secondary treatment tank were designed and constructed in only 12 months. Construction started on 1 September 2004 with completion on 15 September 2005. This is one of the largest plants in the world for the treatment of pulp and paper wastewater.

Secondary effluent treatment tank details

As stated above, the effluent tank consists of two concrete circular tanks, the outer tank wall of 123.3 m diameter and 10.5 m high (the aeration basin) and the inner tank wall of 72 m diameter and 6.5 m high (the clarifier) with a central integral concrete core of 12 m diameter.

Requirement for a geomembrane liner

A conventional concrete floor would not have been feasible because of the following constraints:

- The walls and internal core were supported on a pile and pile cap arrangement where various vertical settlements were expected (outer wall 8 mm, inner wall 22 mm and central core 16 mm)
- The floors of the tanks were expected to have substantial differential settlements of 20 mm to the outer aeration tank and 26 mm to the inner clarifier tank
- The walls were designed for various movements both inwards and outwards due to wall cable tensioning (elastic shortening), creep, shrinkage and temperature change. The net result was that the outer wall could move a total distance of 120 mm horizontally and the inner wall a total distance of 80 mm horizontally! These movements could not be ignored in a water-retaining structure and bearing in mind that these movements would occur at various phases both during the construction stage and the service life of the effluent tank
- In the aeration basin (the outer tank) there was a requirement for five division walls, which spanned between the two circular walls. These walls were stationary and therefore had to accommodate and not impede the circular wall designed movements

Challenges to find a suitable geomembrane liner

Considering the above complications, it was evident that the customary dam lining materials would not be suitable. It was decided to use Hyperliner, an ethylene vinyl acetate material, as a geomembrane liner. This material accommodates differential and multiaxial movements and has an extensive elongation characteristic prior to yield and break stresses. As a result of construction activities over the installed liner,
A 2.0 mm thickness was proposed. Owing to the concrete overlay (described later), the lack of UV resistance of this material was not an inhibiting factor.

An additional advantage with EVA is that it is possible to manufacture an extruded water bar out of exactly the same formulated material. (This advantage will be described below.)

**Basic design**

The floor substrate generally consisted of a substantially thick compacted sand backfill layer (±4 m) between the walls. This was followed by an 80 mm no fines layer and leakage detection system with a 20 mm thick mortar topping to provide a smooth surface for the 2.0 mm Hyperliner membrane. An 80 mm thick reinforced concrete slab was then cast on top of the Hyperliner as a protective layer to prevent future operational damage from pedestrian traffic or mechanical scraper arms, etc. A specially manufactured continuous...
Hyperliner rearguard water bar strip with four protrusions was supplied to and cast into the walls by Grinaker-LTA approximately 600 mm above the floor level.

**Detailed design and solution**

**Water bar**

The entire waterproofing of the lining system relied on the homogenous casting in of the water bar into the walls. Special attention was provided to ensure continuity around the protruding pre-stressing buttresses. This necessitated meticulous on site hot knife jointing methods.

As an added precaution an innovatively designed seal was extruded between the top of the water bar and the concrete and then a gum tape bandage was adhered between the top of the water bar and the concrete wall.

The floor membrane was then later extrusion welded to the horizontal water bar. This extruded weld was quality checked using the spark testing method.

**Differential vertical settlement between wall and floor**

In order to prevent any shearing of the liner at the wall/floor joint, a system of 180 mm thick circumferential jockey slabs (1.5 m wide x 3.0 m long) were cast onto the circumferential ring beam which supported the wall bearings. When floor settlement occurred, the jockey slabs merely tilted, thereby eliminating the vertical shearing action on the liner.

The joints between each jockey slab had an aluminium strip nailed one side, which accommodated any differential movement (both horizontal and vertical) between adjacent slabs.

**Horizontal wall movements**

It is felt that this particular detailed design ensured the complete integrity and success of the water proofing system and hence the entire project! In order to accommodate the substantial and varying wall movements, a 300 x 325 mm triangular corner fillet was cast at the wall/floor joint on top of the jockey slabs. This fillet was tied to the wall with hoop iron ties and a sliding joint was provided on top of the jockey slab with the incorporation of two HDPE sheets. This ensured that when wall movement occurred, the entire fillet moved with the wall by sliding on top of the jockey slab.

Special consideration had to be taken of what movements occurred first to ensure that the liner was not stressed (or ‘stretched’) at any stage. In addition, one had to consider that the inward movement did not ‘pinch’ or ‘squeeze’ the liner against the 80 mm concrete slab overlay. A gap was therefore left between the slab overlay and the concrete fillet. These gap widths varied according to the predicted movements. The slab overlay bottom edge was also chamfered to accommodate the folding of the liner at this point.

**Stationary internal division walls and columns**

As there was no horizontal movement to these internal walls and columns, it was not necessary to make any provision for a movement joint.

Where these walls joined the circular moving walls, they were supported vertically with a corbel on each side and a sufficient gap was left between the dividing wall and the circular walls to ensure free movement.

To accommodate the liner and the above differential movements at the floor area, a 1,0 m x 1,0 m box out was provided in the wall and the water bar and liner were simply taken through this box out. This ensured that there was no threedimensional stresses placed on the liner.

**Central core**

At the central core, in the clarifier, a system of jockey slabs was once again used to accommodate the vertical settlement. A 150 mm wide bridging strip of 2 000 µ HDPE was placed over the jockey slab/central core joint to prevent the liner being compressed into the joint when hydraulically loaded.

The liner was mechanically fixed to the central core using a radiusled 50 x 50 x 5 mm stainless steel angle, gasketting and bolts.

**Pipe support columns**

In order to eliminate any possible leakage at these structures, it was decided to line the entire columns. This operation incorporated some intricate welding work around some of the interconnecting column tie beams and the subsequent prevention of air entrapment had to be considered.
Site installation and quality control
Casting of 80 mm concrete overlay on top of liner
Stringent conditions and controls were in place to minimise pedestrian traffic over the exposed liner. Full cooperation of the Grinaker-LTA and Aquatan site teams was required with regard to the planning and programming of the geomembrane laying and the concrete casting operations. One welding operator was in full attendance during all concreting operations, both day and night, to inspect and repair any accidental damage to the liner.

Water bar installation and sealing
As steel shutters were used for the walls, Grinaker-LTA had to design a special fixing system to hold the water bar in place and to form a recess for the sealant at the top of the water bar. The system worked well and the sealant and gum tape bandage ensured an additional positive waterproofing system (see figure 5 above).

Quality assurance and control
Owing to the vulnerability of the membrane on an active construction site, a stringent system of checking and rechecking was carried out. The subsurface was carefully checked by both parties, signed off and all welds were checked using air pressure testing, spark testing and vacuum testing. The use of a clear Hyperliner welding rod had the added advantage in that a visual check for off centre welding could be carried out. Specially fabricated rubber tipped shovels were used for the concreting operations to prevent any mechanical damage to the geomembrane liner.

CONCLUSION
Considering all of the above implications and difficulties and fast-track programme, and that no leakage occurred, the client may consider the geomembrane lining a complete success. This was a truly phenomenal project, demanding the highest level of design ingenuity and careful supervision while continuously challenging conventional geomembrane installation and construction methods.
A SEVERE DROUGHT RESULTED in the failing of boreholes in the Venda and Gazankulu region in the early 1990s. This led to the Department of Water Affairs and Forestry (DWAF) commencing investigations into the feasibility of providing a safe and reliable water supply to the region.

OBJECTIVES
DWAF investigated the water demands in the west of the Limpopo Province from the Louis Trichardt/Makhado area to Punda Maria on the border of the Kruger National Park. The study concluded that a secure source of supply had to be established to ensure the sustainability of the region’s rural supply.

The decision to construct the Nandoni Dam near Thohyandou on the Luvuvhu River signalled the commencement of the regional water scheme. The Luvuvhu River is a tributary of the Limpopo River and has its origin on the slopes of the Zoutpansberg near Louis Trichardt. It meanders through the northern parts of Limpopo Province and eventually enters the Kruger Park.

The Nandoni Dam is also the site of the new water treatment plant.

PROJECT DESCRIPTION
P D Naidoo and Associates were appointed to design and lead the construction of a 60 Mt/d water treatment plant at the Nandoni Dam site.

The ultimate treatment process incorporated into the design of the plant allows for a three stage phase separation sequence which includes sedimentation, dissolved air flotation (DAF) and sand filtration.

Since the Nandoni Dam is currently still under construction, the eventual character of the raw water in the impoundment is an unknown at this stage. This unknown has been accommodated in the development of the plant by constructing the sedimentation and filtration units only at this stage, while provision has been made for the future insertion of DAF into the process train for removal of algae. Should the condition of the Albasini Dam be taken as a reference, it is likely that the Nandoni Dam might also become eutrophic and that DAF should then be implemented. The current design allows this to be done easily and cost-effectively.

Owing to the relative position and height of the intake structure, raw water will flow under gravity to the head of works until low water levels are reached in the dam. When this happens, the bypass of the raw water pump station will be closed and axial type pumps will provide water to the inlet works. Provision has been made for taste and odour control through the dosing of powdered activated carbon at the raw water pumping station when required. Treated water is finally distributed to the various supply areas through a number of dedicated high lift pumping stations.

CHALLENGES
The site on which the treatment plant is constructed was purchased by DWAF after lengthy discussions with tribal leaders as the site, situated in the former Venda, was in tribal ownership. This resulted in a delay of the commencement of construction of the civil works. The environmental impact assessment (EIA) led to location and relocation of historical grave sites receiving particular attention in the initial phases of the project.

As a result of the remoteness of the plant, declining rate filtration was selected as the filtration mode for the Nandoni water treatment plant in order to eliminate requirements for extensive control operations of the sand filters. This also impacts positively on the future maintenance requirements of the plant. This application makes Nandoni the second largest declining rate filtration unit in South Africa and the third plant in this country using this technology (after Faure and Cullinan water treatment plants). The Cullinan water treatment plant was also designed and constructed by P D Naidoo and Associates. The design principles behind declining rate filtration allow the cleanest filter (that is, the one with the lowest head loss) to receive the largest portion of flow while the load on the ‘dirty’ filter is reduced. The filters that therefore can afford to work the hardest of all.

The Nandoni water treatment plant will deliver treated water into a large distribution network. An analysis of the anticipated free chlorine levels within the distribution network has indicated that chlorine will be depleted to levels below that recommended by SANS 214 by the time it reaches consumers. Provision of on-site ammoniation...
of the treated water in order to promote the formation of more stable mono-chloramines as secondary disinfectant has therefore been proposed to DWAF.

As DWAF has financed the project through rather limited annual budgets, it was impossible to complete the project within the time frames expected of a project of this scope. The anticipated project duration from inception to commissioning is anticipated to be six years.

**PROJECT STATUS**
The construction of the 60 Mℓ/day water treatment plant has reached practical completion on the civil works, while the mechanical and electrical procurement of equipment is within an advanced stage. Completion is scheduled for the end of 2007.

**CONCLUSION**
The establishment of the Nandoni water treatment plant has only become a reality because to the foresight and tenacity of DWAF, which has driven this project despite its limited budget. The department has been assisted by a capable project team in P D Naidoo & Associates. The end result is that the Vembe Local District Municipality can look forward to a sustainable potable water supply in the near future.

