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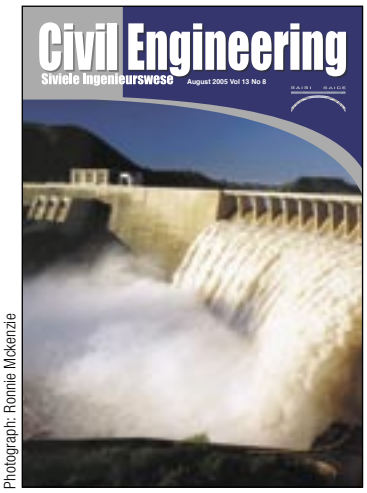

Photograph: Ronnie Mckenzie

ON THE COVER

The completion of the major structures of the Orange River Project marked the fulfilment of the dreams, enthusiasm and planning of three generations of civil engineers spanning more than a century. Thanks to them large regions of South Africa now have access to assured water supplies (see page 8)

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MAIN FEATURE

ENVIRONMENTAL

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OPINION

ENGINEERS, CLIMATE CHANGE AND THE ENVIRONMENT

THERE WAS A TIME When engineering issues were simple. Our objectives were economic optimisation within budgetary constraints. There were only two parties involved, the engineers and the political decision-makers. Water was plentiful and we could plan and build magnificent water supply projects without outside interference.

The 1980s were a turning point in the engineering approach to water resource development. Irrigation was no longer the major concern for future development. It was also foreseen that we would reach the maximum economic exploitation of our surface water resources by about 2010. There were now multiple users and the description 'demand management' was used to describe the solution to the problem of diminishing resources. Other concepts that came into use were risk analysis in the presence of uncertainty and economic optimisation in the presence of non-commensurate objectives, where one objective could only be fulfilled at the expense of the other. These analytical concepts were not popular with water resource engineers at the time, but are sure to be resuscitated.

To make matters worse, environmentalists became increasingly concerned about the effect of the degradation of quality and quantity of flowing and standing waters on aquatic life. Slowly their views prevailed and legislation was introduced that ranked water supply priorities in the order starting with basic human needs, then environmental needs, followed by municipal, agricultural and industrial requirements. It is one thing to have this legislation in the statute books, but it remains to be seen if it will survive political and social pressures during the inevitable severe droughts of the future, as rising demands clash with diminishing resources.

Engineers were having a rough time trying to sort out, collate, optimise and prioritise all these non-commensurate objectives. As though this was not enough, global warming became an emotive issue.

The theory is both simple and complex. Incoming short-wave solar radiation drives all the atmospheric and oceanic processes without which no human life would be possible. It is balanced by outgoing long-wave radiation.The argument is that dangerous greenhouse gas emissions, principally carbon dioxide from coal-fired power stations and from liquid fuel driven engines of vehicles and aircraft, rise into the atmosphere where they inhibit the long-wave outgoing radiation. As a result, the earth is gradually warming. The Arctic and Antarctic ice sheets and the world's glaciers are melting. Here the proof stops and conjecture begins because of the lack of convincing evidence. This is because of the high complexity of the oceanic and atmospheric energy distribution processes.

In 2001 I was invited to attend a workshop on climate and water held at the United Nations University in Tokyo. The climatologists repeated their dire warnings of floods and droughts and criticised water resource engineers for not taking appropriate action. I pointed out that the postulated changes could be accommodated within existing engineering design procedures, but the climatologists were unperturbed.

Strangely, neither the international nor the South African climate alarmists considered analysing the wealth of hydrological and meteorological data to see if there were any changes or trends that could be attributed to global warming. Why was this?

I assembled and studied a very large and comprehensive hydrometeorological database. I could not find any adverse changes that could be ascribed to human activities. I reported that climate change was not a cause for concern. The responses by natural scientists were many and unanimous. I was wrong, they responded.

In the beginning of 2004 I was back in Tokyo as a member of a panel of international experts appointed to advise Unesco on the establishment of a water resource institute in Japan. On the final day of the workshop, the World Wildlife Fund published a full-page advertisement in the English-language newspaper with the clear intention of influencing the discussions. It showed a high arch dam as its centrepiece and proclaimed that building dams would destroy aquatic life. Ironically, our meeting was held within a kilometre of the world's largest fish market where tonnes of fish are processed every day. I took the opportunity to ask the attendees for their views on the effect of climate change on water resources. They were unanimous. The postulated effects were no more than untested hypotheses and could be safely ignored.

THE INTERNATIONAL SCENE

But the international scene worsened. The predicted consequences of global warming were dire. One of the predictions was that there would be an intensification of the hydrological cycle, a phrase that will not be found in any respectable textbook on hydrology. Closer examination showed that the climate alarmists based their prophecies on global climate computer models, which in turn were based on proxy historical tree ring counts and ice cores. Again, the important question: why were the models not based on the wealth of real-world data so that the models could be calibrated and the results verified? The models were treated like trade secrets. Their algorithms and assumptions were withheld from the public and, more importantly, from scientists in other disciplines. This secrecy and lack of transparency eventually led to their downfall.

There was only one viable response to these emotive issues and that was to assemble a large hydrometeorological database and to follow the wisdom of our predecessors and ask: 'What are these numbers trying to tell me?' It took a lot of time and patience but I had to be sure of my position. The picture became increasingly clear. South African rainfall increased by about 9 % during this 78-year period of record. Furthermore, this increase was the result of an increase in the number of beneficial widespread rainfall events that raised soil-moisture levels and generated the river flow that filled the dams.

There was also an increase in open-water surface evaporation. The linkage was clear. The increase in air temperature increased evaporation from the oceans and land surfaces. Atmospheric moisture increased. Clouds formed and this water was released back to the earth in the form of rainfall. The consequences of global warming were beneficial for South Africa. Why did the climatologists not follow this line of logic and come to the same conclusion?

I also found a 21-year, non-cyclical periodicity in the data that was causally linked with corresponding changes in solar activity. If a process is regular, it is predictable. I developed a climate prediction model that was sufficiently realistic for long-term planning applications. My two papers were published in peer-reviewed journals in May this year. They are world firsts.

CLIMATE CHANGE POLITICISED

By now the climate alarmists had developed an influential political lobby. They claimed that there was a wide consensus among international scientists that the world was heading for a disaster if immediate steps were not taken to reduce emissions of harmful greenhouse gases. South Africa was identified as one of the leading culprits because of our reliance on 'dirty' coal for our energy sources. The South African government was persuaded that urgent and expensive steps would have to be taken to curb these emissions, even though this would damage and our national economy and reduce our trading competitiveness, particularly in relation to imports from China and India.

In February this year the Kyoto Protocol came into force. It required all signatory nations to undertake stringent and very costly greenhouse gas control measures. The US and Australia refused to sign the protocol while China and India were exempt. On 5 May the South African Department of Environment Affairs and Tourism issued a press statement titled 'South Africa braces for impacts of climate change. Major conference to be held in October'. It continued: 'Over the next 50 years climate change may well define the worst social, economic and environmental challenges ever faced.' The threats included the spread of malaria to wide regions of South Africa; the extinction of thousands of plant species; and that small-scale agriculture is likely to be hard hit by less rainfall in certain regions and too much in others. The statement concluded: 'In short, climate change will intensify the worst effects of poverty through losses in biodiversity, agriculture, health and almost every sector of society.'

Each and every one of these claims is contestable, bordering on irresponsible, yet they were presented to the public as facts.

By now it was easy to predict that, nationally and internationally, an unstable situation had developed between the climate change scenarios and the economic consequences of reducing them. The increasing level of rhetoric would soon result in its own downfall. It all centred on the US's refusal to commit itself to compliance with the Kyoto protocol on the basis that the action would be very expensive and the dire consequences were as yet unproven.

The countries of the world, including (and especially) South Africa and other developing countries, were faced with two non-commensurate objectives. These were either to maintain economic growth or to comply with the economically damaging provisions that required them to change

their energy sources from cheap coal to expensive alternative sources. Nuclear energy was an attractive alternative, but environmental pressure groups campaigned against it. It seemed as though South Africa had already chosen to follow the greenhouse gas emissions control route despite the reluctance, or inability, of climate alarmists to produce cost figures, whereas cost estimates are at the heart of all planning involving public expenditure, whether by the government or the private sector.

THE GLENEAGLES SUMMIT

Acting on the advice of their chief scientist, the British government threw its weight behind the Kyoto protocol and declared that climate change would be one of the two principal issues that would be addressed at the G8 summit. The other was aid to Africa. The summit was held at the beginning of July at Gleneagles under the chairmanship of the British Prime Minister.

Appreciating that the climate change issue was under threat, the national academies of science of the G8 countries and four others issued a joint declaration on the possible consequences of global warming if no action was taken to control undesirable greenhouse gas emissions. This was unprecedented. In normal circumstances this should have been sufficient to persuade the G8 leaders to take action. But the stakes were high and for the first time in history the politicians confronted the scientists.

A US Senate committee published copies of its letters to the chairman of the Intergovernmental Panel on Climate Change (IPCC) demanding information on the scientific basis for its claims. Similar letters were addressed to the US National Science Foundation that is responsible for the allocation of research funds, as well as to one of the American scientists whose research results had a major influence on the IPCC's recommendations. This researcher had refused to provide details of the computer algorithms and data used for his predictions despite the use of public finance for his research. In the UK, the House of Lords also made a public pronouncement of its disapproval of the scientific methodology used by climate change alarmists. These publicly expressed high-level criticisms were unprecedented in international affairs.

The G8 summit had hardly got under way when the horrific suicide bombing in London took place. The climate change lobby groups were sidelined and the G8 issued a communiqué that signalled the death of the Kyoto protocol and required the IPCC to make fundamental changes to its approach to climate change. Where does this leave us in South Africa?

A NEW APPROACH TO CLIMATE CHANGE

Despite some fundamental differences, the joint statement of the national academies of science and the G8 communiqué have several issues in common. The first is that nations are no longer required to take action that could damage their economies. This would have been a consequence of the implementation of the Kyoto Protocol. The second is the change of emphasis from preventing climate change to adapting to it. This will directly involve engineers for the first time. Before we can take any action we will need firm numerical estimates of the magnitude of the changes from whatever cause. Whereas climatologists rely on unprovable process theory, engineers rely on observational theory that needs no proof. Jointly, we should be able to solve the outstanding issues.

Now is the time for scientists and engineers in all affected disciplines to put their heads together and draw up a strategy for the future. Climate is in a natural state of change on all time and space scales. My studies indicate that we will probably have high, flood-producing rainfalls within the next 12 to 24 months. These will subside to sequences of years when droughts will prevail through to about 2016.

These natural changes will not only pose a severe strain on our water resources, but also on all processes in the natural environment. The issues will indeed be serious, but not for the reasons given by the climate alarmists. What South Africa needs is scientific leadership and guidance. Uncertainty and contentious issues are inevitable. Engineers, with their wide experience of numerical methods and philosophy of optimisation in the presence of uncertainty, can and should play an important role. We are trained to foresee problems and accommodate them in our planning and operational procedures. We should become involved.

Will Alexander's two recent papers published in scientific journals were 'Linkages between solar activity and climatic consequences', *Energy & Environment*, 16(2), 2005, and 'Development of a multi-year climate prediction model', *Water SA*, 31(2), April 2005. He is presently preparing a comprehensive technical report titled 'An assessment of the likely consequences of global warming on the climate of South Africa'. It should be available by the end of September

Mike Deeks was approached by e-tv to be interviewed for their Morning Edition programme on 23 June on the shortage of civil engineers in South Africa

A PROPOS MIKE DEEKS ON E-TV

THE SHORTAGE OF ENGINEERS is not limited to South Africa: we have the same problem in Ireland.

As a South African expat working abroad, it amazes me to hear presidents of the relevant institutions forward all types of 'reasons' for the shortage, but invariably missing the point.

Engineers are not business minded. As such, they are their own worst enemies. They often undercut each other and take on additional work without invoicing ... They focus on technical aspects and forget that their profession is termed 'engineering business'.

Have you ever tried to negotiate the price of a filling with your dentist? Or asked for half a filling?

Of course not.

Lawyers, solicitors, accountants, doctors and architects (to a large extent) stick to their guideline fees. They recognise that they are professional people. Engineers are often forced to cut their fees to a fraction because of client pressure. Engineers know that if they do not comply, the client will go to someone else who will ...

This results in:

- low salaries
- low quality of workmanship (that is, engaging cheap/young/inexperienced/foreign engineers)
- low image of the profession (the clients/developers/contractors dictate the terms)
- low social status (the title 'engineer' is often used by tradesmen such as fitters, mechanics and electricians)
- more responsibilities and a greater workload on the professional engineer because of more complex codes, legislation, H&S regulations, CPD, etc

These are the main reasons for people not wanting to enter the engineering profession.

It is up to people such as yourself to address the above at international level.

Victor Lopes

I WATCHED MIKE DEEKS' interview and was surprised that he did not mention the large reservoir of well-qualified and experienced civil engineers that make up the 'too old' category that is, anyone over 65 years of age.

Here is a wealth of experience and ability that could easily be tapped for the benefit of South Africa. Why a civil engineer is considered too old at 65 when a politician can become president of a country at 75 is beyond me.

I suggest that SAICE should compile a register of the retired engineers who would be available for employment to fill the impending shortage, instead of going overseas to recruit unknowns.

C J S Branscombe

BRANCHING OUT

'WE BORROWED THE LAND from our children and our grandchildren' (wise American Indian).

I come from a family of engineers, but none of their chosen disciplines really sparked my interest. There are several reasons that influenced my choice to pursue environmental engineering. These include a fascination of water in all facets of life, a responsibility to the environment, a holistic approach that allows the 'bigger picture' to be considered, and the appeal of being involved in design and problem solving. Hearing my Wits Professor Prvoslav Marjanovic talk passionately at a Wits open day was the final encouragement that I needed.

I had many expectations of what environmental engineering could hold for me. Although I am only in my third year, I have experienced many exciting aspects in the profession through my enthusiastic lecturers and vacation work carried out at Metago Environmental Engineers. My initial expectations centred on dams, river pollution and other water related activities, but I have come to see that environmental engineering encompasses a far greater spectrum of current and potential environmental issues. I have also realised that environmental engineering can almost be regarded as the 'missing link' between traditional engineering and environmentalists.

In addition to my initial expectations, I have learnt that environmental engineering includes air and soil pollution. Together with water, these categories deal with the prevention, remediation of environmental pollution and provision of economically sustainable long-term solutions. In terms of technology, legislation and management, South Africa is rapidly catching up with the rest of the world in terms of global issues (such as the World Summit that was held in Johannesburg in 2002) and the National Environmental Management Acts. South Africa is also party to the Basel Convention and the Stockholm convention, which consequently requires us to meet international best practice approaches.

Since environmental engineering is still in its 'infancy', I am often asked, 'What is environmental engineering?' This is commonly followed by a clever question like 'So you coordinate the tree hugging?' I have been tempted on several occasions to create the impression that I am a vegan, in fact do study tree-hugging methods and make clothes from leaves and bark, but since I do not wish to shroud the industry in any further unnecessary mist, I usually give an answer which is an honest as possible. My explanation is different every time due to the expansive and dynamic nature of the studies and work I am involved in.

Thus far, I have thoroughly enjoyed my encounter with environmental engineering. I am eager to graduate and be a full-time participant in my calling.

Justin Walls (third year environmental engineering student)

Text Lorraine Fourie
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... my parents bought a smallholding in Hout Bay which was covered in indigenous fynbos, and that's where my love of the natural environment developed ...

Summit of Kala Peak (5 900 m), Western China

True grit with *a gentle touch*

When Jaana-Maria Ball says 'I intend to go to the top,' there is no mistaking the quiet determination in her clear, light-timbred voice. In conversation with her at the offices of Arcus Gibb consulting engineers in Johannesburg, Lorraine Fourie discovers that, in Jaana's case, 'going to the top' has a twofold bearing. Not only was she, at age 35, recently appointed the first female director at Arcus Gibb, but in her spare time this 1,56 m woman scales dizzying mountain peaks as a matter of course

TO TRY AND SEPARATE Jaana the business achiever from Jaana the mountaineer seems almost impossible. In both these roles she thrives in the face of challenges, meticulously strategising and planning her assault, putting in the maximum physical and mental effort, negotiating and managing the pitfalls, and finally, at the peak of sweet success, already casting her eye toward the next obstacle to be conquered.

