Martin van Veelen: SAICE 2012 President
Focus on ICE-SA Division
Moving on from SABS 1200
Delivering sustainable infrastructure that improves our world.
IT'S OUR SMARTER BUSINESS APPROACH.
Let there be Jobs

IT WAS THE FAMOUS John F Kennedy who said that it is not the wealth of a nation that builds roads, but the roads that build the wealth of a nation. Engineering students, in their painful passion for essay-writing, have since then agonised over associations between government, infrastructure and the socio-economic development of a nation. It is well known that the great powers in history depended on their transportation infrastructure for economic development — Rome to manoeuvre its armies and commerce, and Britain (via its reliance on the ocean) to open cultural and foreign (albeit colonial) trade between what is now the commonwealth countries, and so on.

Build a road between two communities and this opens links and nodes for interaction and mutually beneficial trade. The positive relationship between engineering infrastructure and the improvement of a nation’s economy is undeniable. As an aside, another interesting point to ponder is the establishment of trade and capitalism wherever missionaries were posted. The connection between western religion and democracy and capitalism makes for provoking and stimulating debate, but we will leave that for another time.

The National Planning Commission (NPC) under the very able leadership of Minister Trevor Manuel, who happens to have his foundations in civil engineering, revealed its National Development Plan (NDP) for public comment and discussion in November last year. The commissioners entrusted to draft the plan included four engineering practitioners (no wonder the plan is a good one). The macro goal of the plan seeks to transform the lives of the poorest South Africans and to ensure that equal opportunity is available for all South Africans in the next 20 years.

The document is expressed in a 440-page compilation with poor page numbering (the engineers were not involved here), but is neatly summarised in its 40-page overview at the beginning. It highlights nine challenges facing post-apartheid South Africa, namely unemployment, low standard of education (these two are closely related), poorly managed infrastructure, exclusion, our resource intensive economy, a failing public health system, poor public service, corruption and the lack of societal cohesion. The plan proposes to re-write the story of South Africa by addressing nine key development goals — creating jobs, improving infrastructure, transitioning into a green economy, transforming urban and rural spaces, improving education, providing quality healthcare, building a capable state, fighting corruption and uniting the nation.

While engineering, and particularly civil engineering, cuts across all nine development goals, five of the nine require the direct involvement of engineers. So it appears then that circumstances are encouraging tender relations between engineers and government again — to set aside differences and sing off the same hymn sheet. Does the South African government know what engineers do, and more importantly, do South African engineers know what our government does?

The NDP consistently calls for the joint participation of all South Africans to make the dream come true — to make the shift from passive citizenry to active champions in the evolution of our economy. In my opinion this is an absolute requirement. Sitting on the periphery, not participating, and aspiring economic freedom for mahala, is simply not going to work. However, while the private sector, organised society and the general public engage with the NDP, the role of government is fundamental if the brilliant work expressed in the NDP is to be achieved.

Leadership — let us contemplate this for a moment. To bring into alignment the winds of diversity in South Africa, and to focus on the achievement of the NDP’s common purpose, we need charismatic and pioneering leadership, leading from the front. The NDP acknowledges that the “plan is only as credible as its delivery mechanism is viable”. The achievement of the NDP rests largely on the shoulders of an informed, organised and intelligent government service — a professionalised government organisation that knows what its people want and how to deliver it. The Apple Company comes to mind.

The appointment of appropriately qualified people installed in correct positions, and not political friends, is crucial. When it comes to engineering service delivery we must have competent, experienced, registered professionals running the show and making the decisions — or people die, and a nation suffers. The government sector needs to separate the political agenda from technical work — let the engineers get on with it. We are not going to achieve this plan if we still have mamparas identifying and managing multibillion rand service delivery projects and managing the overall procurement processes.

Think. Plan. Act. Throughout history this has been the philosophical mantra of the conquering man. These are the main nodal stops in the pipeline of accomplishment. And the greatest of these is Act.
FROM THE CEO’S DESK
Let there be Jobs

PROFILE OF SAICE 2012 PRESIDENT
Taking decisions in a quietly assertive manner

The SAICE 2012 presidential team

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ICE Membership – an international passport to civil engineering
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Moma Mineral Sands – marine jetty upgrade

INFORMATION TECHNOLOGY
ERP implementation is fundamentally an engineering endeavour

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Taking decisions in a quietly assertive manner

There are three kinds of people in the world: those who make things happen, those who watch things happening, and those who wonder what happened. I want to be part of the group who make things happen," says Dr Martin van Veelen, SAICE’s President for 2012. This mind-set applies as much to his presidential sense of duty as the fulfilment of his responsibilities at Iliso Consulting, where he heads the Centurion office of the company. “Whether this is a positive trait or a character flaw I can’t tell. I’m not always sure how other people see it.”

Martin was six years old when his parents immigrated to South Africa from the Netherlands in 1958. Even though it was 13 years after the end of the Second World War the countries of Europe were still struggling to rebuild their economies. In South Africa, the government was establishing the Sasol petrochemical plant and was launching a recruitment drive for skilled artisans, particularly from the Netherlands and Germany. “My father, who was a fitter and turner at Shell, decided to take up the opportunity. We came out with all our worldly possessions and settled in Sasolburg,” recounts Martin. The three boys in the family were later complemented by two girls; Martin is the eldest.