**PROJECT TEAM**
- **Client**: Department of Water Affairs and Forestry
- **Civil and Mechanical Engineers**: P D Naidoo & Associates
- **Electrical Engineers**: Burotech Consulting Engineers
- **Civil Contractors**: DWAF Construction
- **Mechanical Contractors**: Metsi Projects
- **Project Managers**: P D Naidoo & Associates
SOUTH AFRICA COULD BE facing a water supply disaster within the next few years. The signs are already there. Civil engineers and hydrologists are going to have to make some radical changes in their approaches to water resource development and operation procedures. Computer algorithms will have to be changed and reports rewritten. This has nothing whatsoever to do with global warming.

The basic assumptions in the analyses of annual rainfall, river flow and flood peak maxima are that the annual data are (1) independent, (2) identically distributed, and that (3) the series are stationary in time. All three assumptions are wrong. The annual values are sequentially independent but not serially independent. The sequential values are not identically distributed, as both their mean values and their distribution about the mean values change from year to year in 21-year sequences. The series are not stationary in time because of the presence of statistically significant 21-year serial correlation. All of these properties are related to a synchronous linkage with solar activity. This linkage was observed and reported in South Africa by D.E. Hutchins more than 100 years ago, but nobody listened.

**OUR STUDIES**

We believe that we have made a scientific breakthrough in climate change science and water resource applications. If our conclusions are accepted (a big IF at this stage), it will resolve the greatest scientific issue of our time – whether or not current global warming is the consequence of human activities. These activities are principally undesirable greenhouse gas emissions from coal-fired power stations, heavy industries such as cement manufacture, road and air transport. The issue has become highly politicised internationally. Measures to counter these emissions are being propagated that will cost the world trillions of US dollars. If implemented, they will cause a serious setback to the economies of the developing nations, particularly those of Africa.

Our paper ‘Linkages between solar activity, climate predictability and water resource development’ has been accepted for publication in the SAICE Journal [which is being mailed with this issue – Ed]. I will now take you behind the scenes during the development and integration of the results of our studies.

For four years I had difficulty in getting my papers published. They had one thing in common. The word ‘climate’ was in the title.

Fred Bailey, a retired naval architect in the UK, and I met via the Internet. He experienced similar difficulty in getting his material on the solar linkages published.
We exchanged views. Then a colleague in New Zealand put me in touch with Peter Mason in the UK, who had written articles on the linkage between the water levels in Lake Victoria and solar activity. He was involved with the design of the Van der Kloof Dam at the same time that I was RE on the construction of the Orange Fish Tunnel.

Soon afterwards Nico Willemse in Ireland made contact with his analyses of the long rainfall records in Ireland and the UK. Back in South Africa David Bredenkamp, a hydrogeologist colleague of many years, had also undertaken studies on South African lake levels and groundwater movement where he found similar anomalous groupings. Alwyn van der Merwe put the cap on our studies with his excellent illustrations of the verification of my climate prediction model.

THE ENERGY BALANCE

While all those involved in water resources development are familiar with the hydrological cycle, we should devote more time to the corresponding energy cycle. The sudden changes from series of drought years to years of high rainfall and floods have been known and studied by mathematicians and hydrologists for more than 50 years. These were called the Noah and Joseph effects, but the causes remained elusive. It is the redistribution of solar energy that drives the world’s climate and the hydrometeorological processes, not global temperature.

OUR OTHER CONCLUSIONS

In another study Peter Mason carried out a number of analyses of the linkage between the water levels of Lake Victoria on the equator and sunspot activity. He reported an anomalous sudden increase in the water levels that occurred during the period 1962 to 1964. David Bredenkamp suggested that this was most likely due to tectonic activity, as he had similar experiences with the Uitenhage Springs. Nico Willemse undertook extensive studies of the linkage between sunspot activity and rainfall in Ireland.

Our studies demonstrate an unambiguous linkage with solar activity in South Africa, Lake Victoria on the equator, and in Ireland. There can be no doubt that this synchronous linkage between many hydrometeorological processes and solar activity is a global phenomenon. The evidence is solid.

TIME SERIES ANALYSES

This brings us back to the introduction to this article. The graph of the prediction model for Gariep Dam (figure 1) is one of several similar graphs produced by Alwyn van der Merwe to test the validity of my published climate prediction model. The box and whisker plots are the prediction model for the annual flows in South African rivers. The circles are the actual flows into Gariep Dam.

The first and most important point to note is the very wide year-to-year variability in the box plots. This completely negates the statistical assumption that the flows in the successive years are identically distributed, that is, where all boxes have the same size and same positions relative to the mean value. Nor is there any visual evidence that the data are serially correlated. The 21-year periodicity only becomes apparent when the cumulative departures from the mean are plotted as Rippl recommended 125 years ago!

Notice also that during the past 11 years, while climate change scientists claimed that global temperatures rose to unprecedented heights, half the observed
Their views are fundamentally wrong for a number of reasons. First, they completely ignore the huge volume of hydrometeorological data that demonstrates the opposite. The first recorded observations of the synchronous linkage between these processes and solar activity date back to the early 1800s in India, and the 1880s in South Africa. There is a wealth of published literature on this subject. The second reason is their insistence that the changes in the receipt of energy from the sun are too weak to influence global climate.

WHERE THE CLIMATE CHANGE SCIENTISTS GOT IT WRONG
It is not the purpose of this article to denigrate the activities of climate change scientists, who maintain that activity in the solar system does not play a meaningful role in global warming and consequent undesirable climate change. Their views are fundamentally wrong for a number of reasons. First, they completely ignore the huge volume of hydrometeorological data that demonstrates the opposite. The first recorded observations of the synchronous linkage between these processes and solar activity date back to the early 1800s in India, and the 1880s in South Africa. There is a wealth of published literature on this subject.

The second reason is their insistence that the changes in the receipt of energy from the sun are too weak to influence global climate. Again, our studies demonstrate the opposite. These scientists clearly failed to appreciate the inherent build up of energy until the system becomes unstable, resulting in regular oscillating behaviour. Their computer-based predictions will remain seriously in error and of little practical importance until the undeniable synchronous linkage with solar activity and its consequences are incorporated in their models.

The third reason is the totally unprofessional attempts to silence all those who hold the view that human activities are not the principal cause of historical, present and future undesirable climate change.

CONCLUSIONS
We, the authors, come from different scientific disciplines, using different data sets from different parts of the globe and applied different methodologies. We all came to one conclusion. The synchronous linkage between solar activity and many global hydrometeorological responses is unassailable. Our work on the corresponding synchronous behaviour with solar activity is new to science. It may well be challenged from several quarters. We will do our best to answer any questions or comments whether supporting or critical. We have no wish to follow the example of those who are doing their best to suppress any views that deny human causality of current and future climate change. Our thorough analyses indicate the opposite. Should there remain any serious differences, then we strongly recommend that the South African authorities appoint a multidisciplinary, multi-institutional commission of enquiry without delay. Time is running out.
THE NATIONAL WATER ACT 36 of 1998 (the National Water Act) introduced a paradigm shift in the regulation of water and water use in South Africa. Before the introduction of this Act, water rights in South Africa were governed according to the common law and the 1956 Water Act. This previous legislation recognised that water could be the subject of private ownership. Since the ownership of the water was inextricably linked to the ownership of land, this skewed the right to water in favour of landowners. The National Water Act aims to address this and has done away with the old concepts of riparian water rights and linking the right to use water to land ownership. Instead the National Water Act gives the state trusteeship of all water in South Africa (the state hold and governs all water on behalf of the people of South Africa) regardless of where in the hydrological cycle the water is found.

The state is therefore burdened with the statutory duty to ensure that all freshwater resources in South Africa are optimally used and in addition that the integrity of the water resource itself is adequately protected. Persons wishing to use water resources which impact on the environment will therefore be requested by the state to provide information to the state which will allow the relevant authorities to make an informed decision regarding the impact of the development. This is particularly so with the construction of dams as the impact on a water resource is usually severe. It is evident that the consideration of these impacts is a very fine balancing act. The authorities do not want to deter investment by overly favouring the environment but also have a duty to protect the environment as per section 24 of the constitution and other legislation such as the National Environmental Management Act (NEMA). In addition, the use of any water resource will necessarily mean a diminishment of the resource and if not managed appropriately could potentially lead to the overuse of the resource and even to its destruction. The framers of the National Water Act were well aware of this fact and while the entire National Water Act is dedicated to the optimal use of water, chapters 2 and 3 in particular deal with resource protection. Chapter 2 deals specifically with the establishment by government of a national water resource strategy and the formation of catchment management agencies. Chapter 3 contains provisions regarding the classification of water resources which includes water resource quality objectives.

Part 3 of chapter 3 is particularly interesting in this regard, as it places a duty on the state to determine the reserve for each water resource. When determining the reserve, the authorities are bound to consider another classification in terms of the National Water Act being that under section 13 – the determination of the class of water resources and resource quality objectives. In terms of section 13 and when prescribing a system for classifying water resources and resource quality objectives, the objectives may relate to reserve, the in-stream flow, the water level, the presence and concentration of particular substances in the water, the characteristics and quality of the water resource, the in-stream and riparian habitat, the characteristics and distribution of an aquatic biota, the regulation or prohibition of in-stream or land-based activities which may affect the quantity of water in or quality of the water resource, and any other characteristic. In further determining the reserve of a water resource, the authority must invite written comments to be submitted on the reserve. Before the reserve is submitted, a preliminary determination of the reserve may be made which may later be superseded by a new one.

Section 23 of the National Water Act further states that subject to the national water resource strategy the Minister of Water Affairs and Forestry may determine the quantity of water in respect of which the responsible authority may issue a general authorisation and a license from water resources in its water management area. Until a national water resource strategy has been established, the Minister may make a preliminary determination of the quantity of water in respect of which a responsible authority may issue a general authorisation and license.

All of this is exceptionally relevant to the construction of a dam as there are very few other activities which could potentially impact on the natural flow of a river to such an extent. In addition, in South Africa, because certain parts of South Africa are located on the drainage basins of very large water systems (for example the Limpopo River, the Orange River, and particularly the rivers originating in the Mpumalanga and Limpopo provinces and draining east towards Mozambique) the decisions made in South Africa regarding dam construction and water use have serious impacts for water users, other countries downstream, and the river system itself. Chapter 10 of the National Water Act addresses the issue of international water management. Specifically, section 102 of the National Water Act provides that the Minister may establish bodies to implement any inter-

**Persons wishing to use water resources which impact on the environment will therefore be requested by the state to provide information to the state which will allow the relevant authorities to make an informed decision regarding the impact of the development.**
The difficulty with enforcing the provisions of international conventions is that in order for an individual nation state such as South Africa to enforce the provisions on its citizens or other persons within its jurisdiction, it must develop domestic laws which give effect to the principles of the international treaty.

National agreement entered into by South Africa and a foreign government relating to investigating and managing water resources, regional cooperation on water resources, acquiring constructing, altering, operating or maintaining a waterworks or the allocation, use and supply of water. In terms of section 108 of the National Water Act certain bodies which were in existence when the Act came into effect were deemed to be bodies in terms of the National Water Act until disbanded by the Minister. The bodies which are referred to in the Act are the Trans-Caledon Tunnel Authority, the Komati Basin Water Authority (established by agreement with the Kingdom of Swaziland in 1992) and the Voelvlei Drakensdrift Noordoewer Joint Irrigation Authority (established by agreement with the government of Namibia in 1992). It is therefore evident that the National Water Act provides adequately for the management of water resources, the impact of their use on biophysical and social aspects as well as the effect on international downstream users.