EARLY INFLUENCES

The oldest of three children, Jaana grew up in a home that offered much mental stimulation. 'My dad was a professor of Materials Engineering at the University of Cape Town, so I got to know the engineering environment well from an early age. He would challenge us in many ways, sometimes by unexpectedly firing a question such as "how does a refrigerator work", and expecting an intelligent answer,' she recalls.

'In my early teenage years my parents bought a smallholding in Hout Bay which was covered in indigenous fynbos, and that's where my love of the natural environment developed.' She also got hooked on mountaineering early on, joining the mountain club at school. Life in the outdoors was further filled with team activities as a member of the Girl Guide movements where her latent leadership qualities started unfolding. In her matric year she was chosen to join a selected team of female student leaders on a gruelling 355 km walk up the south-west coast.

STUDYING AND CLIMBING IN TANDEM

Jaana subsequently enrolled at UCT for a BSc degree, majoring in botany and zoology. 'I actually wanted to do geology, but when I realised that, as a woman, I would probably be stuck in an office on a mine somewhere, I didn't pursue that option.' However, the subject remains one of her many interests.

By the time she was doing her honours in botany (1991) Jaana's academic achievements had earned her, amongst other accolades, a Dean's merit listing in the Science Faculty and scholarships from the Botanical Society of SA and the Foundation for Research Development. Concurrently, her competency in mountaineering won her a host of UCT sports scholarships and merit awards, as well as full sports blues for mountaineering.

'One of the most exciting excursions I undertook in my university days was to traverse the Hex River mountains from end to end, climbing all the peaks on the way. A mountaineering friend who is a very experienced climber has taken me to countless remote places, and over the years we have done many week-long traverses where few have gone before. The IGI Challenge was another highlight at the time. It was a national mountaineering competition held in the Drakensberg, in which all the mountain clubs in South Africa competed against one another and I led the team from the UCT Mountain and Ski Club. We won the competition and with it a R10 000 prize.'

In 1993 Jaana received a travel grant to join the Mountain Club of South Africa's (MCSA) women's climbing expedition to the High Atlas mountain range in Morocco. The expedition was organised to celebrate a hundred years of female membership of

Summit of Tuyuk Peak (6 200 m), Western China

the MCSA. Not only was she the youngest member on the team, but she was also selected as a team leader. 'After the Moroccan expedition we went climbing in Spain and France where we continued our "peak bagging".'

By this time Jaana was working on her master's degree in botany, specialising in ecology. 'My original intention was to work towards a PhD, but a year before I was to submit my thesis I realised that I wasn't interested in becoming an academic. I didn't want to be confined to a small office at university, undertaking "blue-sky" research and having no interaction with the real world. So I wrote up my research as a master's thesis, finishing it in '95.'

A short stint at the Institute for Plant Conservation at UCT followed. 'This gave me my first experience of consulting work, giving specialist input on environmental impact assessment projects, which would later become my main field of work.' Quickly getting a feel for the type of work, Jaana lost no time in doing an integrated environmental management course at UCT as well as obtaining a business management diploma from Damelin College in the same year (1996).

In February 1997 she joined the Cape Town offices of Arcus Gibb as a junior environmental scientist, and promotions followed rapidly. By 2000 she was project leader and manager of the Cape Town environmental division and was made an associate in the firm. Two years later, in addition to project manager, she was appointed business development manager, spearheading marketing activities in the southern region of South Africa as well as neighbouring countries.

THE CHALLENGE OF THE UNATTEMPTED

In between hammering out a career she still found time for her other great love. Her involvement with the MCSA was ongoing and, at the time, she was handling the expeditions and environment portfolio of the Cape Town branch. So in 2000 she was selected for the MCSA's climbing expedition to Bolivia and Peru in South America to ascend the technical snow and ice peaks of Huyano Potosi (6 200 m) and Illimani (6 500 m).

The next year saw her being part of the 15-member South African Kuksay climbing expedition to northwestern China, where Jaana was the first woman to summit Kala Peak, an unclimbed 5 900 m ice and snow peak in the Himalaya mountain range. It proved to be a South African height record for a first female ascent. The expedition then proceeded to the 6 200 m Tuyuk Peak, a few kilometres away, where Jaana was again the first woman to summit. Theirs was only the second ascent of this peak.

'Standing in that remote valley where no-one had gone before, not even the locals, with a cirque of unclimbed mountain peaks beckoning was a real privilege,' she recalls.

'It was also the longest expedition I had done – six weeks in all – but a lot of the time was spent reaching the base of the mountain. Although we were all MCSA members we met each other for the first time in Istanbul, from where we travelled by truck along the old Silk Route through Kazakhstan and Kirgizstan. We had factored in four days to get to base camp, but eventually it took six days because of problems with porters.'

For Jaana much of the pleasure in exploring a mountain lies in doing it with people who share her passion and who then become lifelong friends. 'It makes you gel as a team and it really tests your strength, mentally and physically – I would say mountaineering is 60 % mental and 40 % physical.' She says she purposely goes on difficult expeditions slightly unfit and a little bit overweight. 'If you're too fit at the outset you tend to go too fast, you overdo it and you simply get yourself sick. Being slightly unfit in the beginning holds you back automatically. Of course, as you gain altitude, you become more and more lethargic. Every single step is an effort, placing an ice screw or collecting and melting snow or ice for water is a major effort.'

Besides the tough conditions the element of danger is ever present. 'On the Kuksay expedition there were avalanches cascading down all the time,' Jaana recalls. 'In the ascent of one of those peaks we chose not to be roped up because it would have been too dangerous. If one of the group had fallen, the others would have gone too. In fact, on the way down, one of my climbing partners did trip and started rolling, all the way frantically trying to arrest himself with his ice axe, but the snow was too soft to get a grip. He miraculously came to a stop after about 40 m.'

A SOUND BUSINESS GROUNDING

Since her ascent to management at Arcus Gibb, Jaana wanted to do her MBA, and in 2003 she enrolled at UCT's Graduate School of Business. During the year she was awarded the Businesswomen's Association's National Annual Scholarship. 'It was wonderful to join a group of people going places and all being enthusiastic about life in general and their careers in particular.'

In spite of feeling like 'collapsing in a heap at times', as she says, Jaana completed her MBA with top honours and was selected to attend the MBA International Exchange programme in 2004. 'I had a choice of destinations and I chose Barcelona in Spain because, apart from the fact that the ESADE is one of the top business schools in the world, I would be able to visit my family – Jaana is of British-Finnish descent – I could learn some Spanish, and of course it's close to the Alps, which are excellent for mountaineering and skiing.'

It was while skiing that Jaana had an accident severing all the ligaments in one knee. 'It's taken a year to recover fully, and I'm slowly getting back into my mountaineering, rock-climbing and mountain-biking. I also do yoga regularly, not only for suppleness and muscle strength, but for mental focus.

'The past year has also been very demanding at the office. I've relocated from Cape Town to take over the national leadership of Arcus Gibb's environmental business unit and I'm getting involved with the management of the group as a whole.'

Jaana talks enthusiastically about her efforts to turn her division into one of the best-performing business units in the company, but stresses that its success is largely due to the excellent team that she has working for her.

Arcus Gibb's acting CEO, Richard Vries, marvels about her ability to coax the best from her team. 'She's got a clear direction of where she wants to go and is one of the hardest workers here. But she has a soft side that filters through, a personal rapport with her employees and clients that creates the impetus for success.'

To cap this Jaana was recently appointed the first female director at Arcus Gibb. 'Engineering is still a male-dominated industry, but as women we can bring diversity and a different perspective to the workplace,' says Jaana. 'What I love about my work is that no day, no hour is the same. And I'm working on some of the most challenging and exciting projects in southern Africa.'

'When on a mountain face', she says, 'you are only focused on getting to the top, everything else disappears.' It is that stamina, that determination, that positive approach that is also making her go places in the world of business. □

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PART 3

The Orange River

Why drag the chariot wheels?

'Why drag the chariot wheels?' wrote Sir William Willcocks in 1903. 'Let the South African governments confine themselves to the boldest projects.' He advocated three bold projects on the Orange River. The first was an 18 m high diversion weir at the Van der Kloof site and a 240 km long canal to irrigate land as far as Prieska. The second was an 18 m high diversion weir at Prieska to carry water into the Hartbees River valley, 'to be employed in irrigation on a scale not dreamt of yet in South Africa'. The third was another 18 m high weir at Upington and a canal into the Bushmanland south of Pella to command an immense area, which (he was given to understand) was excellent land

DEVELOPMENT OF THE LOWER ORANGE RIVER

Unfortunately Willcocks' proposals were based on scanty topographical information and unreliable estimates of irrigation potential. Subsequent investigations showed his second and third schemes were impractical, but the Van der Kloof scheme was revived several times during the half century that was to pass before its final approval.

It is at Van der Kloof that the valley of the Orange River suddenly widens out after its long journey from the Drakensberg mountains. From the dam site there is a magnificent view of the plains to the north-west. Possibly it was this view that inspired Dr A D Lewis, the Director of Irrigation, to write: 'There can be hardly a single true South African, and certainly no irrigation engineer, with soul so dead that he can contemplate our greatest river tearing down to the ocean through a vast area of the country, which is thirsting for water, without feeling that some great effort should be made to design and carry out irrigation works for the Orange River, which would rival those famous works of other great rivers of the world, such as the Ganges, the Indus, the Nile or the Colorado.' The date was 12 October 1928 and Dr Lewis was addressing the irrigation congress at Graaff-Reinet. He then went on to discuss the future development of the Orange River.

As a result of investigations carried out by his department, Lewis was able to establish that no great development could take place along the Orange River without large storage works. Furthermore, the Orange had carved for itself a deep and rugged valley, whereas most other big irrigation rivers of the world wandered at a gentle slope through flat alluvial lands which they had built up in their past history. Thus it would be necessary to look to the valleys of the tributaries of the Orange for large irrigable areas rather than along the banks of the Orange itself. These tributaries (from east to west) are the Vaal with its tributaries the Harts and the Riet; the Brak (left bank); the Hartbees (left bank); and the Molopo (right bank).

Lewis pointed out that surveys undertaken immediately after Sir William Willcocks' report in 1903 showed that a canal from a 19 m high weir at Van der Kloof would get badly tied up soon after leaving the site and would only command 9 000 ha. Survey operations were resumed in 1919 after World War I, and it was found that this difficult section could be circumvented by a canal 34 m above the riverbed,

Project

which would command a larger area of land.

However, although Beervlei in the valley of the Brak River is less than 113 km from Van der Kloof in a straight line, a canal round the spur between the two points would not be less than 480 km in length and it would have to start considerably higher than 36 m above the riverbed at Van der Kloof. The minimum height of a canal at Van der Kloof would have to be 70 m in order to command the Brak River valley with the shortest canal and minimum loss of head. In addition, at least 12 m of storage above the canal level would be necessary. This would mean an 82 m high dam across the Orange River – a formidable and expensive project in those days.

In order to penetrate into the Vaal River valley, the diversion canal would have to be even higher than that commanding the Brak River valley. Development of the Hartbees and Molopo rivers proved equally disappointing. The department reluctantly abandoned its investigations in 1922 and the survey staff were shifted to the Vaal River valley where more economical storage and diversion schemes were possible. The Vaal-Harts scheme was subsequently developed and the Van der Kloof project was put into cold storage.

NINHAM SHAND PROPOSALS

In 1959 the Northern Cape Regional Development Association published a preliminary survey of water resources of the Northern Cape, prepared by their consulting engineer, Ninham Shand. Ninham Shand proposed the construction of a 107 m high storage dam at the Van der Kloof site with canal outlets at 85 m above the river bed – 15 m higher than the department's 1922 proposals. The development of hydroelectric power was also envisaged. The canal network would extend northwards across the Riet and Modder rivers to Barkly West on the Vaal River and westwards to the Brak and Ongers rivers, the latter from a high-level canal fed by pumps.

WHITE PAPER PROPOSALS

In 1962 the construction of a storage dam at Van der Kloof and a system of canals was finally approved by Parliament. The dam was to be 88 m above the lowest foundation, but this was subsequently increased to 100 m to permit increased generation of electric power.

The left bank canal outlets would be 61 m above the riverbed – 9 m lower than the 1922 proposals and 24 m lower than the Ninham Shand proposals. This would allow the maximum use of the storage in the dam. The canal network would be developed to serve not only the Brak River valley, but also the Hartbees River valley to the west and the extensive Witsands area east of Upington. On the right bank water would be pumped into a high-level canal serving the lower Riet River valley.

Practical and financial difficulties clamped the brakes on the chariot wheels in the half-century following Willcock's proposals in 1903. In 1962 the Department of Water Affairs submitted its White Paper on the proposed Orange River Development Project to Parliament for approval. The brakes were released and the chariot was under way at last.

MAIN COMPONENTS

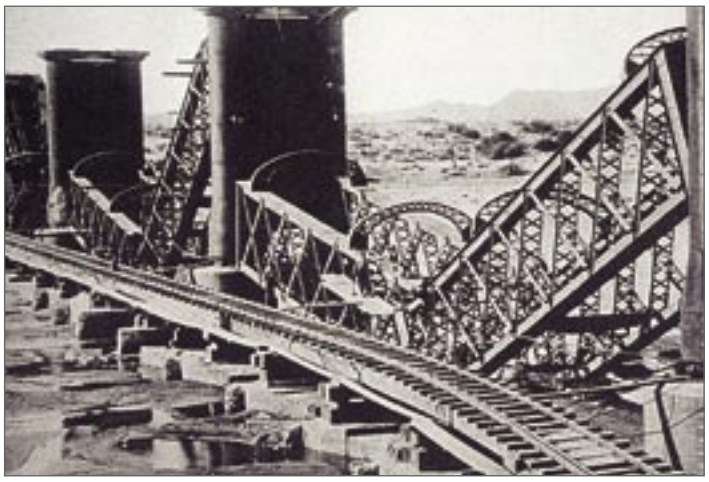
The department's policy was to name its projects after the names of the farms on which they were located. The original 1962 White Paper referred to the Ruigetevallei Dam near Norvalspont and the Van der Kloof Dam near Petrusville. At a later congress of the Cape Midlands Development Association in Port Elizabeth it was recommended that the name Ruigtevallei Dam be changed to Hendrik Verwoerd Dam. This was reflected in the Supplementary White Paper of 1964. The second and third Supplementary White Papers of 1968 and 1971 referred to the P K le Roux Dam at the Van der Kloof site, after the previous Minister of Water Affairs who steered the approval of the project through the political process.

After the change of government the name Hendrik Verwoerd was changed to Gariep, which is the original name of the lower Orange River referred to by Colonel Gordon. The name P K le Roux Dam reverted to its original name, which is well recorded in historical documents.

The main components of the Orange River Project are as follows:

- The Gariep Dam near Norvalspont is the main regulator of the waters of the Orange River. Its other functions are to provide hydropower, reduce downstream flood damage and trap river sediment.
- The Van der Kloof dam and the associated canal distribution system that supplies water by gravity and pumping to a large area in the Orange and adjacent catchments.

▶ *From left to right:*
Gariep Dam: one of six chute spillways. Eskom power station on the left
Gariep Dam: temporary diversion on the right while construction continues within the main cofferdam
Gariep Dam in flood. Note the effect of the energy dissipation splitters



The original Bethulie bridge across the Orange River was destroyed by retreating Boer forces. A temporary bridge was constructed by British engineers

Looking downstream: the new Bethulie road and rail bridge across the future dam basin

- The Orange-Fish tunnel sector supplies water to users in the Great Fish and Sundays River valleys and supplements existing water supplies in the Uitenhage and Port Elizabeth areas. (This is described in the previous article.)
- Hydroelectric power stations operated by Eskom at the two dams.
- Welbedacht Dam on the Caledon River, which supplies water to Bloemfontein and the surrounding area.
- The combined road and rail bridge across the Gariep Dam basin near Bethulie.

DESIGN CRITERIA

From its establishment in 1912, all the way through to the submission of the White Paper to Parliament fifty years later, the Department of Irrigation (now Water Affairs and Forestry) was directly responsible for the planning, design, construction and operation of South Africa's major water supply projects. The following criteria were used for the design of the Gariep and Van der Kloof dams, as shown in the design drawings included in the White Paper.

A major concern was the *high sediment load* that has its origin in the Caledon River, the largest upstream tributary. It was appreciated that the Gariep Dam in particular would become a wasting asset from the time that it was built. In the early 1950s I carried out sediment deposition surveys in Grassridge and Van Ryneveld's Pass dams. I found that there was a steep slope of the deposits in the vicinity of the outlets, indicating that the sediment could not be resuspended once it had consolidated. Accordingly, the Floriskraal Dam near Laingsburg, completed in 1956, was equipped with ten large radial gates near bed level. The idea was that the sediment-laden incoming floodwaters would be routed directly through the dam basin. An exceptionally high flood occurred in 1981, destroying the upstream town of Laingsburg. Owing to human error (an important design consideration), the gates were not opened and the dam wall was overtopped along its whole length. There was therefore no possibility that the rate of sedimentation in the Gariep Dam could be reduced by physical measures, so provision had to be made in the design for future raising.