The above national legislation supports decision making that promotes the sustainable utilisation of South Africa’s water resources. South Africa is also party to several regional and international initiatives. It is a signatory to the Ramsar Convention on Wetlands of International Importance. Regionally, the Southern African Development Community has developed the SADC Protocol on Shared Watercourse Systems. The Ramsar Convention was originally conceived in Ramsar, Iran in 1971. Although the Ramsar Convention does not deal directly with rivers and dams, it deals with the impact of the extraction of water from wetlands of international importance and particularly the effect that the over exploitation of these resources may have on waterfowl habitat. However, as a result of the seamless nature of hydrological systems, development of dams often have a significant impact on wetlands. Therefore wetlands that are designated as those protected in terms of the Ramsar Convention are afforded additional protection in terms of the law. The difficulty with enforcing the provisions of international conventions is that in order for an individual nation state such as South Africa to enforce the provisions on its citizens or other persons within its jurisdiction, it must develop domestic laws which give effect to the principles of the international treaty. In South Africa several sites have been declared Ramsar sites, including the National Drakensberg Park, the Induma Game Reserve, the Seekoeivlei, the Nylsvlei Nature Reserve and the Velorenu valley.

The SADC Protocol on Shared Water Courses was born out of the codification of international water law initiated by the Helsinki rules and the United Nations Convention on the Law of Non Navigational Uses of International Water Courses. The protocol also took cognisance of Agenda 21 of the United Nations Conference on Environmental Development based on the concepts of environmentally sound management, sustainable development and equitable utilisation of shared water courses in the SADC region. The protocol therefore makes provision for the integrated management of shared water courses between the countries. It was signed by fourteen of the SADC heads of state and includes countries as far north as Tanzania and the Democratic Republic of Congo.

At a regional level there are other institutions which must be consulted when impacting on a water resource. According to the National Water Act, regional bodies may be formed such as catchment management agencies and water management institutions. Depending on which catchment it is planned that the dam will be constructed, it will determine which institutions must be consulted. In addition, an initiative has been commenced by the Department of Water Affairs and Forestry (DWAF) to determine the ecological classification of the river systems of South Africa. DWAF, in conjunction with the CSIR, has implemented the River Health Programme which monitors the health and ecological integrity of the various river systems. It would seem that these reports would then be used by DWAF to create the river system objectives and reserves referred to above and required by the National Water Act in order to ensure the optimal use of the water resource. Although water found occurring naturally in water resources is a national competency, the extraction, reticulation and provision of such water often involves local municipalities. Finally, when conducting any and all of the above consultations and initiatives regarding the permitting of a new dam, the general principles of environmental impact assessment as contained in section 2 of NEMA must be adhered to. Section 2 of NEMA follows the international best practice of regulating environmental developments according to the principles of sustainable development. Other principles of environmental development that must be adhered to are the principles of intergenerational equity and equitable access to all resources. Intergenerational equity is often the cornerstone of many environmental and sustainable development issues as it requires that when considering whether a development should proceed, the needs of future generations should not be prejudiced by over exploitation of current resources.

Finally, when applying for the above-mentioned permissions to proceed with dam construction, in all of the various studies and interactions the developer will necessarily need to include the participation of interested and affected parties. Interested and affected parties are by definition a very wide and diverse group and can include any person that has an interest in the proposed development. Although it does not necessarily mean that any person may stop a development, what it does mean is that any person has the right to participate in the process and to make their views known. To the extent that a party has a valid environmental concern that cannot be addressed by the project developer, then problems may arise.

As is evident from the above, the regulatory framework surrounding the use of a water resource and in this example the construction of a new dam is by no means a simple one. Furthermore, what is stated above is by no means exhaustive. For example if a party is intending to borrow funds for the financing of the development then further environmental standards will become relevant such as the equity principles. The equity principles provide specific guidelines for project finances which are borrowing money from financial institutions which subscribe to the equity principles and specifically where dam construction is involved a specific set of guidelines is available.

It is clear that the permitting process of a new large dam is a complicated one which will involve consulting with many different role players. The process, however, is not intended to be adversarial and quite the contrary, is designed to ensure that a solution is reached that is mutually beneficial and acceptable to all role players. However, since water is a scarce resource in South Africa, its scarcity means that it is not always easy or possible to please all parties that are involved. As Mark Twain once said: ‘Whiskey is for drinking water is for fighting over’. 

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MAKING A DIFFERENCE

TO PROMOTE INTEREST IN the civil engineering profession and unearth latent talent among school learners, SAICE holds countrywide annual bridge building competitions. The winners from the various regions go through to compete nationally. In spite of the past success of the competition, it was felt that a pool of potential engineering talent was being overlooked and the involvement of schools in previously disadvantaged areas could be further improved.

The Pretoria branch of the SAICE, in conjunction with the University of Pretoria, focused on the challenge by organising a training competition among students from schools in Mamelodi, Soshanguve and Atteridgeville, to familiarise them with the basic engineering principles and give them the confidence to compete. Africon, as the sole sponsor of this event, has covered the costs of materials, refreshments and any necessary travelling. Winning teams received cash prizes and the top teams were invited to participate in the main northern Gauteng regional competition.

The competition challenged each team, consisting of three students, to design and build a bridge over a defined gap using standard wooden sticks and glue. The basic requirements of the structure and the procedures to be followed were rigorously specified. The final structure was judged on its load bearing ability, the aesthetics of the design and the craftsmanship that has gone into building it.

Chris Fourie, a third-year civil engineering student at Tuks and one of the organisers of the training competition, commented that disadvantaged learners were introduced to something they had never experienced before. ‘It really “grabbed” them and revealed talents they never knew they had. With more nurturing, some of them could make great engineers.’

SAICE’s Edward Archer confirmed that Africon’s support helped introduce twenty-three disadvantaged schools in the Tshwane region to engineering and levelled the playing field for them to compete in the competition.

Africon’s director of business development, Fani Xaba, visited some of the schools during the competition. ‘It was wonderful to experience the atmosphere, the excitement, the tension, the laughter and the cheering as the final structure was put in place. The competition is about inspiring a love for a subject and building a bridge to a new world of engineering!’
MAJOR INTERNATIONAL CONFERENCE ON WATER DISTRIBUTION SYSTEMS

SAFE, ADEQUATE AND ACCESSIBLE water supply is an uppermost priority in the developing world and as such, water distribution forms a primary element in achieving the United Nations Millennium Development Goals. According to the United States Environmental Protection Agency, there is an urgent need for research that enables cost-effective design, construction and management of distribution systems while protecting the public health and minimising water quality degradation.

In view of these and other urgent questions, the WDSA (Water Distribution System Analysis) series of specialised conferences were initiated in 1999 and have since played a huge role by providing a forum for engineers, scientists and other professionals to communicate and debate the latest advances in research on the design, operation and security of water distribution systems.

So far there have been eight international WDSA conferences. The ninth took place in Tampa, Florida, in May 2007. The most recent WDSA conference at the time of writing (Cincinnati, August 2006) included over 150 oral presentations, poster displays, panel sessions, vendor exhibits, technical tours and hosted delegates and speakers from around the world. At the 2006 WDSA conference in Cincinnati, the WDSA Committee requested Professor Kobus van Zyl of the University of Johannesburg to organise the 2008 WDSA conference in South Africa. The 2008 WDSA Conference will be the tenth in the WDSA series and the first to be hosted outside the USA. WDSA2008 will take place from 17 to 20 August 2008 in the Kruger National Park.

The main objectives of WDSA2008 are to provide a forum for water distribution professionals to interact and share knowledge, stimulate scientific collaboration, encourage and foster debate on new ways to supply and manage drinking water systems, and bring together researchers and practitioners from developing and developed countries. Specific themes for WDSA2008 include all aspects of water distribution system modelling and application, including system reliability and security, water demand, water quality, leakage management and water supply in developing countries.

It is anticipated that WDSA2008 will have at least 200 attendees from all over the world, including delegates from academic institutions, municipalities, bulk water suppliers and engineering firms. Presentations will be delivered in a number of parallel tracks to accommodate the expected number of papers within the constraints of time and location.

A compact disc containing the WDSA2008 conference papers will be provided to all participants at the conference and made available to the public. In addition, the electronic conference proceedings will be permanently archived at the ASCE (America Society of Civil Engineers) online research library for secured future availability.

WATER AND HEALTH GROUP AT THE UNIVERSITY OF JOHANNESBURG

THE UNIVERSITY OF JOHANNESBURG is host to a new comprehensive research entity called the Water and Health Group. The group grew out of a number of well-established research clusters in the former Rand Afrikaans University (RAU) and the Technikon Witwatersrand (the merger partners who formed the University of Johannesburg in January 2005). From RAU came the RAU Water Research Group, well known for its research into the engineering problems of water treatment and supply. The Water and Health Research Unit at the Technikon Witwatersrand built its reputation around the management of health-related water quality – in particular that encountered in poor and rural households. Additional to these skills, the expertise of a nanomaterials group (concentrating on the adsorptive capacities of nanomaterials in water applications) and of sanitation professionals was drawn into the new grouping. This cluster is in line with the growing international awareness of the very complex linkages between water and health.

Since 2000, the Water and Health Group has produced more than 40 peer-reviewed journal papers, 15 books and research reports and more than 60 national and international conference papers, and has been presented with numerous awards.

VELA UK’S CAPE TOWN office was recently involved in the construction of a pedestrian bridge across the National Route 2 in the vicinity of Piesang Valley Road, Plettenberg Bay.

The given design brief from SANRAL was to create a safe, functional structure with a location and geometry that follows the preferred routes of pedestrians. The area is well known for its natural beauty, so the structure was required to add aesthetic, as well as functional, value to the local community.

In the conceptual design stage, various structural forms were researched. A beam and slab option was discounted owing to the relatively deep beam required and the associated clearance issues. The option of a suspension or cable bridge was constrained by the land available and concerns over its economy for shorter spans. In the end a truss bridge was judged to best meet the opportunities presented by the site. However, it was considered that an alternative form of truss bridge was necessary to meet the aesthetic demands.

The intuitive response to the proposed site, situated in a cutting, was its suitability for an arch bridge. With this in mind it was concluded that an asymmetric arched truss best met the design brief and the site requirements. This is a proven structural form whose best-known examples are the La Devesa Bridge in Spain, the Merchant’s Bridge in Manchester, UK, and the Markdyke Walk Bridge in Cork, Ireland.

The structural system, although not immediately apparent, is relatively simple. The main structural elements are the arch, tension hangers and the torsion beam. The arch is set at an angle of 10 degrees to the vertical. The vertical load from the deck is transferred to the arch via the tension hangers.

Although this load is out of plane, the arch is prevented from buckling by the tension hangers that are restrained by the horizontal stiffness of the deck as shown in the below figure. As the deck is not centred under the arch, it is inclined to rotate under gravity and applied loads. This rotation is resisted by the torsion beam that transfers the torsional moment to the arch supports.
Bridge structural system

Construction of the reinforced concrete foundations commenced while the steel structure was being fabricated in Cape Town. A trial erection of the steelwork then took place in Cape Town and the structure was transported to Plettenberg Bay in four parts. These parts were then assembled on site and the completed structure craned into place during a six-hour occupation of National Route 2.

MEETING THE CHALLENGES OF FAST-GROWING URBANISATION

A UNIQUE AND USER-FRIENDLY regional flood management information system (RFMIS) has been adopted for use by the City of Tshwane Metropolitan Municipality (CTMM) to better manage flood damage and and reduce the risk of loss of lives.

The RFMIS is an innovative and proactive management system using modern intranet technology to assist in the integration of engineering services. The system focuses on stormwater management which, if neglected, can lead to significant damage to infrastructure and loss of life, as was seen in recent flood events elsewhere in the country.

Developed by SRK Consulting, in association with Imvelo Consulting, the RFMIS is based on commercially available software already being used by several local authorities.

‘Improving the quality of life of the urban population is not just a matter of providing land, houses and services such as water supply, sewage, roads and electricity, but must also incorporate storm water control. It has been repeatedly shown that if storm water management is not included as an integral part of the urban system, flooding causing irreversible damage to property, municipal services and infrastructure, and endangering life, is unavoidable,’ said Matt Braune, a partner of SRK Consulting.

‘It has been shown that by making use of a RFMIS, such as the system developed for the CTMM, storm water control can be proactively managed,’ he said.

Braune added that a local authority has a legal obligation regarding the prevention of unacceptable flood damage, and to ensure the safety of people during flood events.

He said that in terms of the Water Act 36 of 1998, 1:100 year floodlines need to be shown on all development planes, thereby preventing that new developments take place in flood prone areas.

In addition, the Disaster Management Act, Act 57 of 2002, requires that district and local municipalities compile a disaster management plan with one of the components being a hazard and vulnerability assessment to determine amongst other things the flooding hazard and risk of developments.

Existing municipal boundaries have over the past ten years extended to include the lesser formal and informal developments. It is evident that the municipal engineer, environmental officer and town planner have an ever increasing and more important role to play in efficiently managing a town or city.

‘It has become clear that a dual need must be
met: existing infrastructure must be maintained and upgraded where it becomes inadequate while, at the same time, new services in lesser formal and informal developments need to be implemented,’ said Braune.

C&CI FORMULATES TAILOR-MADE TRAINING FOR ENGINEERS

WE READ DAILY IN THE press about the ‘shortage of skilled engineers’ in South Africa, but little is said about the ‘shortage of engineering skills’. This second shortage becomes very evident when the designer of a concrete structure puts together a specification for the materials.

Concrete may be the second most used material on the planet (after water) but it is also one of the most complex and misunderstood, with an infinite variation in properties such as strength, colour, workability, resistance to aggressive environments, shrinkage and cost, to name but a few. The person best suited to identify the concrete properties that will enable a concrete structure to perform to the best of its ability is the designer and there are least 30 properties that spring to mind that can affect structural performance. The general trend, however, is to specify only the compressive strength and then leave the material selection to the contractor, who often has to tender on the basis of price.

But let us not be too hard on our engineers, they usually get a one semester course in building materials during their training that includes timber, aluminium, steel and concrete. Time permits no more. Engineers are, however, expected to keep abreast of the latest developments in their field, throughout their careers, and there have been many in the field of concrete technology in the last few years.

For example, in a case recently, a shear wall had to be constructed with dimensions approximately 500 mm x 10 m. The contractor was under pressure to meet deadlines and used concrete made with cement that had a compressive strength requirement of 42.5 MPa in order to strip formwork after 24 hours. The heat generated was, however, sufficient to crack the concrete, and the engineer instructed that it be demolished and replaced at the contractor’s expense. The contractor said that in the absence of any specification to the contrary he had simply used the concrete offered by the ready mixed concrete supplier at the best price. Who should be blamed? The structural element should never have been built with that cement as it was not suitable for the purpose, nor was the stripping time of the timber formwork.

In another case in a parking garage with a flat-slab design it was found that the falsework close to the centre of a panel had jammed and could not be removed due to excessive deflections. The ultimate deflection was of the order of 80 mm. It was found from cores that the modulus of elasticity of the concrete was substantially less than that suggested in the design code, although the compressive strength satisfied the specified criteria. Who was to blame? A structural element had been designed that was dependent on an assumed strain resulting from a particular stress that was inherent in the design formulae. The actual strain was far too high and the panel had deflected excessively, but was proved to have sufficient strength in a subsequent load test. No modulus of elasticity had been specified, only a compressive strength.

Another point of friction between contractor and designer is the acceptance of cube strengths. There are very strict guidelines laid down in standard specifications on how to do this statistically, that will allow concrete to be accepted under certain circumstances, that is 3 MPa below the specified requirement.

Is it any longer permissible, in the interests of a client, not to specify the desired maintenance-free life span of a structure? The technology, developed in South Africa, is simple and easy to specify, but has not gained wide acceptance. Concrete floors in factories remain another constant source of failures, when a proper understanding of the principles involved in the design and construction would enable the construction of crack-free floors with hardwearing surfaces. Selection of materials, particularly cement type, must be done to suit the needs of the structure, but is frequently left to the contractor to find the cheapest.

Specification of concrete can be done in either a prescriptive or performance-based manner. In a prescriptive specification the engineer would use his superior knowledge to specify the individual materials for the concrete, the mix proportions, methods of placement and curing, etc, but is not favoured as it places responsibility on the engineer for the material’s performance. A performance specification specifies the properties of the end product and leaves the contractor to achieve those properties. Many contractors in South Africa today require assistance to achieve the desired end product and cannot be left without some sort of guidelines from the engineer.

Designers of structures, whether they are engineers or architects, need a much greater depth of understanding of the composite material that is concrete if they are to specify it adequately. Mentors within companies are becoming very scarce and it makes sense to send young (and not so young) engineers on courses where one mentor can pass on experience to many engineers.

The Cement and Concrete Institute has introduced a suite of new CPD-accredited courses on concrete, ranging in duration from half a day to a day to minimise time required away from the workplace. These courses deliver a short, sharp, subject-specific injection of applied technology topics that have been selected by experienced experts to suit the needs of designers and constructors. Topics covered include the properties of concrete that affect structural design, increasing the maintenance free life span, building crack-free floors and many other issues that have been identified from the practical investigation of many, many failures in the field.

The average client wants three things in return for the money that he invests in a reinforced concrete project. The structure must be cost effective (initially and during its life span), it must look good and have sufficient strength not to collapse. These requirements can all be satisfied with the understanding of a few basic principles given on the C&CI courses. In the interests of our clients, it is important that we get our priorities right.
SAVING THE WATER IN SOWETO

THE IMPLEMENTATION OF JOHANNESBURG Water’s ‘Operation Gcin’amanzi’ (‘save the water’) project in Soweto is progressing well.

Johannesburg Water recently appointed the Londa Madi Consortium, which comprises SBA consulting engineers in association with Ilima projects and MIS Pipelines, to address water loss problems within Superblock 12, situated in Protea Glen, Soweto.

‘This flagship project for SBA Johannesburg, involves engineering and social challenges and solutions in partnership with Johannesburg Water, other consortium members and the local community,’ says Lourie Geldenhuys, regional manager of SBA, Johannesburg, part of the B & A Group. ‘A unique aspect of this project is the employment of SMME contractors, each with four plumbing teams, as well as over 120 labourers – all from the local community.’

Before construction commenced, SBA completed a comprehensive hydraulic design and compilation of the ‘block design plan’ which defined the required pipework, bulk meters, pressure reducing valves, isolating valves, hydrants, saddles and other fittings. Pre-intervention property to property plumbing surveys were conducted in order to establish the condition of on-site plumbing.

Once the ‘block design plan’ was approved by Johannesburg Water – which encompassed comprehensive scheduling and costing of the upgrading and rehabilitation requirements – construction work commenced. This includes the installation of secondary and tertiary reticulation where required, secondary mains leak detection, bulk meter installation, domestic prepaid water meter installation, on-property plumbing repair and retrofitting and decommissioning of current secondary midblock mains where necessary.

To date, the consortium has completed approximately 1 400 of the required 3 462 residential sites and is currently completing an average of 90 sites a day.

This R24,7-million contract, which commenced in June 2006, is scheduled for completion by July 2007.

MORE INFO
Lourie Geldenhuys
SBA, Johannesburg
011-438-4370
2007 SAICE PHOTO COMPETITION

COMPETITION RULES:

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

* 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, 1895. Fax: (011) 805 5971

This form is available on the SAICE website: http://www.civils.org.za/photocomp.html

2006 winner: Mapuga dam spill, taken by Rob Foszor from Nihlam shand

1st runner-up: Launching the Mona Jetty by Sally O’Donoghue from Group 5

One of the joint 2nd runners-up, Cranes in the clouds, also taken by Sally O’Donoghue

ENTRY FORM

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

NAME ____________________________

ADDRESS ____________________________________________

__________________________________________________________________________

TEL _______ FAX ____________________

E-MAIL _______________________________________

PHOTO TITLE __________________________

DESCRIPTION ___________________________________________________________

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saice
MICHAEL (MIKE) JOSIAS DE WITT was born in the Eastern Cape town of Tarkastad in 1945, where his father was Town Engineer. He completed his schooling at the Adelaide High School and graduated from the University of Cape Town in 1966 with a BSc in Civil Engineering. He completed his MSc in Geotechnical Engineering in 1968 before joining Eskom, where his first assignment was as assistant resident engineer on the Hendrik Verwoerd Hydropower Station at what is now the Gariep Dam. It was here that Mike developed his intense interest in hydropower and tunnels, a passion that he pursued throughout his career. After Gariep he moved into the design office, where he was involved in the planning and design of coal-fired power stations.

In 1973 he joined Dames and Moore to further his experience in geotechnical engineering. After two years in the US, where he was involved in foundation investigations and related studies for a nuclear power station, he returned to South Africa, where he was responsible for foundation investigations, seismic risk analyses and tsunami risk studies for the Koeberg nuclear power station. Some 30 years later he was again appointed as specialist reviewer of the geotechnical investigations for proposed extensions to Koeberg and for the proposed Pebble Bed Modular Reactor site adjacent to Koeberg.

In 1977 Mike joined Gibb Hawkins and Partners, where he was responsible for many aspects of the design of the underground works and later, detailed interfacing with the construction supervision team for the 1 000 MW Drakensberg Pumped Storage Scheme. Here he pioneered prestressing of concrete lined shafts and pressure tunnels (up to 8 m diameter) by interface grouting, to world record levels, and published several papers on the subject. Another significant aspect was his analyses of embedded spiral casings and tunnel liners subject to high static and transient internal pressures.

In 1982 he began his 25-year association with Ninham Shand, much of which was on the Lesotho Highlands Water Project, initially as project manager for the Orange Vaal Water Transfer Scheme feasibility study, a possible alternative to the Highlands scheme, and subsequently on the Lesotho Highlands feasibility studies themselves. He then moved on to the design phase as project manager of the delivery tunnels, where he could put his Drakensberg experience to good use in the design of tunnel linings in particular. His involvement continued through the implementation of Phases 1A and 1B, where he was involved both in consortium management and providing specialist tunnel design input.

Mike’s graphic and knowledgeable descriptions of the Lesotho geomorphology were inspired and his solutions to tunnelling conditions in both the basalt and Karoo sediments showed his flair for innovative engineering and practical detail.

He became a board member of Ninham Shand in 1991 and his contribution at corporate level continued until his death, driving a number of strategic initiatives.

Mike had a knack of unblocking deadlocked discussions at board level by throwing in a well-considered comment that would take such discussions in a completely different direction, usually to a successful conclusion. His initiatives in driving international initiatives was legendary, with work being procured in places as diverse as Algeria, Benin, Burkina Faso, Uganda and Pakistan. These international initiatives took up much of his time over the past ten years or so, but he still had time to provide specialist input to a variety of hydropower and related projects.