The next most important design criterion was that the two dams had to have a *large flood peak reduction potential*. This is achieved by releasing water from the dam at the maximum safe rate prior to the arrival of the peak, so that the flood hydrograph can be attenuated. While dams equipped with crest gates, for example Vaal Dam, have a limited flood peak attenuation potential, the most efficient arrangement is to have large, lower-level, gated spillways. Three such spillways were provided on each of the two gravity flanks of Gariep Dam and six on the left flank of the Van der Kloof Dam wall.

The third criterion was the need to *accommodate Eskom's hydropower requirements*. For this reason, the originally planned heights of both dams were increased to provide additional head for power generation.

The standard practice in dams designed by the department, including the two Orange River dams, is to incorporate energy dissipaters in the overspill crests of the dam. These were designed by D F Roberts, then resident engineer at Loskop Dam. They have been successfully used in all the department's dams since then.

APPOINTMENT OF CONSULTING ENGINEERS

Subsequent to the approval of the White Paper it was decided that the construction of the two dams and the tunnel should be undertaken by private contractors. Consulting engineers were appointed by the department to undertake further investigations, as well as the detailed design and supervision of

Van der Kloof Dam: chute spillways

Van der Kloof Dam

the construction. All other works other than the Bethulie bridge would be designed and constructed departmentally.

The consulting engineers for the two dams were the International Orange River Consultants, a consortium of French and South African consulting engineers, and Gibb Hawkins and Partners.

A permanent cabinet committee for the project was established by the government. The committee consisted of cabinet ministers who were responsible for those state departments connected with various aspects of the project. The committee was assisted by an advisory council.

GARIEP DAM

The main contract for the civil works at Gariep Dam was awarded in April 1966 to a French-South African consortium UC-Dumez-Borie dams. The contract was scheduled for completion in 62 months. On 18 November 1966, Prime Minister B J Vorster pressed the button that blasted the first cubic metres of foundation overburden into the air. Construction was soon in full swing.

The principal statistics of the Gariep Dam are as follows: maximum height above foundation 90,5 m; crest length 948 m; gross storage capacity 5 960 million m^3; excavation 1,9 million m^3; concrete 1,9 million m3; surface area of dam 374 km^2.

The spillway design capacity for Gariep Dam is 8 000 m^3/s. The six gated spillways together provide another 8 000 m^3/s, totalling 16 000 m^3/s in all. The largest recorded flood downstream of the dam occurred in 1874 when 11 330 m^3/s was recorded at Hopetown. In March 1925, 9 060 m^3/s was recorded at Bethulie. In February 1967 a flood of 8 500 m^3/s flowed through the construction works. During the course of the day the flood rose steadily until it overtopped the left and right bank cofferdams. By nightfall all the construction works in the river channel were completely submerged as the level in the river rose to 5 m above the cofferdam crests.

The next day the sluices in the cofferdam walls had to be opened to ensure that the water level inside the cofferdams was not higher than that in the river. Eventually, after the river subsided, a bulldozer was sent in to clear up the mess. It was soon bogged down in the still fluid sediment deposit. This mixture of floods and sediment deposition nicely summarises the hazards to be encountered when building dams in South African rivers.

Another lesson occurred when I parked my car on an unused road directly beneath the Blondin cableway so that I could take a cinephoto as the 14 tonne bucket of concrete passed overhead. The bucket opened accidentally behind me. The operator applied the brakes and the bucket started swinging backwards and forwards as it emptied. A large piece of stone hit my hardhat, knocked me down and my hardhat rolled away. I had to make an urgent decision. Should I crawl under the car and risk being squashed if the 6 tonnes of concrete fell on the roof, or should I lie where I was and hope that the rest of the concrete would miss me? I compromised by crawling halfway under the car. Other than minor damage to my legs and major damage to my car I survived.

Storage of water in the dam commenced in September 1970. By early June 1971 the dam was already 65 % full. The first power generator with a capacity of 80 MW came into operation in September 1971.

VAN DER KLOOF DAM

The building of the Van der Kloof Dam was scheduled to commence at the same time as the Gariep Dam, but in October 1967 construction was postponed as a measure to curb inflation, but the canal construction continued. In 1969 the cabinet decided to go ahead with the dam, and in 1970 tenders were called for a second time. The tender prices were considerably higher than expected. At the beginning of 1971 it was decided that the dam would be built departmentally under the supervision of the consulting engineers.

The crest length of the dam wall is 765 m, and the height is 107 m. The wall contains 1,1 million m^3 of concrete. At the time of its completion it was the highest dam in South Africa.

COMBINED RAIL AND ROAD BRIDGE

Soon, the construction of the combined road and rail bridge across the dam basin near Bethulie commenced. The 1 152 m long bridge was the longest in South Africa at the time of its completion. It is 52 m above riverbed level and it is wide enough to take a double track and a double roadway.

This is a historical site. This is where the explorer Colonel Gordon first discovered the Orange River. A permanent, steel girder rail bridge was constructed just downstream of the site of the new bridge during the 1880s. During the Anglo-Boer War the Boers destroyed the bridge as they retreated back into the Free State. A temporary low-level bridge was constructed by the British engineers and a blockhouse built to protect it.

Later the British established a concentration camp near this site, as well as at Norvalspont. The inscriptions on the headstones of the women and children buried at the cemetery at the Bethulie camp were heartbreaking. The inscriptions were hand carved on slabs of weathered sandstone. The bodies were re-interred at a new cemetery further from the river as part of the project. The headstones were mounted in a wall of remembrance where they continued to weather. Today, these historical sites are submerged under the waters of Gariep Dam.

▶ TRIBUTE

These articles on the Orange River Project are a small tribute to three generations of civil engineers and all those who contributed to the concept, planning, design, construction and operation of South Africa's largest and most extensive water supply project. Their names do not appear on any memorial, but their achievements will serve the citizens of this country for generations to come. We were told that our efforts would provide 'water for a thousand years'

Text: Jeremy Boswell, Bill Wallace, Peter Boswell, John Boyd, Ike van der Putte, Lorna Walker and Sally-Ann Rigby
FIDIC Sustainable Development Task Force
References available on request

Project sustainability management

Translating words into action

THE CONCEPT OF SUSTAINABLE DEVELOPMENT is changing the way people think about development and its effect on the environment and society. It defines a new development pathway – one on which society can maintain and improve the current quality of life without jeopardising the ability of future generations to maintain and improve their quality of life.

The imperative to make our development sustainable is based on a perceived threat to society. Today there is sound evidence that we are using up critical resources and ecological carrying capacity faster than they can be renewed, replaced or replenished. The evidence is viewed by many as sufficient to begin changing society's approach to economic growth and development.

The task facing society is enormous. Achieving sustainability will be a long journey, perhaps requiring the total overhaul of the way we extract resources, produce and consume goods and services, and dispose of unwanted by-products.

With these intentions in mind, several questions arise. How should facilities and infrastructure projects be designed and implemented in order to make a real contribution to sustainable development? How does one convince stakeholders that true progress toward sustainability is actually being achieved? How does the intent to deliver projects that make a contribution to sustainability get translated into reality and measured?

THE JOURNEY TOWARDS SUSTAINABILITY

The journey towards sustainability was first mapped at the United Nations' Earth Summit in Rio de Janeiro in 1992. One of the key products from the summit was a publication known as Agenda 21, a 40-chapter, 800-page document which outlined 120 separate action programmes for achieving sustainability. The importance of Agenda 21 was that it set out for the first time a comprehensive set of goals and priorities for resource, environmental, social, legal, financial and institutional issues. While not a legally binding document, it was adopted by nations representing 98 % of the world's population.

Agenda 21 urges national governments – as well as international governmental and non-governmental organisations – to identify and develop sustainable development indicators, that is, measures which will enable decision-makers to monitor, assess, diagnose and compare the factors relevant to sustainable development. Agenda 21 also requires that local governments prepare a Local Agenda 21, 'a plan of action aligned to the problems and issues specific to their communities'.[1]

In response to the interest and demands of their stakeholders, many organisations in industry and government are making public commitments to the principles of sustainable development. As a demonstration of those commitments, these organisations are making changes to the way they manage their operations and infrastructure investments. They are starting to build or refurbish facilities and infrastructure using designs and methodologies that make more efficient use of resources and energy, protect ecological systems, and specifically take into account the needs of the communities in which they operate.

Unfortunately, there is little guidance about what constitutes a sustainable project. In the absence of definitive guidance, many non-governmental organisations and public interest groups are applying their own notions about sustainability to projects and organisations, based on their particular agendas and interests. As a result, project owners have been exposed to a confusing array of sustainability indicator systems, of which few, if any, provide a clear connection between the overall goals of sustainability and the individual projects that move society towards those goals.

Recognising these issues, the International Federation of Consulting Engineers (FIDIC) has developed a framework and a process for setting project sustainability goals and measuring progress toward those goals. Embodied in these project sustainability management (PSM) guidelines, the framework is designed to ensure that a project's sustainability goals are aligned towards recognised and accepted whole society goals and priorities.

Conditions of sustainable development are difficult to achieve and even more difficult to demonstrate. Society's goals for sustainable development tend to focus on broad problems and issues facing all of society. These include global warming, biodiversity, access to fresh water, reduction of materials and energy intensity, and others. Although this whole society focus for sustainability is essential, it makes it difficult for organisations to link the performance of their projects back to these higher-level goals and demonstrate their project's overall contribution to sustainable development.

THE FRAMEWORK AND PROCESS

If sustainability is to be achieved, it is essential to develop both a framework and a process for setting project sustainability goals and measuring progress. A framework needs to be constructed to ensure that a project's goals are aligned to that of society. In addition, a process is needed to guide the planning and delivery of projects. The process must

- assist the project owner and the consulting engineer in developing practical project sustainable development goals, striking a balance between the owner's aspirations and the issues of cost, achievability and stakeholder concerns
- incorporate substantive stakeholder input throughout the project life cycle, ensuring that all substantive issues are addressed
- be open and transparent in terms of goals, stakeholder input, and project performance expectations
- provide mechanisms for feedback, assessment of results, sustainability performance benchmarking, and knowledge sharing

An essential ingredient for this process is a comprehensive set of project sustainable development themes and indicators, covering the full range of issues and enabling practitioners to measure the specific project contributions towards sustainable development.

In the PSM process, the project proponent and the consulting engineer work together to select appropriate sustainable development project goals balancing the owner's project vision against available alternatives and costs. Then, working with the owner, the consulting engineer uses the PSM process to create project performance indicators that correspond to those sustainable development goals. If properly done, the indicators will enable all parties to determine whether or not the objectives have been achieved, or if not, take whatever corrective actions that may be appropriate. Stakeholder input is sought

1 As of 2001, over 6 000 local authorities in more than 100 countries had either made a formal commitment to Local Agenda 21 or were actively undertaking the process.

throughout the process.

PSM provides a methodology for benchmarking sustainable development project performance against the performance that others have achieved. At the same time, it provides a way for ensuring that advances in one dimension of sustainability on a project are not accomplished at the expense of others, making the net result sustainability neutral or even negative.

THE ROLE OF PROJECT SUSTAINABLE DEVELOPMENT INDICATORS

While project goals set the direction, project sustainable development indicators provide the means by which progress can be measured. Their purpose is to enable real progress toward sustainability to be gauged by comparing actual sustainable performance achieved against sustainability goals. Thus, a comprehensive set of project sustainable development indicators is an essential tool for measuring actual achievements.

To function properly, the indicators set must be grounded in the principles and goals of sustainable development. Furthermore, they must be sufficiently comprehensive to encompass all relevant aspects of sustainability, yet be of a size that is manageable and effective for communication. Importantly, the indicator set must allow for customisation in order to align to local requirements and conditions. Finally, the process by which these accommodations are made must be open and transparent.

PROJECT SUSTAINABILITY MANAGEMENT – THE FIDIC APPROACH

FIDIC's PSM guidelines describe how project owners and consulting engineers can incorporate the principles of sustainable development into individual projects. The components of the FIDIC PSM system are twofold:

- a framework of sustainable development goals and the corresponding indicators, both of which map back to the whole society issues, goals and priorities of Agenda 21, and the corresponding sustainability indicators developed by the United Nations Commission on Sustainable Development (UNSCD)
- a process for setting and amending sustainable development project goals and indicators, making them consistent with the vision and goals of the project owner, compliant with Agenda 21, and tailored to local issues, priorities and stakeholder concerns

A set of core sustainable development project goals and indicators has been development and organised in a framework which corresponds to the whole society issues, goals and priorities of Agenda 21. A process to amend these goals and indicators has also been devised, allowing them to be customised to actual project conditions, while retaining the whole society scope. In addition, the process addresses the full life cycle of the project, from concept development, through design, construction, operation, deconstruction and disposal. In this sense, project sustainability goals and indicators become part of the overall project delivery process.

Sustainable development issues are divided into categories: environmental, economic and social. Below each category, sustainability issues are organised into themes and sub-themes. Each sub-theme is associated with one or more indicators of sustainable development. Each indicator can be characterised by a spectrum of sustainable performance achieved in relation to the current state of the practice, applicable laws or regulations, and sustainability goals.

THE CORE SET OF PROJECT INDICATORS

The starting point for PSM is a set of 'core' sustainable development indicators derived from national and international sustainability goals and targets. Indicators are used to measure important project performance parameters. Measurements are compared against expected results and corrective actions are initiated if indicator measurements are outside expected values. For PSM, the emphasis is not only on corrective actions, but on measuring performance and contributing to the sustainability knowledge base.

Indicators are typically built in a two-part process, the first being a framework that ties the indicators to overall objectives defined in the global context, which is used to map overall sustainability goals to specific issues that will be addressed.

The second part of the indicator building process involves the development of a series of conceptual models that describe the performance of the project in each framework category in terms of measurable parameters. These parameters describe the cause and effect relationships within the context of the project and ensure that the selected indicators can be used to measure project performance. Indicators are selected for a particular project if they are seen to influence outcomes and respond to changed external factors. As an example, the framework for a global objective of improved health in society might include the sub-category of drinking water with a conceptual model that if safe drinking water were available to a higher percentage of the population, global health might improve. The indicator would then become the percentage of the population having access to clean drinking water. Access to safe drinking water in terms of a project in the developed world might involve issues of maintaining water quality coming out of the taps in each building. In the context of the developing world, the level of improvement might be much more rudimentary and involve a central community clean drinking water source. In a project-specific way, it would be advantageous to engage the local affected community in a dialogue about the feasibility and applicability of the systems and approaches to be used in the delivery of clean drinking water, and in the indicators that might be used to describe the results of the project.

The starting point for the application of PSM is a core set of sustainable development core themes, sub-themes and project indicators, presented in the table below. A subset of 42 indicators was selected, based on their relevance to projects.