Mike was an active member of the South African Council on Tunnelling (SANCOT), where he served as the SAICE representative and was elected chairman for two years.

Mike’s strength of character and ability to think on his feet won many a tough point in negotiations. He also had a wicked sense of humour and it took one a while to figure out just when he was joking and when he was serious. This, understandably, led to some interesting situations occurring occasionally that needed some unravelling. His anecdotes were unlimited and very rarely repeated. He was a caring boss and supportive colleague, and spent many hours enthusiastically mentoring even the most junior engineer in his division.

Mike could also be very demanding in driving a design project or work proposal to a timeous conclusion, and this was part of the reason for his success.

He will be sadly missed not only by his wife, Anne, son, Chris, and daughters, Debbie and Suzie, but by his colleagues in Ninham Shand and peers in the civil engineering fraternity.
THE FINALS OF the Rand Water-SAICE Centenary Schools Water Competition 2006/07 were held at the Sci-Bono Discovery Centre in Newtown, Johannesburg, on 16 March in support of National Water Week.

Winners of the regional competitions came to Johannesburg from Bloemfontein, Cape Town, George and Richards Bay to battle the local winners for top honours. Learners from five of the schools were flown to Johannesburg on the Thursday, an experience that these young people (and some of the educators) will never forget! For most this was their first experience of the ‘big city’. The teams were also taken to the Montecasino complex for dinner. As an unexpected bonus, festivities for celebrating St Patrick’s Day were in full swing and everybody enjoyed the ‘march of the bagpipe band’!

Rand Water and SAICE launched the competition for high school learners in 2003 as part of their centenary celebrations.

THE WINNERS
The Isolesizwe High School from Mtubatuba in KwaZulu-Natal came first with 70 penalty points, the best result since the start of the competition in 2003. Second was the team from Lofentse Girls High School in Soweto with 120 penalty points and third Wittedrift Hoërskool near Plettenberg Bay with 130 penalty points. The members of the winning team shared R4 500 and their school received R2 000. A total of R15 000 in prize money was up for grabs.

WATER DISTRIBUTION NETWORKS
Water distribution systems are important to supply safe and clean drinking water to people. The teams are tasked to design a model water distribution network in order to distribute three litres of water equally between three points on the grid using two different pipe diameters. They are then judged on how well they execute the task. Learners are made aware of the intricacies involved in the design of water distribution networks and actual water delivery to households.

Through the competition Rand Water and SAICE spread the message that water should be managed well, that infrastructure should be maintained and that new infrastructure should be created to provide potable water to those without water. In addition, the competition strengthens government’s initiatives aimed at encouraging learners to take maths and science at school and to follow a career as a science or civil engineering professional.
The medal winners of SAICE’s Water Engineering Division’s 2006 competition for schools were announced at SAICE House late last year. Sam Amod, 2006 president of SAICE, presented the awards after each finalist had made a presentation. Everybody present was pleasantly surprised by the dedication and enthusiasm shown by the young learners.

**WATER QUALITY PROBE**

Shailey Lucas from East London reached the following conclusion through her scientific project: ‘It was proved that a scholar can sample and test the water, therefore showing that the youth can assist our water officials in monitoring and hence controlling our water quality. Water is life. If the youth get involved we will be able to prevent some waterborne diseases from becoming disasters.’ Shailey sampled and tested water at Needs Camp, a rural settlement treatment works, and at Umzonyana, an urban treatment works. She measured the pH, used a conductivity probe, observed the turbidity, and determined if chlorine was present by adding an OTO reagent. She also used the hydrogen sulphide strip method to ascertain the presence of pathogens. Shailey’s finding indicated that Needs Camp’s water was of poorer quality than that from Umzonyana. She was awarded a bronze medal for her project.

**HARTBEESPOORT DAM**

Another bronze medal was awarded to the team from Schoemansville, Hartbeespoort, for their project on ‘Pollution in the Hartbeespoort Dam’. Allyson Dames (Grade 6) and Corrie Cornelissen (Grade 7) share the objectives of the Department of Water and Forestry (DWAF) to remove algae and chemical effluent from industries from the dam by creating wetlands (‘vleilande’). They interviewed Peet Venter, deputy director DWAF, and ascertained that one of the major problems was the different types of algae in the dam. Predacious fish, responsible for the eradication of certain fish species that feed on algae constituted another problem. As a result of the over-population of predatory fish there is a shortage of zooplankton. They aim at protecting zooplankton and fish that feed on algae by creating floating wetlands. DWAF will populate these wetlands with plants growing along the dam. The roots will then grow towards the bottom of the dam, providing protection to the fish feeding on algae. These wetlands will then be removed twice a month to free the fish and to ascertain the condition of the wetland. Different fish species will be relocated in an attempt to eradicate the algae. This will be followed by fishing competitions to reduce the numbers of predatory fish in the dam, which will, hopefully, result in the growth of the population of algae feeders to restore the natural balance.

**‘DOWN THE DRAIN’**

Stephan Koutouvelis, a bronze medal-list, involved his family to prove that their household used too much water. Stephan measured the amounts of water necessary for the garden, to shower, etc, and came to the conclusion that many South Africans could contribute to water conservation by measuring the water they actually used in contrast to what is necessary. Conserving water, obviously, also has an economic benefit.

**SOLAR-POWERED WATER PURIFICATION SYSTEM**

The winner of the only silver medal was Roswyn Duke with her invention of a ‘solar-powered water purification system’. This system has wide application as it can be used in situations where the infrastructure, whether through natural or man-made disasters, has collapsed, or even where communities just have no water distribution infrastructure. Shailey’s finding indicated that Needs Camp’s water was of poorer quality than that from Umzonyana. She was awarded a bronze medal for her project.

Nicholas Popich, researched media reports and articles, installed a rain gauge, and took daily readings for two years, and spoke to scientists and the South African Weather Service. Notwithstanding very good summer rains, climatologists contend that the climate is changing and that we are ‘drying out’. George Oosthuizen provided Nicholas with data that he had been collecting over a 20-year period. Nicholas also obtained rainfall data from an official rainfall station that had 30 years’ data available. He calculated the averages for periods of ten years and compared these periods to those of the different rainfall stations to ascertain if it has become drier or more humid/moist. He studied two-year, 20- and 30-year predictions and came to the conclusion that his immediate environment is in fact ‘drying out’. His comment: heed the warnings that we should use suitable agricultural methods and plant agricultural crops and garden plants that will be able to adapt to these drier conditions.

*Civil Engineering | June 2007*
The first prize of R20 000-00 forms part of prizes totalling R32 000-00 sponsored by Sanlam COBALT

South Africa's SMART legacy - cat's eyes, the dolos, the impact roller, the CAT Scan, the Kreepy Krauly ... Are YOU as SMART or SMARTer than this?

Do YOU have innovative ideas/projects/equipment to resolve, for instance,

- traffic congestion
- water conservation/recycling issues
- sustainable housing for healthy communities
- South Africa's sanitation backlog
- ergonomic challenges for women in construction, e.g. lightweight tools

OR

- have YOU designed a small section of a BIG project that provides a solution, as for ALL the above, that is

- sustainable
- magnificent thinking/innovation
- amazing solution
- right for the time and place
- truly and proudly Civils South Africa

If YOU answered YES to even some of the above, SAICE needs YOUR submission!
The SMART Awards are awarded to individuals and not to projects.

ENTRY FORM: Please contact Zina Girald on e-mail: zgiralda@saice.org.za

The self-employed professional financial planning - cover your risks first

Running your own engineering concern means that you are independent, in control of your own destiny and creating your own wealth.

But, although you are independent financially, there may be others who are dependent on you. Dependants and business partners should fit into your financial plan.

Investing and saving is only a part of making long-term financial provision for yourself and your dependants and/or business partners. The key to a successful financial strategy is to first cover your risks.

In formulating a long-term financial strategy it is very important to take cognisance of the two most important risks. The one is dying too soon and the other is living too long. It is around these two risks that one should plan financially.

For the risk of living too long, in other words, outliving your money, you need to invest wisely throughout your life to build capital on which to retire. But the risk that is too often overlooked is the risk of dying, or becoming disabled, before you reach your financial goals.

What is referred to here is protecting your ability to earn money. Put another way, if you should die or become disabled before you have reached your financial goals, it will have a direct impact on the financial wellbeing of your next of kin, or your business partner.

A life assurance policy is still the only way to make sure that you are able to keep the promise of providing for your family. The same holds true for your responsibility towards a partner or partners in your practice.

What will happen to the practice, for example, if you should pass away at a time when your partner/s cannot obtain the finances to buy out your interest?

This can be solved through what is known as a ‘buy and sell agreement’ between the partners. This is an agreement in terms of which the partners agree to buy out the deceased’s interest, ensuring through a life
policy that there will be enough money available for financing this transaction.

In effect it means taking out life policies on each other’s lives to ensure that there will not be financial problems for the partnership or for your families and other dependants in the event of the death of one of you.

Disability could likewise land your practice in a crisis. Having sufficient disability cover will give you time to reach a suitable decision about your future and that of the practice.

It is important that such a buy and sell agreement should allow for regular re-evaluation of the insured amount. A small business today can grow into a multi-million rand practice in a few years’ time and the agreement should keep pace with the growth of the business.

Sanlam Cobalt offers a full financial solution package specifically focused on the needs of professionals in private practice. Should you want more information regarding the above, call Sanlam Cobalt on 0860 100 539, or visit the website at www.sanlamcobalt.co.za

An offer from our sponsor, Sanlam COBALT, especially for SAICE members

As part of Sanlam Cobalt’s sponsorship of the SMART Awards (see opposite page), all owners of an SME in the engineering industry are invited to have a free business fitness analysis done by them. This analysis objectively scrutinises your enterprise and will highlight possible challenges in six areas so that you may act timeously:

- financial management
- business management
- business continuity
- wealth creation
- employee benefits and
- information technology

If you’d like to subject your business to such an analysis, please phone Sanlam Cobalt on 0860 100 539 to arrange an appointment for an interview. The analysis will be followed by a comprehensive report, which will be mailed to you directly, or one of our consultants will discuss it with you in depth at your convenience.
TO ALL CORPORATE MEMBERS

Nominations for election of Council for 2008

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

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

Closing date: 31 July 2007

SECTIONS

Section A
Information concerning the nominee’s contribution to the Institution

Section B
Information concerning nominee’s career, with special reference to civil engineering positions held, etc

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

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

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

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

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

Notice of the ballot will be sent out using two formats:
- By e-mail to those Corporate Members whose electronic address appears on the SAICE database, and
- By normal surface mail to those members who have not informed SAICE of an e-mail address

D B Botha Pr Eng
Executive Director
17 April 2007
Nomination for Election of Members of Council for the year 2008 in terms of Clause 3.1 of the By-Laws

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

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

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

- The immediate Past President: Mr N A Macleod
- The two most recent Past Presidents: Mr S A S Amod, Mr M R D Deeks

Clause 3.1.1 of the By-Laws reads as follows:

‘Every candidate for election to the Council shall be a Corporate Member and shall be proposed by a Corporate Member and seconded by another Corporate Member.’ Nominees accepting nomination are required to sign opposite their names in the last column of the nomination form.
Executive Director’s Award for the Most Outstanding Small Branch during 2006: Highveld Branch – chairman Vinothan Naicker receiving the certificate from Dawie Botha