Table 1 PSM core sustainable development project indicators

Theme	Sub-theme	PSM core project indicators
Social		
Equity	Poverty	SO-1: Proportion of workers or companies employed on the project from the local area
Equity	Gender equality	SO-2: Existence of hiring and wage policies related to minorities and women employees
		SO-3: Proportion of minorities, women hired
		SO-4: Wage comparison of minorities, women compared to standards
Health	Sanitation	SO-5: Proportion of population with access to adequate sewage treatment
Health	Drinking water	SO-6: Proportion of population with access to safe drinking water
Health	Healthcare delivery	SO-7: Proportion of population with access to primary health care facilities
Health	Occupational safety and health	SO-8: Record of safety performance during construction
Human rights	Child labour	SO-9: Record of the use of child labour during project construction
Housing	Living conditions	SO-10: Proportion of persons living with adequate floor area per person
Population	Population change	SO-11: Change in number and proportion of populations in formal and informal settlements affected by the project
Culture	Cultural heritage	SO-12: Assessment of impacts on local culture, historic buildings

Theme	Sub-theme	PSM core project indicators
Culture	Involuntary resettlement	SO-13: Degree to which the project displaces the local population
Integrity	Bribery and corruption	SO-14: Efforts to monitor and report bribery and corruption
Environmental		
Atmosphere	Climate change	EN-1: Quantities of GHGs emitted in all phases of project
Atmosphere	Ozone layer depletion	EN-2: Quantities of ozone-depleting substances used in all phases of project
Atmosphere	Air quality	EN-3: Quantities of key air pollutants emitted in all phases of project
Atmosphere	Indoor air quality	EN-4: Quantities of indoor air pollutants
Land	Agriculture	EN-5: Proportion of arable and permanent crop land affected by this project
Land	Agriculture	EN-6: Quantities of fertilizers used compared to norms
Land	Agriculture	EN-7: Quantities of pesticides used compared to norms
Land	Forests	EN-8: Extent to which forests are used or affected in the development, design and delivery of the project
Land	Forests	EN-9: Extent to which wood is used in all project phases
Land	Desertification	EN-10: Extent to which land covered by project is affected by desertification
Oceans, seas and coasts	Coastal zone	EN-11: Measurements of changes in algae concentrations
Oceans, seas and coasts	Coastal zone	EN-12: Changes in populations living in coastal areas
Freshwater	Water quantity	EN-13: Measurements of water usage on project during all phases
Freshwater	Water quality	EN-14: Measurements of BOD on water bodies affected by project during all phases
Freshwater	Water quality	EN-15: Measurements of faecal coliform in freshwater bodies affected by project during all phases
Biodiversity	Ecosystem	EN-16: Proportion of area affected by the project that contains key ecosystems.
Biodiversity	Species	EN-17: Measurements of affect of project on the abundance of key species
Economic		
Economic structure	Economic performance	EC-1: Extent to which the project provides economic benefit to the local economy
Consumption and production patterns	Material consumption	EC-2: Extent of use of materials compared to norms, other practices
Consumption and production patterns	Energy use	EC-3: Extent of energy consumption compared to norms, other practices
Consumption and production patterns	Energy use	EC-4: Extent of the use of renewable energy resources compared to norms, other practices

Theme	Sub-theme	PSM core project indicators
Consumption and production patterns	Waste generation and management	EC-5: Quantities of industrial and municipal wastes generated compared to norms, other practices
		EC-6: Disposition of industrial and municipal wastes compared to norms, other practices
Consumption and production patterns	Waste generation and management	EC-7: Quantities of hazardous wastes generated compared to norms, other practices
		EC-8: Disposition of hazardous wastes compared to norms, other practices
Consumption and production patterns	Waste generation and management	EC-9: Quantities of radioactive wastes generated compared to norms, other practices
		EC-10: Disposition of radioactive wastes compared to norms, other practices
Consumption and production patterns	Waste generation and management	EC-11: Extent to which waste recycling and reuse is employed in all phases of the project, compared to norms, other practices
Consumption and production patterns	Transportation	EC-12: Measurements of transportation modes and distances people and materials in all project phases, compared to norms, other practices
Consumption and production patterns	Durability (service life)	EC-13: Extent to which durable materials were specified. Design for extended service life
Consumption and production patterns	Care, ease of maintenance and repair	EC-14: Extent to which the facility requires care and maintenance, compared to norms

In the PSM process, the list of core indicators can be modified and expanded in a series of steps, applying local sustainable development indicators and stakeholder input. The process does not, however, allow an indicator to be deleted or materially modified if it is seen as being pertinent.

CREATING PROJECT-SPECIFIC SUSTAINABLE DEVELOPMENT GOALS AND INDICATORS

The PSM process for creating and implementing sustainable development goals and project indicators is summarised below.

Stage 1 *Establish sustainability goals and baseline project indicators*

- Determine the project owner's vision, goals and objectives for the project
- Establish the project scope and setting assumptions
- Identify and engage key stakeholders

Stage 2 *Adjust goals and project indicators to local conditions*

- Incorporate applicable safeguard policy considerations
- Identify and incorporate local Agenda 21 or other local indicator development activities

Stage 3 *Test and refine project goals and indicators*

- Refine goals based on systems integration considerations
- Test project indicator functionality
- Refine indicators to align with applicable regulations, protocols

Practitioners who complete these three stages of the PSM process will have developed a set of sustainable development goals and the corresponding indicators for their project.

MEASURING AND REPORTING

Once agreement is reached on the final set of indicators, the engineer and the project owner should work out an implementation plan. The plan consists of methods and schedules for measuring, assessing the indicator values and reporting the results.

In addition to producing the reports, additional effort should be made in reviewing the results periodically so that the project owner and the engineer can detect unforeseen problems with either the indicators themselves or the values being generated. Unexpected results, or results greatly out of line with pre-set thresholds, should be noted and reported to the project owner. This process aligns well with typical project quality management systems.

Throughout the course of the project, the indicators, the methodologies and the measuring schedules should be reviewed regularly and the results assessed. Sustainable development issues and the corresponding indicator frameworks are in a constant state of change because of new information, issues and values. The review process should be incorporated into the project owner's management processes.

PATH FORWARD

The FIDIC Sustainable Development Task Force believes that the PSM process can make a substantial contribution in progress toward sustainability. It is also felt that even small projects, which may not warrant a formal implementation of the procedures, can benefit. By evaluating the checklist of indicators and taking note of site specific activities that may be of relevance, both design and construction solutions that address these in a beneficial manner is a step forward.

PSM is by its very nature an evolving system that will change as society improves its understanding of the issues of sustainable development. FIDIC intends to follow this evolution closely, making changes to PSM as our knowledge and experience improves.

The system is still in its infancy, and as such concrete implementation examples are not yet available. A number of examples in different types of project areas are being worked on and it is hoped that these valid additions will be tabled in the next 18 months. These will provide valuable support to consulting engineers in their role in designing and delivering projects that truly improve conditions of sustainability. □

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‘Green’ waste minimisation

THE CITY OF CAPE TOWN was formed in 2000 through the amalgamation of seven former municipal local councils (MLCs) in a single metropolitan council (unicity). Solid waste services that are provided by the new metropolitan council include the bulk disposal service of the former Cape Metropolitan Council as well as the collection and cleaning functions of the other six former MLCs.

The city’s population of approximately 3,1 million is growing at an estimated 1,6 % a year, while the waste being disposed of is growing by an estimated 4,5 % a year. Given this growth factor, by 2031 the city will be disposing of some 3,5 million t of waste every year. Figure 1 indicates the composition of the waste stream generated on an annual basis.

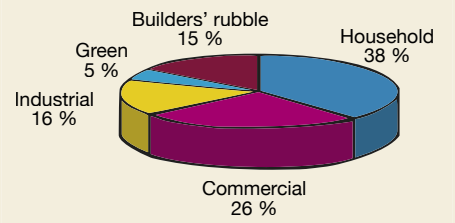

Figure 1 Percentage of waste categories generated in the City of Cape Town

There are currently five operational landfill sites in the Cape Town Metropolitan Area, accepting about 86 % of the residential, commercial and industrial waste stream generated in the area (the rest is recycled). Four of these landfills are owned and operated by the City of Cape Town and the fifth one is privately owned and operated.

It is expected that three of the remaining four municipal landfills will be closed within the next four years. A new regional landfill site is planned that will provide for the shortfall in airspace as the existing landfills reach their full capacity before they are closed.

The overall landfill capacity for Cape Town as it currently stands (not including any extensions and designs for new landfills in the near future) is about eight years. In view of the tremendous volumes of waste generated, the operational cost of collecting and landfilling the waste, and the limited available airspace, it has become essential to develop strategies for waste reduction.

WASTE MINIMISATION

Currently legislation in South Africa does not explicitly require ‘waste minimisation’ measures as part of day-to-day waste management. (In this article ‘waste minimisation’ is defined as ‘any activity that prevents or reduces the volume and/or environmental impact of waste that is generated, treated, stored or disposed of’.)

Certain policies and planning documents, such as the White Paper on Integrated Pollution and Waste Management (2000) and the National Waste Management Strategy (NWMS) Action Plans (1999), provide strong guidelines, practical recommendations and targets, however.

Given the threatening situation of only eight years of landfill airspace available and the need to look at waste management in an integrated manner, the city started to develop its integrated waste management plan (IWMP). The overall objective is to develop an IWMP that incorporates appropriate, affordable and environment-friendly solutions that will reduce the mass of waste requiring disposal and provide a dynamic framework for managing the city’s waste stream based on the waste hierarchy.

Figure 2 Waste hierarchy

CHIPPING AND COMPOSTING GREEN (ORGANIC) WASTE

Some 40 % of the waste generated in households in the City of Cape Town is organic in nature. Most of this waste, which includes kitchen and food waste, comprises garden refuse. It was clear that this waste stream was there ‘for the taking’ when one considers waste minimisation initiatives.

When the City of Cape Town was established, the various MLCs had different waste collection systems in place. These varied from a ‘self-help’ system whereby residents transported their own garden refuse to centrally located drop-off sites to call and collect systems. In two of the MLCs a separate two-weekly ‘kerbside’ collection system fetched the garden refuse and disposed of it at landfill sites.

Organic composting of garden refuse in wind rows and separation of green waste stream at drop-off site

The city has adopted a policy of providing an equitable level of service to all households and the dedicated kerbside collection system for garden waste in certain areas has been terminated. Households have a number of choices for the collection of garden waste including topping up the existing household refuse bins, acquiring an additional container at a cost, using drop-off sites, or employing private collectors. The drop-off facilities at present are used principally for the disposal of garden waste.

This uniform policy not only ensures an equitable service for all residents but facilitates the composting of the waste stream instead of landfilling it.

in Cape Town

CAMPAIGN

The 'Zero greens to landfill' campaign started in 2001 as a pilot project when the Tygerberg Solid Waste Department initiated a scheme to separate all green waste at its Morningstar drop-off facility in Durbanville.

Chipping of garden refuse

A specialist private contractor was appointed to chip the waste and compost the chips instead of landfilling them. The project was later formalised in a public tender for a two-year period. With the formation of the City of Cape Town the Tygerberg tender as basis for the greater city area.

It soon became clear that one contractor could not handle the workload generated in the city. Three contractors have therefore been appointed for the current contract term but are now also struggling to keep up with the monthly increase in volumes to be chipped.

Removal of contaminants to ensure a good quality product

Currently the city is saving 560 000 m^3 of landfill airspace a year through diverting garden refuse away from landfill sites. The current cost of landfill airspace (capital and operational expenditure) is ± R150,00 per m^3. This has facilitated a direct operating budget saving of more than R8 million. (This figure is calculated as the difference in the price of chipping the waste stream and transporting it to a composting site and traditional transporting and landfilling charges. The saving of airspace to be used for future disposal purposes is excluded from this calculation.) A volume reduction of 4 to 1 is obtained by chipping the waste before transporting it.

Organic composting of garden refuse in wind rows

The steps associated with the separation, chipping and composting of garden refuse are illustrated in the photographs. □

Text Don Hunter PrEng MSc MSAICE

Recycling oils, reducing

ENGINEERING WORKS, particularly capital-intensive projects, consume oils and grease at rates that are incomprehensible to the ordinary person. One major South African-based mining firm alone consumed 5,8 million litres of oils and 280 000 kilograms of grease in 2004. Even the smallest civil engineering contractor, with a solitary tired TLB, makes use of an occasional oil change.

But where does this lake of hydrocarbons all end up? Consulting engineers dealing with local environmental legislation commonly come across, or indeed generate statements in environmental management plans such as:

- Hazardous waste such as oils etc shall be disposed of in a Department of Water Affairs and Forestry approved hazardous waste landfill site.
- Used oil, lubricants and cleaning materials from the maintenance of vehicles and machinery should be collected in a holding tank and returned to the supplier. Water and oil should be separated in an oil trap. Oils collected in this manner should be retained in a safe holding tank and removed from site by a specialist oil recycling company for disposal at approved waste disposal sites for toxic/hazardous materials.

Similarly, large companies which undertake environmental audits, such as ISO 14001, also require that records of oils used on site and oils disposed of be kept to ensure that only authorised disposal techniques are used. The reasons that suitable disposal of the used oils is required include the following:

- Dumped or spilled oil causes long-term soil and water pollution as it decomposes very slowly. It also reduces the oxygen supply to the surrounding micro-organisms in the soil.
- The burning of used oil on site, or in ordinary furnaces, releases toxic gases and metallic dust particles. The engine wear of the host engine causes a high concentration of metal ions such as lead, zinc, chromium and copper in the used oil. These can be toxic to ecological systems and to human health if they are emitted from the exhaust stack of uncontrolled burners and furnaces.
- Some of the additives used in lubricants are also contaminants, for example molybdenum disulphide and other metallic compounds.
- Certain compounds in used oil, for example poly-aromatic hydrocarbons (PAHs), can constitute a health risk owing to their carcinogenic and mutagenic nature.

Given the risks involved in unsuitable disposal, is landfilling the answer to minimising the damage to the environment? As there are few hazardous landfills in South Africa, their limited airspace and the requirements of co-disposal with suitable dry matter to ensure the oils do not leach out of the landfill tend to indicate that this is not an efficient or sustainable solution.

Indeed, the shortage of space for landfill sites of suitable standard and a greater awareness of the inherent long-term risks of disposing hazardous substances have led to a greater recognition of the need to recycle as much waste material as possible. The local oil industry in general is committed to this ideal and strives to recycle or re-use as many waste products as possible.

As one of the players in the oil industry, FFS Refiners are processors and marketers of industrial furnace fuels. The company produces a range of fuel oils to suit almost all industrial liquid heating fuel requirements. The business started out in the alternative fuel oil market by identifying low value waste and by-product oil sources and by developing suitable technology to render these materials usable. The technology required is not conventional oil refinery equipment and is not available off the shelf. The company pioneered the use of high-speed centrifuges for solids-liquid and liquid-liquid separation, where the various liquid densities differed. It also developed a complete set of fuel reticulation equipment to enable the successful use of high viscosity, high pour point and low flash point oils. This included low watt density electric line and outflow heaters with reduced coking potential for the more viscous products.

One of the important raw material streams is used lubrication oils. This includes car and truck engine oil, industrial gear oils, and some hydraulic and transformer oils low in PCBs. These used oils are made up of a base oil with application-specific additives (which contain organo-metals), wear contaminants and products of combustion. The contaminants received in the used lubrication oils as collected also include water and cleaning solvents.

impacts

Left to right:
Stripping of the light ends is done in an FFS-developed forced feed evaporator
Heat exchangers and product storage tanks with the two reactors (centre, background) which are the heart of the refinery
Petrus Scholtz (left), FFS general manager marketing and supply, with a sample of used lubrication oil. Don Hunter, chief executive officer, holds a sample of clear base oil of exceptional quality. Other members of the FFS design group are Pierre Rossouw, marketing procurement manager, and Gregg Hurter (right), senior project manager

The first level of processing is to remove the water and solvents. This can be done using chemical de-emulsifiers, centrifuges, thermal evaporators, or all three. The solid contaminants can be removed using filtration or centrifuging. However, the bulk of the ash content remains as chemically bound metals from the lubrication oil additive packages. Up to this processing stage it remains a low-grade furnace fuel with high ash content. The removal of the remaining contaminants and colour is challenging and many technologies have been developed to achieve this.

FFS has developed a patented chemical de-ashing process that has a high recovery rate (+92 %) and does not produce an acid sludge. This process typically reduces the ash content from 0,6 to 0,8 % m/m to around 0,06 to 0,08 %. This increases the value of the used lubrication oil to a high-grade furnace fuel suitable for use in steam boiler applications. However, this product is still 'black' and has a contaminant level that is still not suitable for use as a base oil, which is the 'Holy Grail' of recycled products.

After assessing all the known technologies available, FFS embarked in 2002 on a major research and development project investigating an economically feasible hydrogenation plant solution that would refine the used lubrication oil to produce a high-quality base oil. Hydrogenation, or hydrotreating, is a well-known technology in conventional petroleum refineries, but it was always believed that it could not be significantly scaled down economically. The chemistry of this technology is to saturate any unsaturated hydrocarbon bonds and to de-oxidise and trap the metals and colloidal carbon using hydrogen substitution in a fixed bed catalytic reactor. This process is carried out at high temperatures and moderate pressures.

A fully operational, instrumented continuous pilot plant was designed and constructed to establish the design parameters, operational conditions and catalyst required. The test work took twelve months to complete and hundreds of simulated runs were carried out.

With the exception of some mechanical and thermal design provided by local South African consulting engineers, the process, equipment, control and instrumentation engineering and detail design was carried out in-house. All the plant equipment, including the special steel reactors, heat exchangers, pressure vessels, columns and the fired heater, was fabricated in house. A redundant electrolytical hydrogen-producing plant was purchased and reconditioned to supply the H2 required to drive the process.

The full-size plant was commissioned in October 2004. The results have been astounding, with qualities far in excess of expectations. The cost of the project was completed at a fraction of the quoted estimates. The base oil produced has less than 10 ppm of total metals and is clear and bright and of acceptable colour. Although this was a relatively small plant, capable of producing 3 000 t per month, the range of engineering required covered all disciplines and equipment used in a conventional petroleum refinery.

Although this technology has been researched and tested all over the world, to our knowledge this is the first commercially viable unit in operation. Small plants and processes require an approach which is different from very large projects. There are some interesting principles to be learnt from this. South African engineers are amongst the most inventive and innovative. They are very inquisitive and pioneering. They are very adaptable and flexible. Where mega projects can absorb costly specialised input, small projects require in-house generalisation that remain financially viable without compromising on standards and safety.

From an environmental perspective the project is of great significance. The country consumes some 400 000 t of lubrication oil per year, and of this it is estimated that some 45–50 % is recoverable. FFS currently recover only 50 000 – 60 000 t per year, or 25–30 %. The balance is finding its way into the environment, putting water treatment works under undue pressure or filling up landfills. This is obviously not a healthy situation. The lubrication oil producers, through an organisation called the Rose Foundation, subsidise the collection of used lubrication oil to make it more economically viable to collect from outlying areas. Most of the used lubrication oils collected are currently used as industrial furnace fuels. However, the more value that can be added to the used lubrication oil, the more economically viable the recovery and collection will become. Each extra litre of used oil recovered results in a litre less virgin material required, thereby reducing the utilisation of scarce natural resources, as well as foreign exchange expenditure, to the benefit of our overall economy.

It is hoped that through this initiative we will be able to improve the national recovery percentage and achieve a true sustainable recycle option. Industry must then do its part to limit the environmental impact of its operations by taking the trouble to put in place recovery systems for the collection of used lubrication oils. □

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Mine closure planning – time for a holistic

ESTIMATING LIABILITY

As a result of the requirements in the new Mineral and Petroleum Resources Development Act 28 of 2002 and Regulation 527 promulgated in terms of the said Act, consultants are increasingly being called upon by mines' environmental managers to estimate the mines' current (premature closure) and end-of-life (post planned closure) liability for residual and latent impacts of mining operations. Typically, this involves:

- a site visit entailing a brief inspection of the mine area and its workings
- reviewing the mine's environmental management programme report (EMPR) and other relevant documentation for closure commitments and requirements, including a review of the risks identified in the EMPR for completeness and depth of understanding
- measuring quantities from available mine plan drawings
- estimating the cost of the closure scope of works by a third party (usually an earthworks contractor with the assistance of a demolition subcontractor)
- formalising the estimated closure liability into a report suitable for submission to the Department of Minerals and Energy (DME) authorities, and
- an agreement between the DME and the mine as to the provision, in an acceptable form, of the required closure amount

OMISSIONS

This approach is considered acceptable by the authorities (and the mines), provided that closure costs are regularly reviewed and updated.

There are, however, omissions in this approach that could see the mine failing to obtain its DME closure certificate and not being able ultimately to 'walk away' from the area, or not having sufficient funds to meet all its closure requirements. Also, a closure certificate issued in terms of the Act does not necessarily mean that the mining company is protected from all potential environmental liabilities associated with the property.

Some of these omissions are the following:

- *Community acceptability:* The closure objectives given in the EMPR are often open to interpretation. For example, 'visually acceptable' and 'adequate rehabilitation of the land' do not have set definitions and vary according to the circumstances. This issue will become more relevant as the area surrounding the mine becomes increasingly populated and developed, which means that the authorities and the community will have ever-increasing expectations of what is considered adequate closure of the mining area.
- *Long-term physical sustainability:* The long-term physical sustainability and performance of rehabilitated areas are seldom considered or even investigated. This is particularly important in the case of facilities such as tailings dams and other mine residue deposits. Erosion modelling studies can identify differences and robustness of alternative closure options over longer time frames (anything from, say, 50 to 1 000 years), thereby allowing optimisation of closure solutions. These studies would promote acceptance of a particular closure strategy to the authorities, the mine and the surrounding community in terms of sustainability.
- *Long-term environmental rehabilitation:* The long-term environmental rehabilitation of mine areas typically caters for the management of surface water (controlling 'polluted' waters and avoiding mixing polluted waters with 'clean' waters) and re-vegetation of previously disturbed areas. The costs of groundwater remediation or decant from flooded mine workings are seldom assessed and costed. To cost groundwater remediation strategies accurately, detailed groundwater seepage and contaminant flow assessments are required to quantify the long-term effect of pollution plumes on the environment. This assessment would form the basis of any future groundwater monitoring programme.

  Coupled with long-term physical sustainability and groundwater rehabilitation is the need to investigate surface water infiltration and surface water evaporation (similar to the climatic water balance for leachate generation specified in the Minimum Requirements for Waste Disposal by Landfill) and consider the implications for the particular closure strategy.
- *Unaccounted for short- to medium-term expenses:* It is standard practice to make provision for a maintenance and aftercare period (typically three to five years) following mine closure and rehabilitation of the mine area. This is typically a percentage of the overall closure cost and makes allowance for the monitoring and control (by third parties) of aspects such as vegetative cover, species composition, animal grazing, weed control, surface and ground waters, erosion damage, re-planting and fertilizer requirements, and the need for fire-breaks.

  Often no allowance has been made for the overall running costs of the rehabilitated mine area such as mine security, basic services (water and lights), accommodation, food provision (canteen) and site allowances for remaining mine staff. This could ultimately represent a significant amount of money, especially if the mine does not achieve its closure certificate immediately after the maintenance and aftercare period.
- *Social and labour plans:* There are currently no clear procedural and substantive guidelines on the development of social and labour plans. It is expected that, in feature, there will be greater emphasis on the mitigation of socio-economic impacts associated with mine closure and on human resource development. To develop sustainable alternative livelihoods, the mine may need to support ex-employees in small and medium enterprise (SME) development, support local business communities and procurement, or establish a sustainable development trust to underpin economic diversification.

Under the new Minerals and Petroleum Resources Development Act, on receipt of a closure certificate the mine is reimbursed any excess financial provision less any amounts retained for latent and/or residual impacts (this is left to the minister's discretion). Without adequate documentation and assessment of the residual risk, the Department of Minerals and Energy may conservatively hold back more financial provision than is required.

FUTURE MODUS OPERANDI

In future, mine environmental managers should be encouraged to compile complete and accurate closure plans incorporating all of the above, instead of basic desktop closure estimates that could result in significant underfunding of closure costs, failure to achieve a closure certificate, and being prevented from ultimately 'walking away' from the area.

South Africa has a particular problem associated with closure planning, as few mines have actually been issued with closure certificates in terms of either the new Act, or its predecessor. There are therefore virtually no benchmarks against which to judge the acceptability of a particular level of residual risk. Most benchmarks are governed by the mining companies' and consultants' view of acceptable residual risk, which means that closure performance objectives and provisions for closure costs vary widely. For example, one mining company may provide funds for grassing an acid-generating tailings dam although there is a relatively high risk of the acid-generating process eventually (after 20 or more years) leading to die-back of the vegetation and associated dust generation and water erosion. Another company, faced

approach

with a similar situation, may have a different view of the residual risk and a different closure risk appetite, and may therefore provide for reshaping and rock cladding in addition to vegetation cover to ensure that there is no long-term effect of dust on surrounding communities.

The answer to 'What is this residual risk?' depends on who asks the question. Using the example above: to a neighbouring community it may be the risk that a dust problem could develop after decommissioning caused by nearby tailings dam(s). On completion of the decommissioning programme – and even after five years of aftercare – the tailings dam will be well vegetated, and to the neighbouring community, the residual risk associated with the vegetated but otherwise unmodified tailings dam will appear to be low. Only with time will the vegetation and slopes deteriorate and erosion set in at an ever-escalating rate.

To the DME, residual risk is the risk that they will have to return to fix the problem after they have issued a closure certificate, at a cost well in excess of maintenance provision. To the mining company, it is the risk of incurring higher than expected decommissioning, aftercare and maintenance costs. In spite of the provisions of Section 19 of the National Water Act 36 of 1998, for the mining company this risk diminishes to nearly zero when a closure certificate is issued and – based on historical evidence – to practically zero on the sale of the mine to a third party.

There really is only one winner in this game. Either the state takes a very conservative view by assuming worst-case long-term outcomes and therefore demands conservatively high closure provision costs, or the mining company gets away with underproviding for closure and aftercare and effectively transfers liability to the taxpayer when a closure certificate is issued. Whoever the winner, it is seldom future generations and the environment downstream of the mining facility.

Two issues need to be dealt with to improve the status quo. First, we need to define and implement a set of policies that deal specifically with closure risk appetite. What is an acceptable level of risk for any particular residual or post-closure risk? For example, is a probability of 1:10 that dust generation will occur at an unacceptable level at some stage in future acceptable? It may be that for remote tailings dams located 20 km from the nearest population the acceptable risk is 1:10, whereas for a tailings dam located in a populated or sensitive area it is 1:10 000.

Second is the challenge that environmental engineers and scientists need to face up to and continually improve on, and that is the ability to assess these long-term risks scientifically. Considerable development has taken place in recent decades in the assessment of some of these risks; in other areas progress in the development of analysis tools and a broadening of the knowledge base are required. Waste characterisation is one such focus area.

An area that has lacked focus, however, is the development of tools to understand geomorphological processes to which tailings dams will be subjected in future decades and how these processes will change the annual maintenance costs with time. Our confidence with respect to how different claddings, stormwater management structures, vegetation covers and slope angles will stand up to the long-term geomorphological processes over 10, 20, 50, 100 or more years is relatively poor. Much more effort is required to develop and improve the tools at our disposal for the assessment of residual risk before we, as environmental engineers, can improve our levels of confidence. □

Completed construction of the first 2,5 ha capacity waste cell

Landfill site at Roundhill in Eastern Cape to be fully operational soon

Construction of 100 kℓ leachate tank to collect leachate generated by the waste cell

AFTER MANY YEARS of effort, the first waste cell at the newly constructed Roundhill landfill is operational. The Buffalo City Municipality has developed a landfill site for the disposal of local general waste and regional low hazardous waste, which was initiated by the 1989 Environmental Act requiring licensed landfill sites for waste disposal.

The last eleven years has seen a number of potential sites identified and ranked and the prescribed feasibility study completed in 1998 with a permit being obtained in 2000. As funds have become available, construction has proceeded slowly and basic infrastructure services have been constructed, culminating in the completion of the first waste cell in June 2005.

The Roundhill landfill site is situated between the N2 and R102 at Berlin in the Eastern Cape. This new central landfill replaces the existing illegal landfill sites. In addition to the central landfill, a network of transfer stations is being developed across Buffalo City to optimise the transport of waste over the long distances. Simultaneously, a comprehensive recycling programme is being introduced to reduce the overall costs of waste management.

The Buffalo City Municipality awarded the design and construction management to consulting engineers Arcus Gibb, who project managed the team of specialists. The project included cell excavation by Roberts Bros and lining by Fountain Civils. The project team worked with Buffalo City Municipality's Directorate of Engineering Services and the process was monitored by the Waste Management Services Department.

Successful project management and technical expertise culminated in the design and construction of a modern, well-engineered landfill facility which is fully compliant with current minimum requirements. A fully lined 2,5 ha cell has been built to H: h standards suitable for both domestic and low hazard waste. The waste cell has been constructed as a lined dam and provides an outlet system draining all traces of leachate into containment tanks. The infrastructure services include 1,8 m palisade fencing enclosing the site, road and stormwater networks, a weigh bridge and waste receiving area, as well as operational buildings.

Since inception, R40 million has been spent on the Regional Disposal Scheme funded mainly by central government, through the CMIP programme and the municipality. Of this, R30 million has been spent on construction on the landfill site. The waste cell alone cost R10 million.

Once the waste cell has been completely utilised it will be capped using soil, clay and hydro-seeded soil. A new waste cell will be constructed annually that will exceed future construction costs of R10 million.

Although buildings to house the operations staff will only be completed by the end of 2005, the Roundhill landfill site can technically be used. Commissioning is at present under way to prepare the site for operations with the recruitment of a landfill site manager and procuring of an operations contractor.

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Kingston Vale
a win-win solution

IN 1999/2000 THE MANGANESE METAL COMPANY embarked on the process of identifying a suitable site and obtaining regulatory approvals for a new hazardous residue management facility in the Nelspruit area, subsequently named the Kingston Vale landfill site.

The company appointed Golder Associates to undertake four environmental legal processes involved in the project: EIA authorisation, the granting of water use licenses as well as a waste disposal permit, and re-zoning. A single integrated public consultation process meeting the requirements for each individual legal process was designed and accepted by key authorities and stakeholders.

The site, which is being constructed by Concor, is surrounded by commercial agricultural activities. Affected stakeholders were farmers, labour communities supporting the farms, and active environmental and community NGOs in the area. Engineers had to take into account the needs of the farmers and labourers. This resulted in engineering designs including aspects such as providing safe accesses and crossing during construction and operation, addressing construction layout to accommodate the daily activities of the communities, addressing how services were sourced and how the project scope could be enhanced to provide some benefit to the community.

In accordance with the Department of Water Affairs' Minimum Requirements for Hazardous Waste Disposal, a monitoring committee was established. The committee convenes monthly to monitor the environmental requirements during construction.

Issues that had to be dealt with during the operational phase of the facility included community safety, soil erosion and dust (and its effect on people and commercial crops), operating hours for noisy equipment, traffic and access, visual and aesthetic aspects, the potential for contaminating groundwater and stormwater, and the aquatic ecology in the receiving water environment.

A large number of indigenous trees and shrubs were planted on the periphery of adjacent homesteads to ensure minimal visual impact. The site is flanked by two small streams and care was taken not to disturb the surrounding wetlands. Silt traps and water energy dissipators were constructed to ensure that sedimentation is controlled and managed during construction and operation. Disturbed areas were hydro-seeded and re-vegetated with indigenous grasses and reeds immediately after construction had ceased.

Golder facilitated, designed and supervised the construction of a water purification plant in the adjacent farm workers' community, the supply of electricity to all the houses, associated ablution facilities, and the upgrading of the community hall. The community was fenced off to provide a greater level of security.

As waterborne sewage systems are the exception rather than the rule in rural parts of South Africa, Golder provided training on the correct use of the infrastructure and held numerous meetings to ensure that the needs of the community were met.

The Kingston Vale landfill site is the first permitted hazardous waste site outside Gauteng. In a recent environmental audit, BHP Billiton reported that the site was one of the best construction sites they had ever visited. □

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Advantages of arbitration

Arbitration contains elements of informality in that the arbitrator can choose the venue for the hearing, he or she can do so fairly quickly, and in terms of the Act, has four months to make his or her award.

Having shown these elements, the issue of costs must be mentioned. It is not uncommon for disputing parties to be represented by both instructing attorney and advocate, on both sides. The costs of such an action would then be very similar to a High Court suit.

The arbitrator does determine the issue of costs and the costs usually follow the result, unless special circumstances warrant otherwise.

Arbitration as a *dispute resolution*

EXAMPLE

In the 'General Conditions of Contract of Works of Civil Engineering Construction' mediation is peremptory, while in most Building Industries Federation of South Africa contracts, mediation is merely directory.

It is also found in the 'Principal Building Agreement', prepared by the Joint Building Contracts Committee, that mediation is merely directory in nature.

Although mediation may be obligatory in some contracts, it seldom brings the dispute to finality, and the parties to the dispute can, by mutual agreement, avoid mediation and proceed directly to arbitration.

WITH THE HIVE OF ACTIVITY taking place, inter alia, in the civil engineering construction industry, it is inevitable that disputes will arise between the contracting parties.

In this article the discussion will centre on the various forms of dispute resolution sometimes referred to as alternative dispute resolution, or ADR.

The most common forms of ADR are negotiation, adjudication, mediation and arbitration.

NEGOTIATION

Negotiation is a voluntary process whereby two or more parties with actual or perceived differences seek to resolve their differences without the use of a third party.

The rules of negotiation are set down by the parties themselves and the acceptance of the outcome of the negotiations may or may not be final and binding on the parties.

This process is not used very often in South Africa and is not prescribed in most formal contracts.

ADJUDICATION

Adjudication is simply a process whereby a neutral third party is called upon to decide a dispute, and if contract specific, would be legally binding upon the disputing parties. There is currently a move in South Africa to include this method of dispute resolution in building contracts and civil engineering contracts.

The decision of the adjudicator is reviewable by any competent court of law or by way of arbitration.