Executive Director’s Award for the Most Outstanding Medium Branch during 2006: Limpopo Branch – chairman Janos Tshikundamailema and Dawie Botha

Executive Director’s Award for the Most Outstanding Large Branch during 2006: Durban Branch – chairman Professor Phil Everitt with Dawie Botha

Executive Director’s Award for the Most Outstanding Division during 2006: Transportation Division – André Frieslaar receiving the certificate from Dawie Botha on behalf of chairman Jan Coetzee

André Frieslaar of the Transportation Division receiving a trophy and certificate from SAICE President Neil Macleod at the SAICE Council meeting of 17 April 2007. The Transportation Division was the winner of the Civil Engineering Magazine 2006 Award for the most supportive SAICE division and André was once again instrumental in the division winning the award

Professor Elsabé Kearsley after having been nominated as President-Elect 2008

At the AGM the SAICE 2006 President’s Award was made to Spencer Hodgson for his courageous, innovative and dedicated leadership in construction industry development and for his role as the first chief executive of the Construction Industry Development Board (2000–2006)

A special award was made to Advocate Patrick Lane for his unique contributions in the field of dispute resolution in the construction environment over many years. He is recognised as an exceptional leader, facilitator and authority who has added value and has contributed to an area of the profession that requires skill, understanding and fairness. Here SAICE Executive Director Dawie Botha hands Advocate Lane his certificate. At the event Advocate Lane was also invited to become a member of SAICE
Minutes Of The SAICE Annual General Meeting

The SAICE AGM was held on 17 April 2007 at SAICE House in Midrand

1 OPENING AND WELCOME
Mr Neil Macleod, SAICE President 2007, welcomed everyone present. He also extended a special welcome to Mr Spencer Hodgson and Advocate Patrick Lane and the latter’s guests, as well as to Professor Deon von Willich, who had been SAICE President in 1983.

2 ATTENDANCE
Apologies were received from SAICE Presidents Professor Ken Knight (1977), Don Macleod (1987), Louis de Waal (1990), Professor Fred Hugo (1993) and Mrs Allyson Lawless (2000). Dr Ross Parry-Davis also apologised for being unable to attend.

3 MINUTES OF THE ANNUAL GENERAL MEETING HELD ON 19 APRIL 2006
The minutes of the AGM held on 19 April 2006 were presented and accepted, subject to the following changes:

   Item 4: … seconded by Johan de Koker ...
   Item 5: … Numbers and Needs, researched and ....

4 PRESENTATION OF THE ANNUAL REPORTS AND FINANCIAL STATEMENTS OF THE YEAR ENDED 31 DECEMBER 2006
Mr Peter Kleynhans presented the SAICE Financial Statements for 2006. He briefly highlighted various aspects of the SAICE finances and thanked Dr Martin van Veelen who had chaired the Finance and Administration Committee during 2006, as well as the National Office staff who had contributed in such a big way to achieve the good financial results. He mentioned that the auditors once more gave SAICE a clean bill of health regarding the finances. He also indicated that the auditors would be willing to remove the customary qualification that was caused by the fact that they did not audit the branches and divisions.

To remove the qualification, they would require audits for branches and divisions on a rotational basis. He also mentioned that the auditors had indicated that from 2007 onwards, the SAICE Section 21 Company would be incorporated into the SAICE financial statements, since the company is deemed to be wholly owned by SAICE.

Mr Kleynhans also presented the SPEBS review for 2006. He expressed his satisfaction regarding the fact that a number of goals that he had set out for himself and for SAICE for 2006, had indeed been achieved. The SAICE Infrastructure Report Card, which was launched in November 2006, made a huge impact and the media coverage, which was still ongoing at the time of the AGM, had been exceptional. He mentioned that initial reservations and fears that the initiative could be received negatively by government, had all proved to be unfounded. Government was very positive about the initiative, and plans have been made to continue with a series of report cards.

Mr Amod thanked his colleagues, the members of the Institution and National Office for their support and cooperation during 2006. He also expressed a special thanks to his family, especially his wife, Lekha, and his daughter, Shaista, who supported him with his company and duties as President during 2006.

5 REVIEW PRESIDENT 2006, MR SAM AMOD
Mr Sam Amod presented his President’s Review for 2006. He expressed his satisfaction regarding the fact that a number of goals that he had set out for himself and for SAICE in 2006, had indeed been achieved. The SAICE Infrastructure Report Card, which was launched in November 2006, made a huge impact and the media coverage, which was still ongoing at the time of the AGM, had been exceptional. He mentioned that initial reservations and fears that the initiative could be received negatively by government, had all proved to be unfounded. Government was very positive about the initiative, and plans have been made to continue with a series of report cards.

Mr Amod thanked his colleagues, the members of the Institution and National Office for their support and cooperation during 2006. He also expressed a special thanks to his family, especially his wife, Lekha, and his daughter, Shaista, who supported him with his company and duties as President during 2006.

Review Executive Director, Mr Dawie Botha
Mr Dawie Botha presented his 2006 report and highlighted some of the contents as published in the Review 2006. He proceeded to thank the SAICE Office Bearers, other SAICE leaders, his staff and his family for their support. He made special mention of Mrs Debbie Griesel, SAICE’s Financial Manager, and Mrs Carla de Jager, Manager Education and Training, who had both resigned during 2006 after more than ten years of service each, to pursue new occupations. He mentioned that these two ladies had made a huge contribution to SAICE’s wellbeing and success in recent years.

The AGM accepted the reports by Mr Amod and Mr Botha with appreciation.

6 ELECTION OF AUDITORS
The AGM considered the recommendation by Council, held earlier in the day, that the current auditors should be retained.

The AGM resolved:
That PricewaterhouseCoopers Inc be retained as auditors for SAICE for the 2007 financial year.

7 ELECTION OF LEGAL ADVISORS
The AGM considered the recommendation by Council, held earlier in the day, that legal advisors should be chosen only as and when necessary.

The AGM resolved:
That SAICE would not appoint any particular legal advisor at this point in time, but that such advisors be appointed by the
Executive Board as and when required during the course of 2007.

8 PRESENTATION OF AWARDS

President’s Award 2006

Mr Sam Amod presented the President’s Award to Mr Spencer Hodgson, who was the first CEO of the Construction Industry Development Board (CIDB) and who is currently personal advisor to the Minister of Public Works. The following citation was read out:

President’s Award 2006 awarded to Spencer Hodgson for his courageous, innovative and dedicated leadership in construction industry development, and his role as the first Chief Executive of the Construction Industry Development Board (2000–2006).

Mr Amod congratulated Mr Hodgson, thanked him for his contributions to the construction industry and handed over the certificate of appreciation.

Mr Hodgson thanked Mr Amod for the honour bestowed on him. In his acceptance speech Mr Hodgson said that he was very grateful for the leadership role that SAICE had been and still was playing in the built environment. He said that he could always rely on the SAICE leaders, and that SAICE members played a huge role in developing best practice frameworks and that many of these initiatives were internationally recognised. He was of the opinion that SAICE has been producing leaders of international class for decades. He also thanked Mr Botha and the National Office team and said they had been very supportive and had worked with him and the CIDB on several occasions. He lauded the Minister of Public Works, Ms Thoko Didiza, for her insight and leadership, and indicated that she was grasping the important matters within the construction industry very well and very quickly and was determined to find solutions.

Executive Director’s Branch and Division Awards 2006

Mr Botha announced that the Director’s Awards for the most outstanding branches and divisions for 2006 had been handed out at the Council meeting to the following recipients:

- Division Transportation
  - Large branch Durban
  - Medium branch Limpopo
  - Small branch Highveld

Advocate Patrick Lane

Mr Botha announced that SAICE had decided to make a special award to a special person who had been associated with civil engineering in an exemplary way. He presented the following citation:

Patrick Lane is hereby recognised by the members of the Civil Engineering profession of South Africa for his unique contributions in the field of dispute resolution in the construction environment. He is recognised as an exceptional leader, facilitator and authority who has added value and contributed to an area of the profession that requires skill, understanding and fairness. He is a worthy and deserving citizen of our country and is also honoured by his local and international peers.

Mr Botha proceeded to read a message of greeting from Dr Ross Parry-Davis who had proposed the award, but who could not be present at the AGM. A certificate of appreciation was handed to Advocate Lane.

Advocate Lane then thanked SAICE as follows for the honour bestowed on him:

I am humbled by the honour shown to me tonight and can only express my gratitude.
I think my science teacher would be turning in his grave if he knew that I would be standing here today receiving this award. My career in construction law commenced in 1977. One of your members, introduced to me by an attorney from Durban, sat one evening in my chambers regaling me with wonderful stories and polished off a bottle of Scotch. I thought, whilst being a most entertaining evening, that that might be the last that I would hear from him. On the contrary, a month later my telephone rang and I was briefed in my first serious construction dispute. It opened a wonderful path for me which has led me, amongst other things, to being a member of the English Bar, Chairman of the Association of Arbitrators (Southern Africa), a member of the ICC panel of Arbitrators, a Member of the Dubai International Arbitration Centre and a Chartered Arbitrator of the Chartered Institute of Arbitrators and has allowed me to work throughout Africa and in places such as London, Paris, Austria, Italy, Germany, Georgia and Dubai. I have met and worked with numerous members of your profession locally and internationally and have had the pleasure of sitting with them on tribunals and adjudication boards.

Construction law has become recognised as a specialised field of study. In the early days it was merely brushed aside as an extension of the law of contract. Specialised postgraduate courses are now being offered in construction law. I was most fortunate to meet the late Duncan Wallace, the author of ‘Hudson’s Building and Engineering Contracts’, a member of my then chambers in London. He was probably the most important figure in placing construction law on the map.

I am touched by the kind words of Dr Ross Parry-Davies and particularly in his reference to my interest in dispute resolution. This is particularly so and in this regard one of the outstanding features has been the growth of synergy between the engineering profession and construction lawyers. Dispute resolution is not about merely resolving the disputes, but as clearly intended by the growth of dispute adjudication boards, the prevention of disputes. As mentioned by Ross, I am presently chairing the VRESAP and Berg River Projects Dispute Adjudication Boards and have the pleasure of working with very senior and accomplished engineers in attempting if not to prevent the disputes arising, to ensure that any dispute goes no further than adjudication.

The growth of the standard form contracts used domestically and internationally again is another example of the synergy which exists between construction lawyers, engineers, contractors and others involved in the construction industry. It is closely connected with the process of dispute resolution insofar as the contractual balancing of risks and the management of the risk when it eventuates. It is through the collaboration of the various disciplines that the risks are properly defined, apportioned and managed.

I again must thank you for the wonderful honour bestowed on me.

8 CLOSURE

Mr Macleod thanked everybody for their attendance, declared the meeting closed and invited everyone to dinner.
A new era for
International relations

THE INSTITUTION OF Civil Engineers (ICE) and SAICE began fifteen years ago with an exchange of ideas and comparison of their individual procedures, policies, criteria and requirements for admitting civil engineers to membership and also discussed other matters of mutual interest. These initial talks paved the way to ongoing communications, which has subsequently led to the establishment of a SAICE-ICE Liaison Committee. Renewed discussions about the format of cooperation structures that had been taking place since 2004 now resulted in the establishment of the new Joint ICE-SAICE Division.

The official inaugural meeting for the new joint ICE-SAICE Division, which was chaired by SAICE Executive Director Dawie Botha and ICE Country Representative Andrew Baird, took place on 22 March 2007. At this meeting, nominations for committee members were accepted.