MEDIATION

Mediation is once again a voluntary process whereby the disputants agree, usually in a written and legally binding contract, to resolve their dispute through the services of a neutral third party (the mediator). The parties are not permitted to be represented in the process and the mediator, after considering the various submissions by each party, gives an opinion.

Most contracts make provision for mediation, and in some cases mediation is merely directory while in others it is peremptory.

ARBITRATION

Of all the dispute resolution processes mentioned above, only arbitration is a statutory process, governed by the provisions of the Arbitration Act (Act No 42 of 1965), as amended.

Once the arbitrator has made his or her award, the award can be made an order of any competent court in term of Section 31 of the Act. Although the award is not subject to statutory appeal, it is always subject to be taken on review.

Arbitration is a formal process, and the Act, together with relevant case law, has set down formal requirements for arbitration to have the full force of the law. These are:

- There must be a legal and binding contract between the disputing parties which contains a written arbitration clause.
- Alternatively, the disputing parties can voluntarily submit themselves, in writing, to arbitration.
- The written contract between the disputing parties need not be signed, but must comply with the requirements of the Law of Contract (refer also to case law: *Fassier, Kanistra & Holmes v Stallion Group of Companies 1992 (3) SA 825 (W)).*
- A prima facie dispute must have crystallised, failing which there can be no dispute and consequently no arbitration. (Here the applicable case law is *Within show Properties v Dira Construction 1984 (4) SA 1073 (A).)*
- The arbitrator must have been properly appointed in terms of the conditions as set out in the contract.

Emilé is an arbitrator, advocate of the High Court, professional civil engineer and registered town planner. Members are cordially invited to submit topics of interest to Emilé at e.p.m@mweb.co.za

VERSATILE PRODUCTS FROM OLD BOTTLES

TO PRODUCE NEW PRODUCTS from a used product is not a new concept, but can a new product that meets critical civil engineering specifications be produced from such recycled resources?

The answer is a resounding YES.

At Kaytech, this is exactly what is being done with part of South Africa's ever-expanding population of plastic cooldrink bottles, those which would otherwise have inevitably landed up in a landfill site somewhere in South Africa.

Kaytech is producing a 'green' material by recycling someone else's discarded product and ultimately putting it to useful and environmentally safe use. Kaytech's Bidim range of geotextiles, by reason of its application in the civil engineering industry, ends up in the ground and stays there for as long as does the structures it helps to support. No further 'plastic' contamination of the environment takes place.

Over the past ten years, Kaytech has taken more than 15 000 000 kg of polyester (PET) that had previously been used to provide packaging for a wide range of consumer products, such as cold drinks, and was subsequently discarded in landfill sites, and turned it into a useful, continuous filament, spun-bonded geotextile.

The stringent specifications that the food industry and bottle manufacturers have placed on the PET raw material, allowing for the production of thin-walled, food contact approved containers, allows the production of a high-quality non-woven geofabric which ultimately meets and exceeds the civil industries standards.

Kaytech has been assisted by partners, ranging from South African Nylon Spinners (SANS) – whose virgin industrial grade material has been replaced with recycled material – to Custom Polymer, Trirom Trading, B & B Recycling, Econo Recycling and SupaPlas Plastics, all preferred suppliers of recycled flake. These partners collect and process the beverage industries' discarded PET, indirectly generating an income for currently unemployed people.

The collecting/cleaning/shredding process lies in the hands of Kaytech's suppliers and their bottle collectors. The more attention to detail by the bottle designers, incorporating the need to recycle, the easier their job becomes.

It is people who pollute and it is people who have to clean up, therefore credit must be given to those in the industry who have redesigned bottles and label types and in doing so, have made recycling more feasible. Durable adhesives, heavy printing and foreign polymer types entering the PET stream all contribute to more difficult and less economic recycling

Once received at the factory, the granulated bottles are melted down, crystallised and spun directly into filaments. The PET is therefore only melted once more after the bottle had been made. The desirable properties built into the raw materials are thus retained and the resultant filaments have the tenacity (strength) and stability (durability) required by civil engineers.

Kaytech has invested heavily in its plant to modify and upgrade its capability to make it more efficient at processing recycled PET. As an ISO 9001 registered organisation (recently accredited version 2000), the commitment to their customers and their demands has ensured that Kaytech is now exceeding the strength specifications originally set with the standard virgin industrial grade of PET for which the plant was originally designed.

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WSP ENVIRONMENTAL INTRODUCED

WSP WALMSLEY HAS RECENTLY announced that it has changed its name to WSP Environmental (Pty) Ltd. This gives WSP Environmental in South Africa an even closer branding affiliation with its parent company in the United Kingdom, WSP Environmental Ltd.

The MD of WSP Environmental, Brent Ridgard, says: 'We are one of the bigger environmental consultancies in South Africa in terms of annual turnover and staff members. We are well represented in the mining, industrial, manufacturing and infrastructure sectors. Our aim is to become the leading supplier of environmental and contaminated land services in southern Africa. We are planning to establish a remediation contracting business in the next few months that will offer a turnkey service, from site investigation, to design, costing and implementation of remediation solutions.'

He adds: 'We are a company that is solutions driven, entrepreneurial, innovative and ambitious in terms of growth. We have the privilege of being part of a global environmental business, which gives us access to cutting-edge technologies which, when combined with local knowledge, gives us a distinct advantage over our competitors.'

WSP Environmental offers a full spectrum of environmental and contaminated land services, including:

- Air quality management services
- Asbestos surveys
- Contaminated land and remediation
- Due diligence, compliance and liability audits
- Environmental management systems
- Environmental project management
- Environmental risk assessment
- Geotechnical investigations
- Groundwater monitoring and modelling
- Integrated environmental management
- Integrated systems
- Surface water hydrology
- Sustainability reporting
- Waste management, waste characterisation and delisting

WSP Environmental has offices in Gauteng, KwaZulu-Natal and the Western Cape. Its Namibian subsidiary, Eco Plan, offers the full range of environmental solutions to clients in that region.

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DELIVERING ON BULK WATER SUPPLY PROJECTS

IN MANY RURAL AREAS, households have to walk 200 m just to get water. This situation has led to the Fort Brown bulk water supply project, an initiative that is aimed at the supply of bulk water to rural areas. 'The project was requested by the Makana Municipality in Grahamstown and is currently in its commission phase,' says Kwezi Mpuhlu, one of the partners at MBSA Consulting Engineers.

According to Kwezi, the project is extremely labour intensive and is aimed at assisting the community with job creation. 'We used unskilled workers to help with the water supply and appointed a consultant to supervise the process. This arrangement turned out to be a win-win situation as community members were taught how to provide water for themselves and acquired much needed income and invaluable skills in the process,' says Kwezi, adding that the feasibility test was conducted in January 2004.

Owing to its sizeable scope, the project was divided into two phases. The first half of the assignment entailed the extraction of water from the river to portable purification plants. Water was then stored in containers and filtered through a chemical process. The total cost for

Phase I is R1 million. It started in September 2004 and has completed in February 2005.

The idea in Phase II of the project is to build an agri village. Agri villages are smallholdings where community members are allocated small plots of land for grazing and services. The cost for Phase II is estimated at R15 million. It is likely to be completed in 2007.

Most of MBSA's projects are water and road related. 'We tend to concentrate on rural access roads, rural water schemes and bulk water supplies. In all cases we make use of Civil Designer and AllyCAD to fulfil our design needs. We are also in the process of employing more students so that we can teach them how to use the program and thereby create additional backup staff for projects.'

Another venture that MBSA is currently working on is the Hota-Mbewula bulk water scheme project. 'We have just completed the preliminary designs for the water scheme and submitted these to the client. The aim of the project is to make water accessible to rural areas, which means a greater commitment towards spring water protection. This activity entails the collection of water from mountain springs and the construction of water purification reservoirs for reticulation purposes. The process requires no power as the entire procedure makes use of gravity. Once we have sized the pipes, we make use of AllyCAD to complete the design.'

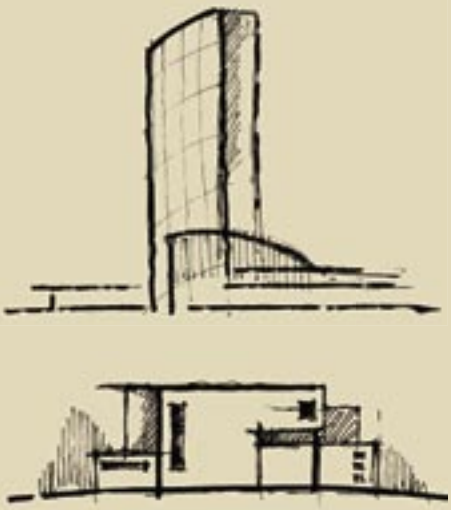
The bulk water scheme project was requested by Chris Hani District Municipality and is estimated to cost R5 million.

Yolanda Desai
021-701-1850

MORE THAN US$2 MILLION TO BE AWARDED FOR SUSTAINABLE CONSTRUCTION DESIGN

IN AN INTERNATIONAL COMPETITION announced in November 2004, the Holcim Foundation invited architects, engineers and other specialists from the construction industry to submit innovative projects meeting the challenges of sustainable construction. Within five months, 1 508 projects from 118 countries were submitted to the dedicated website.

More than 90 % of the submitted projects met the formal requirements for tangible construction projects at an advanced design stage. These projects were submitted to judging panels appointed by the Holcim Foundation partner universities in each of the five regions for evaluation against Holcim Foundation target criteria for sustainable construction. The African/Middle Eastern jury, appointed by the University of the Witwatersrand, consisted of independent authorities from the field of sustainable construction who judged the projects for quantum change and transferability, ethical standards and social equity, ecological quality and energy conservation,



economic performance and compatibility, and contextual response and aesthetic impact.

The regional juries are responsible for the ultimate evaluation and allocation of three Holcim Awards, as well as three acknowledgement and three encouragement prizes, amounting to US$220 000 per region. The Holcim Foundation prizes will be presented at regional ceremonies hosted by the local Holcim Group company in Beijing, Boston, Geneva, Johannesburg and Rio de Janeiro. The three top projects from each region qualify for the global Holcim Awards competition in April 2006 in Bangkok, where prizes totalling US$900 000 will be awarded to the winners selected by a jury of independent specialists representing all regions.

The resounding success of the Holcim Awards competition confirms that sustainable construction design is back in the spotlight.

www.holcimfoundation.org

NEW LIFE INSURANCE PRODUCT ENGINEERED FOR PROFESSIONALS

'A PROFESSIONAL, including an engineer, earning just R20 000 per month at the age of 41, has the potential to earn another R10 million or more before he or she retires at 65,' says Stuart Wenman, Liberty Life's Divisional Director of Product Development and Marketing.

Speaking at the launch of Liberty Life's new product 'The Professional at Liberty Life', Wenman said that it was for this reason that they believed that income protection is generally the most important cover professionals can have.

'If they cannot practise their profession due to a temporary or permanent disability, their ability to maintain their income is severely compromised,' he stressed.

The reality of the situation is driven home when one considers that if a professional becomes permanently disabled at the age of 45, he or she would require a lump sum of approximately R1,9 million in order to replace a monthly income of R10 000 for a period of 20 years in the current economic environment, allowing for a 5 % per annum escalation.

Wenman also stressed that not just elderly individuals face these issues. 'Of the R63 million that was paid out in lump sum disability claims by Liberty Life last year, 64 % were paid to people under the age of 50,' he said.

A number of new features have been added to Liberty Life's Income Disability benefit with the needs of the professional in mind, including:

- A top-up option, which enhances the professional's disability benefit by 20 % in the first two years of their disability. This ensures that there is money available for rehabilitation purposes during this critical period.
- A seven-day waiting period with payment

backdated to the first day of disability has been introduced for self-employed and fee-earning professionals. For these individuals, even a short-term disability impacts significantly on their income.

In addition, Liberty Life has increased its maximum benefit levels and positioned its rates extremely competitively in the young professional market.

Further information can be obtained from a Liberty Life accredited financial adviser, by visiting www.libertylife.co.za or by contacting the Liberty Life call centre on 0860-456-789.

Stuart Wenman
T 011-408-3626

MIKROPUL WINS SECOND ENVIRONMENTAL CONTRACT AT HOLCIM'S DUDFIELD PLANT

LEADING CEMENT PRODUCER Holcim South Africa has awarded a multimillion rand follow-up turnkey contract to MikroPul for an additional gas cleaning system at the company's Dudfield plant near Lichtenburg in North West Province.

Seen here while under construction by MikroPul is the kiln baghouse of Kiln No 3 at Holcim South Africa's Dudfield plant

It follows a successful turnkey contract, worth over R35 million, that MikroPul executed in 2002/03. That contract involved design, manufacture and installation of grate cooler off-gas and kiln off-gas systems at the plant's Kiln No 3 and also incorporated the recovery of clinker dust for re-use.

The fast-track new contract, awarded to the Johannesburg-based dust control and gas cleaning specialists in February this year and scheduled for completion later this year, is for the design, manufacture and installation of an advanced gas-cleaning system on Kiln No 2.

Both the previous and current environmental contracts form part of an ongoing modernisation programme Holcim South Africa is carrying out at the Dudfield plant.

'The environmental systems provided and installed at Kiln No 3 in the first contract featured a number of technological "firsts" for southern Africa. It was the first instance in the region of the utilisation of bag filters in a cement kiln off-gas system in place of the traditional system of using electrostatic precipitators for the purpose,' said Des Tuck, MikroPul's Manager Marketing & Sales.

In addition, the single-pass forced draft cooler and the pre-cyclone collector for the grate cooler off-gas system were the largest supplied and installed on the sub-continent to date.

Des Tuck
T 011-478-0456

BE RESPONSIBLE OR FACE THE CONSEQUENCES

IT'S TIME THAT structural engineers in South Africa realised that they have a unique responsibility in the engineering domain. This is the opinion of the executive director of the Southern African Institute of Steel Construction (SAISC), Dr Hennie de Clercq.

'Structural engineering mistakes can be not only expensive, but also dangerous, yet many structural engineers in South Africa seem not to take sufficient cognisance of the consequences of negligent practice,' he says.

According to De Clercq, the SAISC is receiving

an increasing number of reports of problems ranging from work having to be redone at great cost to catastrophic collapses.

'We are concerned about the number of complaints and implore engineers and contractors to raise their standards or face dire consequences as the industry becomes even more pressurised by the expected increase in work volumes over the next few years,' he says.

According to De Clercq, there are several factors that contribute to this situation.

Firstly, he says that complicated design is often left in the hands of inexperienced engineers without mentoring or guidance and often their work goes to the client unchecked by more senior, experienced personnel.

'These inexperienced designers do not have a good perception of what happens in workshops and on construction sites and what is possible to achieve "on the ground", and what is not.'

Secondly, says De Clercq, an over-reliance on digital technology compounds the problem. 'For example, computers make it possible to enter the geometry and loading of a structure, press a button and miraculously produce the design as a CAD drawing. But computers do not have the experience or the insight of a trained and experienced engineer and, if design is left to inexperienced designers, mistakes will almost inevitably occur. One cannot overestimate the value of the personal understanding of an experienced professional.'

Thirdly, poor and inadequate information passed to the contractor by the designer exacerbates the situation. The contractor often unnecessarily adds complication by not telling the engineer what he is going to do, particularly regarding the erection of the structure.

'The bottom line is that there is often very little communication in our industry between designer and contractor, between client and engineer and between junior engineers and more senior partners in a firm,' says De Clercq.

According to De Clercq the law does not help either.

'It is impossible to regulate the behaviour of professional people by rules and sanctions, unless you have a huge enforcing mechanism and are willing to impinge on people's freedoms, including their creative freedom. Most engineers in South Africa adhere to high ethical standards and do excellent work without even thinking about any law forcing them to do so but there are those who get by with murder. They are creating an environment where it becomes even harder for the good engineer to do his work to the standards he regards and adequate.'

Finally De Clercq stresses that the clients of engineers are not only part of the problem, they are often the origin. 'Clients often put pressure on engineers to do things cheaper without regard to quality. Engineers' services are regarded as a commodity and, as with any commodity, price becomes the central concern. This is a grave mistake in the construction environment and clients must be cognisant of the dangers of constantly putting even the best engineers under unrealistic price pressure.'

De Clercq reiterated that structural engineers have a unique responsibility.

'Other branches of engineering are able to test their work in various situations before it is completed. Structural engineers have one shot at it and their mistakes can cost lives. I implore the industry to take much greater responsibility for their actions.'

De Clercq believes that the solution lies in recognising structural engineering as a speciality within civil engineering, and only allow people to call themselves 'structural engineers' once they have demonstrated through stringent tests that they are proficient in the field. 'Then, only structural engineers should be allowed to sign for the adequacy of the design and construction of structures,' he said.

▶ SAISC
Dr Hennie de Clercq
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BANKS OF THE APIES STABILISED

EROSION CONTROL PRODUCTS designed and supplied by Maccaferri/African Gabions were

The Apies River – after its banks were stabilised

recently installed to protect the banks of the Apies River that flows through the grounds of the National Zoological Gardens in Pretoria.

Martin Schaffner, Gauteng Area Manager of Maccaferri/African Gabions, said the company's PVC-coated flexible gabions, Reno mattresses, and AG geotextiles were placed on the banks of the river by contractors, Fanie's Plant Hire. The products were installed as bank protection and also to act as retaining walls in certain sections along the protected areas of the Apies River.

Prior to the start of the project in July 2003, Maccaferri/African Gabions designed a system to suit the needs of the consultant, Bakopane Civil Consulting. Bank protection provided ranged between heights of 1,5 m to 5 m with a 2 m flexible apron installed in front of the retaining walls for maintenance purposes and to protect the banks from further erosion, Schaffner said.

Maccaferri/African Gabions provided comprehensive training for the installers and on average about 1,6 m^3 of gabions were installed daily per worker. A total of 130 jobs were created for around 300 days and all labour funds for the R12,4 million project went to the local community. About 45 % of the workers involved were women.

'The company's erosion control system was chosen for this project because of its innovative approach to the problem, its environmental friendliness and cost-effectiveness compared to alternatives, he added. Bakopane Civil Consulting decided against the use of concrete or segmental block walls because of the much higher costs involved.

Adriano Gilli
031-700-8456

WINNER OF 2005 J D ROBERTS AWARD

THE 2005 WINNER of the prestigious J D Roberts Award is Dr Sharon Biermann of CSIR Building Technology. This award recognises Biermann's research contribution to public sector infrastructure investment and development, focusing on integrated land use, infrastructure planning, land suitability assessment, development prioritisation and spatial infrastructure economics.

Biermann is a geographer and leading expert in sustainable urban development. She has a PhD in Geography and has made a significant contribution to creating a better understanding of the challenges of low-cost and affordable housing in a rapidly urbanising South African environment. She has won many awards for her work and was a finalist in the 2004 Woman of the Year Award.

Her research has been applied, amongst others, by the Gauteng Province in its investigation into the costs and benefits associated with different housing localities; the Policy Unit of the Presidency in updating the National Spatial Development Perspective; and the National Department of Housing in producing a series of national atlases.

Biermann has recently been appointed to serve as an advisor on the Gauteng Infrastructure Committee of Inquiry and also heads a team developing an Infrastructure Investment Spatial Targeting Framework for the province.

The annual J D Roberts Award was instituted by Murray & Roberts in the late 1970s in remembrance of one of the group's founding fathers, Dr J D 'Douglas' Roberts. The award recognises and promotes competitive and environmentally sustainable solutions to human dilemmas and encourages scientific research into technology that will enhance the quality of life of all South Africans.

CONCRETE SLEEPERS FOR MAXIMUM DURABILITY ON WEST COAST

SPOORNET HAS APPOINTED Protekon Rail Solutions' Perway South to undertake the R5,7 million upgrading of the Kalbaskraal–Langeenheid railway line in the Cape's western coastal area. A large-scaled replacement of wooden sleepers with concrete units is a feature of this contract.

Chrizelle Isaacs, site agent of Perway, Protekon Rail, says this project – initiated as a result of increased Saldanha Steel traffic – entails the replacing of 16 500 wooden sleepers with concrete sleepers as well as the re-railing of 46 000 m rail in various sections between Kalbaskraal and Langeenheid, spread over 49 work sites. The 40 kg/m rails are to be replaced with 48 kg/m long-welded and fish-plated rails, laid on concrete sleepers.

In the ballasted track, the rails that rest on sleepers form the superstructure. At Kalbaskraal, wooden sleepers were initially used on the track. 'But the compressive strength of the wood grain is not great and the base plate cuts into the wood, causing a gap that in which water can penetrate. This causes the rapid deterioration of the quality of the sleepers so the timber sleepers were replaced by concrete units. With concrete sleepers climatic influences have little effect; concrete offers a longer service-life expectancy; and excellent electrical resistance is also provided to ensure reliable and safe track circuiting.'

Kalbaskraal: Placing of cross blocks

Concrete sleepers are manufactured locally, while wooden sleepers have become more expensive as a result of the shortage of indigenous hard wood. So the use of concrete sleepers encourages the preservation of precious forest wealth.

Heavier concrete sleepers produce higher resistance to lateral movement and reduce the vertical movement under traffic in areas where sleepers may have been imperfectly packed – important factors when it comes to continuous-welded rail. In conditions of excessive heat and humidity – such as at Kalbaskraal – a concrete sleeper track is less prone to vertical and horizontal distortion and this has important safety as well as maintenance implications.

Concrete sleepers also maintain the rail gauge much better than timber units where an increase in gauge over the years has become an accepted phenomenon – particularly on curved tracks.

The durability of concrete sleepers is an important consideration. Concrete sleepers can last for about 50 years whereas timber, in extreme conditions particularly, can last just 15 years.

The upgrading of the track is necessary to ensure that the track meets safety and quality standards – at minimum cost. Traditional methods were chosen over mechanical track renewal, so that the upgrading process causes virtually no delays to normal operations. The main focus identified is the rail and track geometry.

'Great ballast resistance, minimal disturbance to the track after renewal, as well as no irregularities in the alignment are some of the specifications that need to be adhered to. This is why the sleepers are renewed first, and then the rails, said Ms Isaacs.

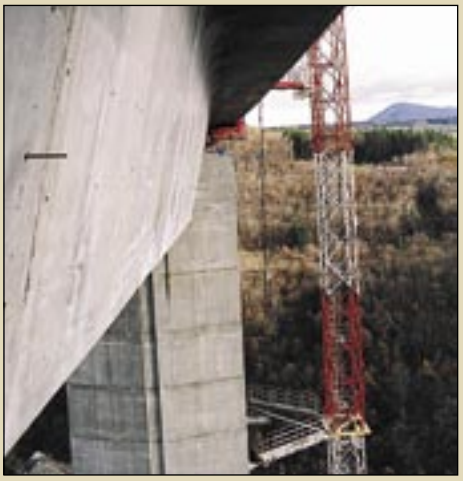
The execution of the project will allow the Kalbaskraal–Langeenheid section to achieve its objective: to carry heavier tonnage safely with minimum maintenance.

Theunis Steenkamp
T 031-361-6072

UNIQUE CONCRETE USED FOR SIOULE VIADUCT

CHRYSO'S NEW Chrysofluid Optima 175 played a vital role in the production of what is claimed to be the world's first freeze-thaw resistant B70

Work in progress on the Sioule Viaduct



Chrysofluid contributed to the viaduct's excellent finishes

concrete formulation without an air-entraining admixture. This special concrete is being used for the construction of the multi-million francs Sioule Viaduct in France.

The Sioule Viaduct will enable the A89 Motorway (linking Bordeaux and Clermont-Ferrand) to cross the deep Sioule Valley in the Puy de Dôme region. With a maximum span of 192 m, it is one of the largest civil engineering projects currently under construction in France.

Chrysofluid Optima 175 had already been successfully used for the concrete produced to build the world's highest bridge, the Millau Viaduct, also in France.

Construction of the gently curving Sioule Viaduct began in September 2002 and will be completed early next year. More than 49 000 m^3 of concrete, 6 500 t of steel, and 1 200 t of prestressed concrete will be used on the massive project.

The Sioule Viaduct consists of two abutments, four single piles (between 14 m and 70 m in height), and three double piles (between 82 m and 131 m) with webbing-reinforced bases.

The single hollow box deck varies in depth (10 m to 5,5 m) over the four central spans and remains at a constant 5,5 m on other sections. The viaduct includes seven spans, built in successive cantilevers using mobile crews.

Given the extreme weather conditions in the Puy de Dome region with is strong winds, cold, snow, and wide variations in temperature, the project owner, Autoroutes du Sud de la France (ASF), insisted that the concrete used for the deck and piles should satisfy freeze-thaw criteria imposed by the Groupe Rhône-Alpes (GRA). GRA rules call for the systematic use of air-entraining admixtures. However, the B70 concrete class required to meet stress and creep calculations did not allow recourse to traditional solutions to meet the specifications.

The development of new calculation rules for reinforced and prestressed concrete structures permitted the use of a high-performance and 'self-resistant to frost' concrete. The concrete was designed with a low-efficiency water-cement ratio, giving it a high density.

A silica fume concrete with an average resistance of 90 MPa (the specified strength was 70 MPa at 28 days) was used for the different segments of the deck. Chrysofluid Optima 175 was added to the mix to ensure a minimum of 90 minutes' workability.

Each segment was poured in several phases and Optima 175's flexibility permitted a variety of casing techniques for lower slabs, cores, and upper slabs.

The viaduct's architect is Berdj Mikaelian, the design consultants are SECOA, and design engineering is being handled by JMI Structures.

Chryso SA
Norman Seymore
T 011-395-9700
www.chryso-online.com

New tender procedures for municipalities

THE MINISTER OF FINANCE, Mr Trevor Manuel, on 31 May 2005 tabled in Parliament new regulations on supply chain management processes for all municipalities and their entities. The regulations were formally promulgated at the end of June 2005.

The regulations spell out significant reforms for the procurement of goods and services in municipalities. This framework modernises financial governance in municipalities and improves accountability and transparency for the award of municipal bids. It further establishes key procedures to minimise fraud and corruption in the bidding process, and to prevent and minimise possible conflicts of interest.

For big tenders above a value of R200 000 ('competitive bids'), the regulations introduce a three-stage process, which requires separate specification, evaluation and adjudication committees. To promote transparency, all bids must be published in a bid register and made available on the municipality's website. The new procedures also make it easier for municipalities (and their entities) to approve smaller bids below R200 000, as it differentiates between petty cash (R2 000), written or verbal quotations (R10 000) and formal written price quotations of up to R200 000. These procedures should also reduce administrative and other compliance burdens for small enterprises and suppliers, who can apply to be listed as suppliers for bids below R200 000. It also aims to reduce the waiting period between the publication of tenders and the awarding thereof.

The new regulations also gives effect to Section 117 of the Municipal Finance Management Act, which preclude councillors from participating in the operation of the supply chain management system, being specifically excluded from being a member of, or even an observer on, any bid committee. Instead, the council must delegate supply chain management powers and duties to the municipal manager who is responsible for appropriate delegations within certain financial constraints, for the implementation of the policy.

The regulations also prohibit persons in the service of the state, like councillors and other elected representatives (members of provincial legislatures and national Parliament), full-time employees (national and provincial public servants, municipal officials) and directors of public or municipal entities, from being eligible to bid or be awarded a contract to provide goods or services to a municipality. The prohibition will also apply to companies if an elected official, public employee or director of a public or municipal entity is an owner, a director or a principal shareholder. Awards to a close family member of an employee in the service of the state, or to a person who has left less than 12 months from an elected or employed position in any sphere of government, must also be disclosed in the annual financial statements of the municipality.

Tough provisions apply to ensure that bidders do not corrupt supply chain officials, as their bids will be disqualified should they do. Officials who are responsible for procuring goods and services will need to comply with a strict code of ethics with regard to gifts and other inducements, and must immediately withdraw from the process if a family member has any interest in a bid. All bids must be opened in public and a register kept that is available for public inspection. Companies that supply goods or services must also disclose all sponsorships, and are obliged to declare any illegal gifts, rewards or favours to officials. Non-complying companies risk being placed on a list by the National Treasury that will prohibit them from doing business with the public sector.

Unsolicited bids are generally prohibited except where such good or service is demonstrably innovative, exceptionally beneficial to the municipality, and provided by a sole provider. Such bids cannot be secret, and must be transparent and made public as a municipality can only approve such a bid through a public process, which affords the public, potential rival suppliers and National Treasury the opportunity to submit comments, including assessing whether such bid is truly innovative exceptionally beneficial and whether there are no similar products available to open up the process to potential competitors.

Bidders whose tax matters or municipal service accounts are not in order, or who are in arrears to a municipality, may be disqualified, unless satisfactory payment arrangements have been made. Moreover, bidders are required to furnish information disclosing any non-compliance, non-performance and any dispute with any other municipality or organ of state.

The regulations also allow the municipality to better align and coordinate with other legislation, like the Preferential Procurement Policy Framework Act (PPPFA) and the Broad-Based Black Economic Empowerment Act (BBBEEA). Council is expected to oversee the implementation of its supply chain policy.

Municipalities are further required to appoint an independent and impartial person to assist in the resolution of disputes with any bidder. It is envisaged that this will minimise the referral of disputes to a court of law.

The tabling of the Municipal Supply Chain Management Regulations in Parliament follows a period of extensive consultation and inputs from various stakeholders, when a gazette with draft regulations was published on 29 October 2004. Thirty five written submissions were received, as well as many more verbal and other less formal comments via workshops or discussions with officials, resulting in the draft being significantly revised since then. These regulations have also been agreed to by the Minister for Provincial and Local Government, Mr Sidney F Mufamadi.

Given that these regulations represent a major shift from current practices, the regulations are phased in for municipalities. Municipalities and municipal entities will be allowed three to twelve months to implement the regulations, depending on their capacity – the proposed implementation dates will be 1 October 2005 for high-capacity municipalities, 1 January 2006 for medium-capacity municipalities and 1 July 2006 for low-capacity municipalities. Training and support will be provided by the National Treasury. All municipalities are, however, encouraged to implement these regulations as soon as possible, as they represent best practice in supply chain management. In order to assist municipalities, a draft policy guide is provided for municipalities to use (or revise) as the supply chain policy of the municipality, to be adopted by the municipal council before these regulations take effect in a municipality. A more detailed guide will be made available shortly.

Copies of the regulations are available in *Government Gazette* 27636 or on http://www.treasury.gov/mfma.

Enquiries
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T 012-315-5165
083-378-0333

Call for nominations

GEOTECHNICAL DIVISION AWARDS 2005

THE GEOTECHNICAL DIVISION wishes to invite nominations for the Jennings Award for 2005. The Jennings Award is presented annually to the author(s) of a paper on a geotechnical subject published at a local or international conference or in a journal. The award is made in honour or Professor J E Jennings, who is widely regarded as the pioneer of modern soil mechanics in South Africa.

The Geotechnical Division also invites nominations for the Barry van Wyk Award. This award is presented annually to a final-year student at a South African university or technicon for his/her final-year dissertation, which must be in the field of soil mechanics or geotechnical engineering.

Nominations, accompanied by a copy of the relevant paper/dissertation, should be forwarded to

Dr S W Jacobsz
Jones & Wagener, PO Box 1434, Rivonia, 2128
E-mail: sw@jaws.co.za

Take note

The deadline for submissions is 30 September 2005. The presentation of the awards will take place at the Geotechnical Division's annual general meeting to be held on 17 November 2005 at SAICE National Office

CIVIL ENGINEERING SKILLS IN LOCAL GOVERNMENT

SAICE HAS TAKEN NOTE of and identifies with the recent statements by President Thabo Mbeki regarding the need to employ skilled technical personnel within local authorities to ensure the promised delivery of municipal services to their communities.

SAICE has for some time been concerned at the continuing erosion of technical, particularly civil engineering, capacity within municipalities and the negative effect this has had on the roll-out of infrastructure projects and sustainable delivery of services.

A recent extensive study undertaken by SAICE has pointed to several reasons for the current situation, including:

- low salaries of engineering professionals in government service
- early retirement, often as a result of affirmative action
- a shortage of experienced professional mentors to develop candidates
- appointment of non-technical personnel to key technical positions

In a significant number of instances, skilled and experienced engineering employees have been replaced by unqualified or underqualified appointees, resulting in the inevitable degradation of municipal services. SAICE believes that the current tendency to downplay the importance of professional engineering competency as a selection criterion for appointment to senior technical posts in municipalities will have further serious effects in terms of service delivery. It therefore calls on decision-makers to cease such selection practices.

Civil engineers, technologists and technicians play the leading role in municipal service delivery and, in SAICE's view, deserve greater recognition for their contribution. The Engineering Council of South Africa (ECSA) is currently formulating its 'identification of work' for registered persons, which is expected to have an impact on the policy for appointments in the public sector. □

International and local learners 'bridge the gap' at the SAICE International Bridge Building Competition ...