According to ICE Country Representative Andrew Baird, the ICE-SAICE Division model was a first for ICE which, if successful, would be repeated in other countries. ‘The structure will serve to provide more effective resources for the ICE Country Representative’s role,’ said Baird.

ICE members, including members who hold dual ICE-SAICE membership, will automatically become members of the new division. In addition, SAICE members can apply to become members of the division.

The SAICE Executive Board resolves to have a direct link to the division through representation on the committee, as international affairs are in general handled at SAICE national level,’ explained SAICE Executive Director Dawie Botha.

With the two institutions working side by side, it is hoped that South African engineers will have a greater voice and that longstanding membership issues, as well as other pressing issues, will be addressed and resolved on this platform.

The newly elected committee members will serve until December 2007 at which stage the second committee will be elected by the division membership to serve for 2008. Dawie Botha will serve as ex officio representative of SAICE National until the end of 2007.

Prestigious award made to former South African

DR JAMES L BARNARD, well-known South African water engineer now residing in the United States of America and acknowledged in South Africa for his development of the Bardenpho Process, will be awarded the prestigious Athalie Richardson Irvine Clarke Prize for Outstanding Achievement in Water Science and Technology by the American National Water Research Institute. The award (a gold medal and a cheque of US$50 000) will be made on 12 July 2007 at a function to be held at the Hilton Waterfront Beach Resort in Huntington Beach, California. Dr Barnard, who will be the fourteenth recipient of this award, will deliver the 2007 Clarke Prize Lecture at this event. (Dr Barnard has promised to send us his lecture for publication in Civil Engineering later this year – Ed)
EFFECTIVE TEACHING ENTAILS more than just the application of effective classroom techniques. Exemplary teachers must also master the broader endeavour of instructional design – the process of crafting coherent learning activities and experiences that ultimately result in students’ achievement of desired instructional objectives.

When designing instruction, professors must invariably answer a wide range of questions, such as:

- What are the learning outcomes I expect my students to achieve?
- To what extent should I expect my students to read and understand the course textbook?
- Should I devote our limited classroom time to discussing theory, working problems, or both?
- Should I work an example problem at the chalkboard, or is it better to have the students work problems at their seats?
- What kind of homework problems should I assign?
- How should the homework be graded? There are no universal right or wrong answers to these questions. Rather, the answers depend on the subject being taught, the students’ capabilities, the amount of time available, and many other factors. The challenge of instruction design is taking these factors into account in a logical and coherent way.

STUDENT LEARNING AS THE BASIS FOR INSTRUCTIONAL DESIGN

In this article, we present a general model for instructional design, developed as an integral component of the ASCE ExCEEd teaching workshop. This model instructional strategy is both simple and flexible. More importantly, it derives directly from a well-established model of the human learning process. As such, the strategy provides a decision-making framework that will help you answer questions like the ones posed above – in a manner that ultimately will facilitate effective student learning.

Let’s begin with a design project: Suppose that you are an undergraduate student who is required to learn a complex subject-matter concept – one with a variety of important problem-solving applications. You currently know nothing about this concept. The resources available to you include a textbook that covers the topic, a subject-matter expert, and six hours. The subject-matter expert is available to you for two of the six hours; for the remaining four hours, you’re on your own. Your challenge is to design a sequence of activities that will help you learn the concept and its applications most effectively.

For the past five years, we have posed this same problem to ExCEEd teaching workshop participants, as an introduction to instructional design. In response to the challenge, teams of participants develop integrated sequences of learning activities and then present their solutions to the workshop faculty and other participants. And while the teams’ solutions differ considerably in detail, they are invariably consistent in terms of overall concept and structure. A typical team’s solution to the instructional design project follows:

First, we would ask the subject-matter expert to provide us with a broad overview of the concept. We would want to know why the topic is important and what kind of practical problems we’ll be able to solve once we’ve mastered it. Next, on our own, we would read about the concept in the textbook. We would return to the expert to ask questions about aspects of the text material that we didn’t understand. The expert should then work an example problem, to demonstrate a typical practical application. The expert should give us several homework problems to solve on our own. The initial problems should be relatively simple, to confirm that we understand the basics; others should be more challenging, to expand our understanding. If we have difficulty solving these problems, we would consult with the expert and perhaps with the expert. Finally, the expert should give us feedback on our work. If we make errors, the expert should coach us toward correct solutions. Ideally, we would then get an opportunity to solve an even wider variety of problems and again receive feedback – to ensure that we really do understand the concept and its applications.

This typical solution to our introductory instructional design project is significant for two reasons. First, it very closely reflects the model instructional strategy that is presented in the ExCEEd workshop – but which the participants have not yet seen at the time they do the design project. Second, this solution is typically proposed by faculty members who have never employed this sort of instructional strategy in their own teaching.

How do workshop participants intuit our model instructional strategy, even though they are largely unfamiliar with this form of instructional design? The answer

A Model Instructional Strategy

- Provide an orientation:
  - Why is this important?
  - How does it relate to prior knowledge?
- Provide learning objectives
- Provide information
- Stimulate critical thinking about the subject
- Provide models
- Provide opportunities to apply the knowledge
  - In a familiar context
  - In new and unfamiliar contexts
- Assess the learners’ performance and provide feedback
- Provide opportunities for self-assessment

![Figure 1 The model instructional strategy](image)
lies in how the question is asked. The design problem statement asks participants to assume the role of an undergraduate student. Their responses, then, do not reflect ‘how I would teach this subject’, but rather, ‘how I would prefer to learn this subject’. It seems that, when placed in the role of the learner rather than the teacher, they are much better equipped to design learning experiences that will produce effective learning outcomes. This observation suggests the obvious but often ignored notion that student learning should be the foundation upon which instructional design is based.

**A MODEL INSTRUCTIONAL STRATEGY**

The ExCEEd model instructional strategy derives directly from the ‘learning process methodology’ developed by Apple et al to enhance students’ skills as self-learners (Daniel K Apple et al. *Foundations of learning*, 1995). Thus the model instructional strategy reflects the premise that instructional design should build upon an underlying model of the human learning process. The strategy describes an eight-step process for facilitating student learning of a major concept or topic. The eight steps are summarised in figure 1 and explained in the following paragraphs.

**PROVIDE AN ORIENTATION**

The instructor should communicate why the topic is important and how it relates to other topics that students already understand. Educational research demonstrates unequivocally that students learn more effectively when they clearly perceive the value in what is to be learned, when they are able to meaningfully connect new learning to prior knowledge, and when they are able to attach personal meaning to new learning.

**PROVIDE LEARNING OBJECTIVES**

The instructor should define what students will be able to do upon successful completion of the learning process. Research suggests that students learn more effectively when they are aware of the desired learning outcomes, as well as the standards by which their achievement of these outcomes will be evaluated.

Learning objectives should be expressed in terms of measurable action verbs, defined in accordance with Bloom’s taxonomy. Ideally the upper two levels of Bloom’s taxonomy—synthesis and evaluation—should be addressed in every course, in order to develop students’ higher-order thinking skills. It is important to recognise, however, that Bloom’s six levels of cognitive development are generally achieved cumulatively. True synthesis-level thinking cannot occur without first developing students’ capacity for analysis-level thought. Analysis must be preceded by application, and so on. Students cannot reasonably be expected to exhibit evaluation-level cognitive development without having first developed the previous five levels.

In any event, using Bloom’s taxonomy as the basis for defining lesson objectives is a valuable enhancement to the instructional design process, because the act of choosing the appropriate cognitive level prompts the teacher to add clarity and specificity to the desired learning outcomes.

**PROVIDE INFORMATION**

Effective teaching entails much more than simply providing information; and effective learning entails much more than receiving information. Nonetheless, it is often necessary for the learner to acquire basic-level information— theories, concepts, terminology, methodologies, techniques—before higher-order learning can occur. Depending on the instructional design, information might be provided by the teacher (eg in a lecture), by the learner
is high-quality time on task. Practice makes perfect. More specifically, practice provides learners with opportunities to reinforce what they know and to reveal what they do not yet know. In engineering, practice typically takes the form of problem-solving homework assignments and projects; however, opportunities to apply knowledge can just as easily be provided through in-class exercises, performed by individual students or by teams of students. The advantage of in-class problem-solving is that the instructor can monitor students’ work, assess their progress, and answer their questions immediately. The disadvantage is that, as teachers, there is never as much in-class time as desired to devote to a given subject. Because of the inevitable constraints on in-class time, homework problems can generally be more complex and more comprehensive than in-class exercises.

Regardless of the format, students should always be provided with opportunities to apply knowledge at two distinctly different levels. First, they should be asked to solve relatively simple problems in a familiar context – for example, a homework problem that is similar to the instructor’s in-class example problem. This initial application reinforces students’ nascent understanding of the topic, identifies misconceptions or gaps in their understanding, and builds confidence.

Having successfully solved a familiar problem, students should then be presented with a problem (or problems) of greater complexity in a new and unfamiliar context. This component of the model instructional strategy is critical, because it promotes transfer of learning—the ability to apply concepts and problem-solving strategies to wholly new types of problems in entirely new settings. As a National Research Council report notes, ‘A major goal of schooling is to prepare students for flexible adaptation to new problems and settings’. This is particularly true for engineering graduates, who will likely encounter many real-world situations that are vastly different from the types of problems they learned to solve as students.

Engineering educators generally recognise, at least implicitly, that transfer of learning is important. All too often, however, they ignore this in instructional design and then evaluate it on exams – for example, by using conceptually challenging exam questions that are substantially different from problems that students have worked in class and on homework assignments. However, for many students – particularly immature learners – the ability to transfer learning does not come naturally or easily.

Models are examples, usually provided by the instructor, for the purpose of advancing students’ understanding in some way. Models can be physical (eg a rubber model of a beam, used to illustrate bending) or conceptual (eg a problem-solving strategy). In engineering, instructors often model the problem-solving process by working representative example problems in class. The objective of this activity should be more than just showing students how to solve a particular example. By ‘thinking out loud’ as he or she works through the problem, the instructor can help students understand a more generalised problem-solving approach, with emphasis on the key decisions and assumptions that are made en route to a correct solution. By asking questions during the solution of an example problem, the instructor can also stimulate critical thinking, thus effectively merging this step with the previous one.

EDUCATIONAL RESEARCH EMPHASIZES THE IMPORTANCE OF STUDENTS’ ACTIVE ENGAGEMENT IN THE LEARNING PROCESS. STUDENTS MAY THINK THEY UNDERSTAND A CONCEPT AFTER HEARING THE INSTRUCTOR EXPLAIN IT; HOWEVER, THEY DON’T TRULY KNOW THE CONCEPT UNTIL THEY CAN APPLY IT SUCCESSFULLY THEMSELVES. RESEARCH ALSO SUGGESTS THAT ONE OF THE STRONGEST CONTRIBUTORS TO STUDENT LEARNING
work problems’). Like most skills, this one must itself be learned – preferably before it is evaluated. And as with most skills, an effective way to learn how to transfer learning is through practice and feedback.

**ASSESS PERFORMANCE AND PROVIDE FEEDBACK**

As noted above, problem-solving practice reinforces students’ learning of a subject, while providing the teacher with opportunities to identify students’ misconceptions or incomplete understanding. Clearly, however, shortcomings in students’ learning can only be identified if the instructor rigorously assesses the students’ performance, with respect to the established learning objectives. And performance assessment can only result in improved learning if it is accompanied by constructive feedback oriented toward improving those shortcomings.