EARLY IN THE MORNING of 29 July, 17 teams from schools countrywide as well as from Zimbabwe and Namibia gathered at the Sci-Bono Discovery Centre in Newtown, Johannesburg, to take part in the South African Institution of Civil Engineering (SAICE) International Bridge Building Competition 2005.

The aim of this competition is to arouse awareness and interest in the civil engineering profession among learners.

Following a background lecture by Pieter Louw, a bridge engineer and member of SAICE, the teams, made up of three learners each, began building the bridges of wood, string, paper and glue according to technical specifications that were handed to them that morning. Once the bridges were completed and the glue had set, each bridge was tested to destruction. The winning bridge would carry the highest loaded mass. Judging the bridges were Tom Marshall: Vela VKE, Sam Amod: DEC, and Sakkie van der Westhuizen: Sappi.

St John's College from Zimbabwe won the event by far with a score of 260,1. In the second place was Zimuto Secondary, also from Zimbabwe, with a score of 190,7. Hoër Tegniese Skool Daniel Pienaar was placed third, scoring 150,3. The winning teams left the venue with substantial cash prizes for each team member as well as the participating school. The competition was a great success thanks to our sponsors: Murray & Roberts, Holcim, Sappi, Vela VKE, TCTA, Golder Associates and Pratley. □

Zina Girald, SAICE communications officer, with the winning team from St John's College, Zimbabwe. At the back is Karl Meissner-Roloff, Holcim South Africa's managing director. Holcim was the gold status sponsor for the competition

Learners in action ...

Allyson Lawless, SAICE president 2000, commentating during the bridge testing phase

Text Ron Watermeyer
President, SAICE 2004

A perspective on new international trends and thinking

The SAICE global network

A SAICE PRESIDENT has the privilege of meeting and interacting with many members, engineers, built environment and other professionals, academics, decision-makers, visiting dignitaries and politicians.

During my term of office I had several opportunities to rub shoulder with members of the international community on visits to South Africa and on my travels to Atlanta, Baltimore, Jaipur, and Geneva. Let me share with you some insights that I gained during my international travels.

CUTS-CITEE PROJECT ON TRANSPARENCY IN GOVERNMENT PROCUREMENT

Increasing transparency will reduce corruption

The CUTS Centre for International Trade, Economics and Environment embarked on a research project on two of the so-called Singapore issues, namely Transparency in Government Procurement and Trade Facilitation, called IWOGDA II (International Working Group on the Doha Agenda II). CUTS-CITEE researchers identified experts and invited them to develop papers and to attend the workshop at their headquarters in Jaipur, India, in June 2004. I was invited to develop a South African country case study which considered the hypothesis ***'Increased transparency in government procurement will reduce corruption'***.

The workshop participants agreed that

- procurement reform is not about corruption, but rather about good governance and achieving national development objectives
- although there may be considerable agreement on the ends (efficient, non-corrupt, and transparent procurement systems), remarkably little has been published about the means to attain them, and
- there is little publicly available literature on effective and replicable strategies that developing countries have adopted, or could adopt, to improve their public procurement systems

I was requested by the workshop to produce a synthesis report. The report, entitled 'Unpacking transparency in government procurement' – rethinking WTO government procurement agreements' (www.cuts-international.org/tgp.htm), defines the requirements for a fair, equitable, transparent, competitive and cost-effective system in a qualitative manner and asserts that a transparent procurement system is characterised by the documentation of clear rules and the means to verify that those rules were followed. It provides a replicable model for a public procurement system based on the national standards approach to procurement advocated by SAICE and the Construction Industry Development Board (see figure 1).

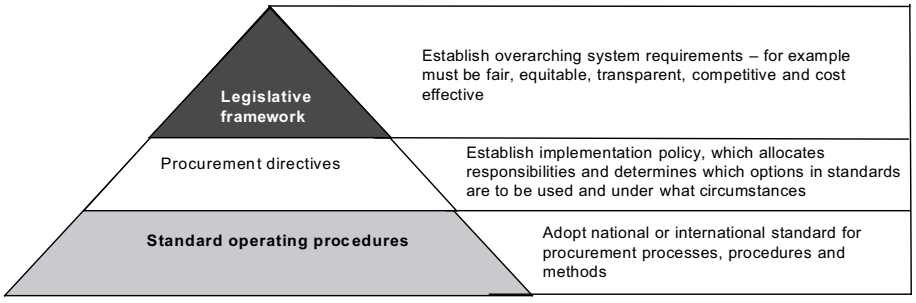

Figure 1 Universal model for implementing procurement within institutions

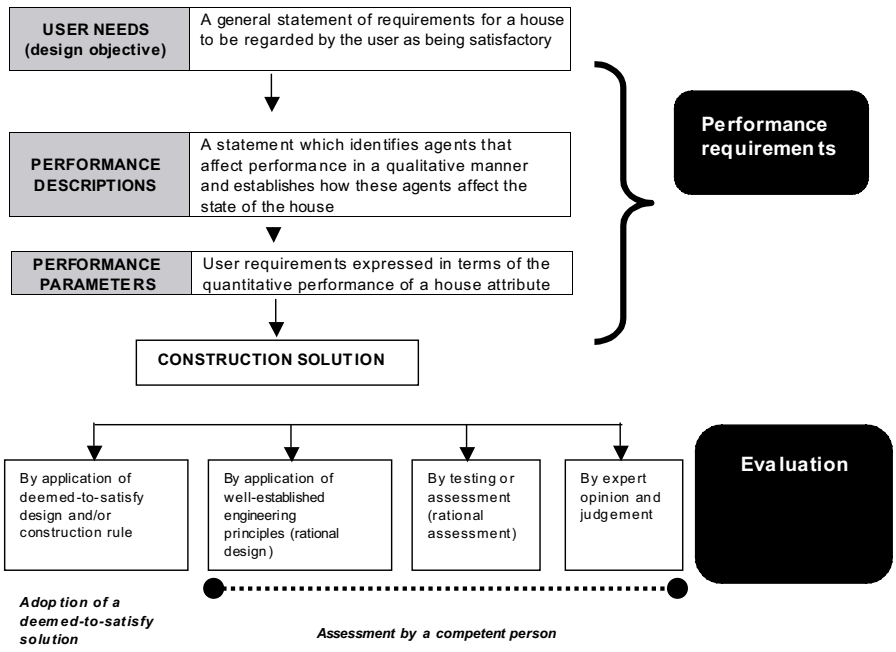

Figure 2 The performance-based approach to the procurement of houses as advocated by ISO 15928

DESCRIPTORS OF PERFORMANCE FOR HOUSING

User needs and the performance of houses

A subcommittee tasked with the development of a series of standards to identify the

methods that will be used to describe the performance of houses has after a number of years perfected the technique for describing performance (see figure 2).

The technique (or discipline) allows complex technical situations to be communicated simply and has many applications. It is a particularly powerful technique to develop a framework for the regulating processes.

GREEN AGENDA		BROWN AGENDA
Ecosystemic well-being	**Key concern**	Human well-being
Forever	**Time frame**	Immediate
Local to global	**Scale**	Local
Future generations	**Concerned about**	Low-income groups
Protect and work with	**Nature**	Manipulate and use
Use less	**Services**	Provide more
Affluence and over-consumption		**Poverty and underdevelopment**

Figure 3 Johannesburg World Summit – poverty, development and the environment

BALTIMORE 2004

ASCE charting the future

In October 2004 I attended the American Society of Civil Engineers' (ASCE) Baltimore 2004 Civil Engineering and Conference Exposition. The theme was 'Charting the Future'.

INTERNATIONAL ROUNDTABLE

Countries – green and brown agendas

I also made a presentation at the International Roundtable where the topic was ***'Technical Capacity Building in Developing Countries'***. This event was a response to the notion that developing countries need to enhance their human, institutional and infrastructure capacity in the pursuit of a more secure, stable and sustainable world. The United Nations Education and Scientific and Cultural Organisation (Unesco) and the World Federation of Engineering Organisations (WFEO) are mounting major efforts at technical capacity-building to developing countries. Unesco and WFEO recognise that developing countries need a solid base of technologically prepared people to effectively improve economies and quality of life. It is anticipated that such a base of engineers and technologists will facilitate the infusion of foreign capital by attracting multinational companies to investment in developing countries, assist in the making the most of foreign funds, and provide a basis for business development by local entrepreneurs.

In my address on 'Capacity-building assistance from one developing country to another in the construction sector' I pointed out that 20 % of the world's population live on less than 1US$ per day while 47 % live on less than 2US$ per day. As a consequence, income levels impact directly on resource mixes (labour and equipment), choice of technology and materials, and construction quality (accessibility, maintenance plans).

I outlined the differences between the so-called ***'green' and 'brown' agendas*** that characterise the differences in approaches to development between the north and south nations (see figure 3) and argued for a holistic approach to project evaluation. I also presented the four areas of capacity-building as contemplated by the African Engineers Forum's protocol, namely individual, institutional, technical and decision-making capacity, and posed the question: ***'Should developed or developing countries capacitate developing countries?'***

I pointed out that the developed countries (the north) have resources and pursue a 'green' agenda, while the developing countries (the south) are without resources and pursue a 'brown' agenda. However, developing countries with dual economies and limited resources are in a position to bridge this gap. They can offer in this capacity-building process perspective, understanding, an ability to relate to both agendas, a capability to develop best practices for developing countries, and an ability to advise other developing countries on appropriate responses. Accordingly, capacity-building should be undertaken by developing countries with the support and backing of developed countries.

GLOBAL PRINCIPLES FOR PROFESSIONAL CONDUCT

Forecasters estimate that by 2015, 80 % of the spending on infrastructure will be in developing countries and by 2020 two thirds of the world's major cities will be in those countries. This will lead to the globalisation of engineering practice on an unprecedented scale. According to experts, bribery and corruption can consume up to 30 % of a project's budgets and account for more than 10 % of the precious dollars spent globally on vital infrastructure. As construction firms from developed countries compete for contracts, they confront a clash of differing views on how to control bribery and corruption.

In January 2004, international engineering and construction companies signed and adopted a set of business principles for countering bribery as part of the World Economic Forum's annual meeting in Davos, Switzerland.

ASCE is part of an initiative for professional integrity which is conceived to curb bribery and corruption. The initiative is premised on engineers wanting to do the right thing and bribery and corruption being major causes of poverty. ASCE has established a task team on Global Principles for Professional Conduct under the chairmanship of Bob Crist. The team has been tasked to consider the codes currently governing engineering practice, consult with others (particularly those institutions which have cooperation agreements with ASCE), develop principles of conduct for individual engineers, and set forth performance expectations. WFEO, FIDIC and engineering societies in the UK, Canada, Mexico and the USA are collaborating on this effort.

A workshop was held to explore the role of the individual engineer in preventing corruption in business dealings and draw up draft principles of conduct that will define an engineer's professional behaviour in securing and performing engineering assignments as *a model of integrity for civil engineers* elsewhere.

A NEW ROLE FOR LEARNED SOCIETIES?

'Honest broker' role for learned societies

Learned societies are well placed to perform an 'honest broker' role and use their networks to facilitate activities that governments are not always in a position to do or have difficulty in doing so. It became apparent to me in my discussions with the ICE president, Douglas Oakervee, that the UN and many other agencies have at last come to the realisation that the Millennium Development Goals will not be achieved without the appropriate infrastructure being put in place. Learned societies, who come together in the common pursuit of a better quality of life for all, have a key facilitating role to play in this regard, particularly through their international networks.

I also began to see the timeliness of SAICE's initiative that gave birth to the African Engineers Forum Protocol of Understanding in Harare in 2001. This initiative is all about capacity-building.

THE CHANGING ROLE OF ENGINEERS

ASCE has issued a document in January 2004 entitled ***'Civil Engineering Body of Knowledge for the 21st Century: Preparing the Civil Engineer for the Future'.*** According to this document, the 21st-century civil engineer must demonstrate

1. an ability to apply knowledge of mathematics, science and engineering
2. an ability to design and conduct experiments, as well as analyse and interpret data

3 an ability to design a system, component or process to meet desired needs
4 an ability to function on multi-disciplinary teams
5 an ability to identify, formulate and solve engineering problems
6 an understanding of professional and ethical responsibility
7 an ability to communicate effectively
8 the broad education necessary to understand the impact of engineering solutions in a global and societal context
9 a recognition of the need for, and an ability to engage in, life-long learning
10 a knowledge of contemporary issues
11 an ability to understand the techniques, skills, and modern engineering tools necessary for engineering practice
12 an ability to apply knowledge in a specialised area related to civil engineering
13 an understanding of the elements of project management, construction and asset management
14 an understanding of business and public policy and administration fundamentals
15 an understanding of the role of the leader and leadership principles and attitudes

The 'ICE Presidential Commission 2004: Engineering without Frontiers' also examines the role of the engineer. The report on Phase 1, although acknowledging the historic role the engineer has played in development and the alleviation of poverty, contends that 'if engineers are to truly deliver the best possible outcomes to society, engineers must understand their role in this wider field, and shape their work and their contribution accordingly. Engineers must remain experts in their fields but must also understand the interaction between their work and the environment, culture and society, and the economy.'

The Institution of Structural Engineers has also commissioned a report on the changing roles of structural engineers in society. This study concludes that 'there is an increasing demand from government, clients and from society for construction professionals who are able to tackle the complex problems facing modern society and deliver a more sustainable future'.

Civil engineers need to work together with engineers from around the world to improve the quality of life for all. In order to do so, they need to embrace much more than the basic issues of health and safety.

COOPERATION AND PARTNERING WITH OTHER INTERNATIONAL ORGANISATIONS

The reason for global networking of professional organisations

In Baltimore I signed a renewal of the co-operation agreement with ASCE. The agreement is intended to facilitate the enhancement of the efforts of each organisation to better serve the public and the engineering profession in its own country. It focuses on the exchange of information, technical periodicals and the like and the encouragement of joint events, exchange of lecturers, exchange of publications, etc. (ICE and SAICE already have a cooperation agreement in place.)

CONCLUSION

Earth shapers

in 1994 Brian Bruce used the following definition of civil engineering in his presidential address: '... the application of science and technology in the control and use of forces and materials of nature, for the progressive benefit of all the peoples of our planet Earth'. Civil engineers are truly 'Earth shapers' and need to respond to global, national, regional and local issues. Politicians and law makers can capture the desires of the world's population. Engineers and other built environment professionals, however, are required to transform words into reality. □

Dawie's chronicles of his

recent 'sabbatical'

Background: The Kinderdijk region near Rotterdam is famous for the high concentration of windmills. It is also a Unesco heritage site

Keukenhof: At times Dawie is too small for his shoes!

Saluting Eng Cornelis Lely, father of the the Afsluitdijk, which connects North Holland with Friesland. The dike is a fundamental part of the larger Zuiderzee Works, damming the Zuiderzee, a saltwater inlet of the North Sea, and turning it into a freshwater lake, the IJsselmeer

At the Koninklijke Instituut van Ingenieurs van Nederland in The Hague: Dr Piet Looije, Drs Ing Bouke Bosgraaf, Dawie Botha, Eng Piet Gilissen and Ria Botha

Stockholm: Bo Wennerstrand, managing director of the Swedish Society of Civil and Structural Engineers, Dawie Botha and Jan Jerström, previous MD of the Society

Could only be Keukenhof ...

DIARISE THIS!

Event	Date		Venue	Contact
General Conditions of Contract Roadshow *Willie Claassen*	30 August – Umtata 31 August – East London 1 September – Port Elizabeth		Umtata Country Club East London Golf Club PE Tech Conference Centre	Dawn Hermanus*
SAICE Wits/Pretoria Afternoon Lecture Course	24 August 5 October 12 October	Water Division Geotechnical Division Professional Registration	SAICE National Office More topics on the lectures to be sent via e-mail	Dawn Hermanus*
Short Course on Coastal Engineering	5–9 September	Course will be presented on Monday, Tuesday & Thursday	University of Stellenbosch Cape Town	Marechia Jacobs T 021-808-4352 F 021-8084351 msjacobs@sun.ac.za
Catchment management conference: Public Participation in Developing CM Strategies	18–20 September 2005	Deadline for abstracts 20 July 2005	Misty Hills Country Hotel Muldersdrift, Krugersdorp	Carla de Jager T 011-805-5947 F 011-805-5971 cdejager@saice.org.za
Landfill 2005 Conference	20–21 October 2005		Greensleeves Castle Hillcrest, Durban	Lia Russell ktechptn@kaymac.co.za T 031-717-2300 F 031-702-0435

*Dawn Hermanus' details: T 011-805-5947, F 011-805-5971, E-mail dhermanus@saice.org.za