For the purpose of this discussion, it is useful to differentiate between assessment and evaluation. Assessment is the process of measuring performance, for the purpose of improving future performance. Evaluation, on the other hand, is the process of measuring performance against a defined standard, usually for the purpose of reward or punishment.

The distinction is important, because many professors choose to assess students’ performance with examinations, even though exams are far better suited for evaluation than for assessment. Exams inevitably occur at the end of the learning process, when there are few (if any) remaining opportunities for students to apply feedback to improve future performance. Effective assessment should be primarily formative, rather than summative. It should provide students with formal and informal performance feedback throughout the learning process, rather than solely at the end of that process. Note the feedback loop on figure 1, an indication that several iterations of performance and feedback are often necessary to achieve high-quality learning outcomes.

Formative assessment can be performed in many ways. Traditional problem-solving homework assignments can be used as assessment tools, provided that (1) they are assigned at interim points within a block of instruction, rather than only at the end, (2) they are graded and returned to students very soon after they are handed in, and (3) the grading includes specific feedback about the students’ errors, rather than generic point deductions. The key is that homework can only be effective as an assessment tool if students receive substantive performance feedback with sufficient time to integrate that feedback into their future performance.

But to rely solely on homework for performance assessment is to ignore a rich array of other assessment tools that are effective, economical, and easy to use. Simple classroom assessment techniques – such as the minute paper, muddy point paper, preconception check, and approximate analogy – can be administered in the final one or two minutes of any class and can provide the instructor with immediate feedback on the extent to which student learning outcomes coincide with the instructor’s expectations. In instances where assessment results are inconsistent with expectations, the instructor should provide specific feedback to students at the start of the following class and should adjust the planned learning activities to address these problem areas.

**PROVIDE OPPORTUNITIES FOR SELF-ASSESSMENT**

Most engineering students will eventually graduate. Once they have left school, they will no longer have the benefit of their professors’ performance assessments. Graduates will need to learn new concepts and skills on their own – and they can only be assured that their self-directed learning is correct if they are able to assess their own learning processes. Thus long-term growth as a self-learner requires strong self-assessment skills. Students can and should be given opportunities to develop such skills before they graduate from college. Instructors can foster the development of assessment skills, for example, by asking students to check each other’s homework, just as practicing design engineers conduct design reviews or by having students critique their own oral presentations before receiving feedback from the instructor.

**APPLICATION OF THE MODEL INSTRUCTIONAL STRATEGY**

Although there are no hard-and-fast rules regarding the application of the model instructional strategy, our experience with the model suggests a few guidelines. First, the model works best when it is applied to a block of instruction – say, two to five lessons, all of which are associated with a single learning objective or with a single coherent set of learning objectives. Given its emphasis on iterative practice and feedback, the model cannot be effectively applied to a single lesson. (An important corollary is that discrete single-lesson topics are unlikely to produce high-quality learning outcomes.)

Second, while the eight steps in the model are arranged in a logical sequence, many deviations from that sequence are possible. For example, for a given instructional design, it might make sense to establish and communicate learning objectives prior to the orientation. For the benefit of inductive learners, it might be desirable for the instructor to present a specific practical application at the very beginning of the learning process – even prior to students’ acquisition of basic-level information about the subject. Deciding when such deviations from the model are warranted is an integral part of the instructional design process. The strategy enhances this process by prompting the instructor to make conscious decisions about the sequencing of learning activities and to justify these decisions on the basis of enhanced student learning.

Finally, the model instructional strategy helps to guide the instructors’ decisions about allocating responsibility for student learning. Some of the steps in the strategy must necessarily be performed primarily by the instructor. Providing an orientation, setting objectives, modeling the problem-solving process, and assessing student performance generally require a professor’s disciplinary expertise and breadth of perspective. Application of knowledge and self-assessment, on the other hand, must be performed primarily by the students. Responsibility for providing or acquiring information and for stimulating critical thinking may be assigned to the instructor or to the student, or the responsibility may be shared. Again, the model instructional strategy prompts the instructor to make conscious decisions about the allocation of responsibilities in a coherent, learning-centered manner.

Let’s conclude this discussion with a specific example. Below, the strategy is applied to the design of a three-lesson block of instruction on truss analysis, as might be found in a typical statics course.

In this example, ‘lesson 0’ is the lesson immediately prior to the three-lesson truss analysis block.

**Lesson 0** During the final ten minutes of class, the instructor provides an orientation to the topic of trusses. She shows digital images of real-world trusses – a local truss bridge, the roof structure of the university’s basketball arena, a construction crane, Simple classroom assessment techniques – such as the minute paper, muddy point paper, preconception check, and approximate analogy – can be administered in the final one or two minutes of any class and can provide the instructor with immediate feedback on the extent to which student learning outcomes coincide with the instructor’s expectations.
The strategy enhances this process by prompting the instructor to make conscious decisions about the sequencing of learning activities – and to justify these decisions on the basis of enhanced student learning.

and a power transmission tower – all of which are familiar to her students. She explains that, through their prior study of two-dimensional static equilibrium, the students already possess all of the theoretical knowledge required to perform truss analysis. She concludes class by outlining the learning objectives of the upcoming truss analysis block and pointing out portions of next lesson’s reading assignment that deserve special attention.

Lesson 1
The instructor begins class by reviewing today’s learning objective: Solve for internal forces in truss members using the method of joints. She asks a series of questions to ensure that students understand the information they were required to read in the course textbook before class. She uses a wooden model of a truss to illustrate the assumptions used in truss analysis – that joints are represented as frictionless pins and that loads are applied only at the joints. She then works a simple truss analysis problem at the chalkboard, models the problem-solving process, and asks lots of questions that emphasise the application of equilibrium concepts that the students had been studying in previous lessons. For homework, she assigns students a truss problem that is very similar to the one she has just worked at the chalkboard – a familiar context. She also gives a textbook reading assignment covering the method of sections. She concludes the class by asking students to write down the one concept or technique from today’s class that most requires further explanation. She uses this ‘muddy point paper’ to assess the students’ level of understanding of the method of joints.

Lesson 2
The results of the lesson 1 ‘muddy point papers’ indicate that, while most students feel comfortable with applying the method of joints, many are puzzled about which joints to select for a given analysis problem. The instructor begins the day’s class with a mini-lecture on this topic. She then presents the solution to the homework problem (on a transparency), asking the students to assess their own work (using a coloured pen provided by the instructor). After responding to the students’ questions, the instructor collects the students’ homework. She reviewing today’s learning objective and then presents an example problem illustrating the method of sections. She only works a portion of the problem at the chalkboard. Once she has modelled the process of isolating a section of the truss, she asks the students to complete the solution, working individually at their seats. As the students work, she circulates around the room monitoring the students’ progress and answering their questions. At the conclusion of class, she assigns another homework problem involving a relatively advanced application of the method of sections.

Lesson 3
The instructor begins class by returning the lesson 1 homework, which she has graded and annotated with detailed performance feedback. She reviews the students’ most common mistakes and suggests that those who are still struggling with the method of joints schedule some time for tutoring after class. She then collects the lesson 2 homework and responds to students’ questions about the method of sections. She reviews today’s learning objective: model a truss structure. She organises the students into teams of three and presents them with a highly unorthodox truss problem involving a component of the International Space Station – a highly unfamiliar context. The students are asked to formulate a solution to the problem, and with about 20 minutes...
remaining in the class, one team is asked to present its solution to the class. The other teams are asked to assess the first team's solution, and a general discussion follows. In the final few minutes of class, the instructor wraps up the topic of truss analysis. She notes that truss problems, in some form, will appear again on a future homework assignment, a mid-term exam, and the final exam. Future courses will address advanced applications of truss analysis in the context of axial member design, indeterminate structural analysis, virtual work, and steel design. The instructor concludes the class by outlining the learning objectives for the next block of instruction. This example illustrates how the model instructional strategy can be used as the basis for designing a coherent series of learning experiences spanning a block of lessons associated with a particular engineering topic or concept. The strategy provides for continuity from lesson to lesson; it ensures consistency between in-class and out-of-class learning activities; and it provides a basis for allocating the instructor's and students' individual and shared responsibilities to the learning process.

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References are available on request

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### Course Schedule

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<tr>
<td>20–21 August – Cape Town</td>
<td>Business Finance for Built Environment Professionals</td>
<td>Wolf Weidemann</td>
<td>Dawn <a href="mailto:Hermanus@saice.org.za">Hermanus@saice.org.za</a></td>
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<tr>
<td>23–24 August – Cape Town</td>
<td>Handling Projects in a Consulting Engineers Practice</td>
<td>Wolf Weidemann</td>
<td>Dawn <a href="mailto:Hermanus@saice.org.za">Hermanus@saice.org.za</a></td>
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<tr>
<td>25–27 September – Cape Town</td>
<td>Compaction of Road Building Materials</td>
<td>M White</td>
<td>Dianne Myles <a href="mailto:sarfuse1@acenet.co.za">sarfuse1@acenet.co.za</a></td>
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<tr>
<td>20–22 June 2007 – Cape Town</td>
<td>Management with Microsoft Project</td>
<td>Andrew Holden</td>
<td><a href="mailto:admin@classic-sa.co.za">admin@classic-sa.co.za</a> 073-533-6590</td>
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<tr>
<td>27–28 June – Gauteng</td>
<td>Technical Report Writing</td>
<td>Peter Bailey</td>
<td>Sharon Mugeri <a href="mailto:Cpd.sharon@saice.org.za">Cpd.sharon@saice.org.za</a></td>
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<tr>
<td>9–12 July – CSIR, Pretoria</td>
<td>The 26th Annual SA Transport Conference</td>
<td><a href="http://www.up.ac.za/academic/civil/satc.html">www.up.ac.za/academic/civil/satc.html</a></td>
<td>Ammie Wissing 012-348-4493 <a href="mailto:wissing@iafrica.com">wissing@iafrica.com</a></td>
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<td>16–17 July – Durban</td>
<td>Advanced Microsoft Project</td>
<td>Andrew Holden</td>
<td><a href="mailto:admin@classic-sa.co.za">admin@classic-sa.co.za</a> 073 533 6590</td>
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<td>23–25 July – Pietermaritzburg</td>
<td>Contract Documentation</td>
<td>D van As</td>
<td>Dianne Myles <a href="mailto:sarfuse1@acenet.co.za">sarfuse1@acenet.co.za</a></td>
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<tr>
<td>24–27 July – Midrand</td>
<td>Proactive Project Management</td>
<td>Andre Nortier</td>
<td>Sharon Mugeri <a href="mailto:Cpd.sharon@saice.org.za">Cpd.sharon@saice.org.za</a></td>
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<tr>
<td>17 August – Gauteng</td>
<td>Water Law of South Africa</td>
<td>Hubert Thompson</td>
<td>Dawn <a href="mailto:Hermanus@saice.org.za">Hermanus@saice.org.za</a></td>
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<tr>
<td>28–29 August – Gauteng</td>
<td>Traffic Calming Measures</td>
<td>J Coetzee</td>
<td>Dianne Myles <a href="mailto:sarfuse1@acenet.co.za">sarfuse1@acenet.co.za</a></td>
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<tr>
<td>17 &amp; 18 September 2007 – China</td>
<td>5th International Conference on Current and Future Trends in Bridge Design, Construction and Maintenance</td>
<td>ICE</td>
<td>Dayle Long <a href="mailto:Dayle.long@ice.org.uk">Dayle.long@ice.org.uk</a></td>
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