He initially wanted to pursue a career in pharmacology, but financial assistance was not readily available. When all matric boys received letters from the Department of Water Affairs, offering them the opportunity to study engineering with the aid of a departmental bursary, he took up the offer. He has been engaged in water-related engineering ever since, currently totting up 34 years of experience in particularly water quality monitoring, assessment and management, as well as environmental management and project management.

In a hurry to get on with life

After military conscription Martin was in a hurry to get on with life. He chose the University of Pretoria (UP) for his tertiary studies because UP offered a BSc Eng (Civil) degree course over four years instead of five. “I was very conscientious in my first year and did well. Maybe I became a bit too complacent, or maybe it was because I got hooked on the game of bridge in my second year, but that’s where I struck a dip,” he remarks ruefully. He did complete his engineering subjects in four years but not all the supplementary subjects. “By then the bursary had run out. So I worked at the Department as a technician because I was still an undergraduate, and in the evenings did the outstanding subjects. I realised I had to accelerate the pace a bit.” He took a year’s unpaid leave, got a job as a part-time assistant lecturer – “this was really the lowest of the low, but it paid the bills” – and finished his Honours degree in water utilisation in one year. Martin was back on track.

He also fitted marriage into his schedule. “I met my wife Gerna when we were both first-year students and we got married at the end of my fourth year. She trained as a teacher, but then worked in the archival section at the Department of Defence because there were no teaching vacancies for married women in Pretoria at the time.”

Fully qualified by 1977, Martin was assigned to the planning division of the Department of Water Affairs. The Orange-Fish tunnel, transferring water from the Orange River to the Fish River, had just been completed. “The water...
quality of the two rivers differs vastly and a study had to be undertaken on how to manage the system in order to optimise water quality,” he elaborates. “It was sheer luck that I ended up with the task. I was simply told, ‘Here, sort it out.’ It was a wonderful challenge,” he says. “I’ve always been interested in chemistry, so to get involved in water quality was just perfect.” It has become his specialist field; later on the environmental aspect was added, and in conjunction with the engineering side, it is what Martin is best known for.

With the private sector offering lucrative opportunities for engineers, and with Martin and Gerna’s first child on the way, he decided in 1980 to join Chunnett Fourie and Partners in Pretoria. It turned out to be a brief stay, because in about two years’ time the government had redressed the disparity in salaries. “I also needed to do research for my Master’s degree in water utilisation at what was then the Hydrological Research Institute, which functioned under the Department of Water Affairs.” He resigned and went back to the Department, once again into the planning division.

**PROBLEM SOLVER**
In this period he investigated various water supply schemes, including the Lower Fish River Government Water Scheme and the Mossel Bay Regional Water Scheme, for both of which he prepared a planning report and a White Paper. “The latter was a high-profile development at the time; it involved strategic water application from the Wolwedans Dam near Mossel Bay for the Mossgas project,” he recalls. His engineering involvement, on the whole, has been on the planning side. “I’m not a design engineer; I’m a problem solver – that’s what I have always liked to do.”
Then the post of deputy director became available at the Hydrological Research Institute, a field right up Martin’s alley. His application was successful and he was transferred to the Institute. “There was a whole suite of laboratories doing water quality analyses; there were hydrologists, botanists, ecologists – it was as if I was acquiring an additional university degree. I went out with the teams into the field to take water samples, catch fish and other organisms for analysis and follow through on the results – I had a wonderful time,” he says enthusiastically. He obtained his M Eng degree in water utilisation in 1983.

**UNDERWATER SPORT ENTHUSIAST**

Being passionate about water during office hours wasn’t enough. Since his undergraduate days Martin had been an enthusiastic member of UP’s underwater sport club. “Gerna and I were both members of the university’s outdoor club. She was more into hiking, but that didn’t appeal to me – it seemed too much about who could carry the heaviest backpack or move from point A to point B the fastest. So I said, ‘I will accompany you on a hiking trip, but then you go on a diving trip with me to Mozambique’.”

Back in inland Pretoria, the only way for him to continue the activity was to play underwater hockey. “To participate competitively we had to start an independent sport club at UP,” he continues. Martin was a founding member and subsequently chairperson of this club, but later had to call a halt to active participation. “It required a lot of practice and I ran out of time. Having a job and a family by that time, some things had to fall by the wayside,” he says. Martin and Gerna’s eldest son, Martin, was born in 1981 and the second one, Jan-Willem, in 1987 – “and that’s where we stopped.”

However, he had also become involved in underwater orienteering, a sport in which he won university, provincial and national colours. He sheds some light on this pastime: “You go to a dam with low-visibility water – where you can only see about an arm’s length ahead. A course is marked by planting buoys in the water, and you survey the course from the shore to get a compass direction and the distance to be covered. Then you swim the course underwater using your compass and a distance measuring device. If you surface en route you’re disqualified.”

His competency in diving is reflected by the 4-star diving certificate – the highest grade allocated – that he holds. Apart from being a past president of the South African Underwater Sport Federation he was also voted onto the international body that organises and controls the sport of underwater orienteering. He has been a member of that committee for about 15 years, also serving as an international judge. In 2011 he acted as chief judge at the world championships held in Germany.

He still jumps at a chance to go diving when the opportunity arises, such
as when he visited the Maldives as part of the South African water sector that provided some support to the islands after the 2004 tsunami. It was not only his expertise that led to his participation; he also represented SAICE on the committee created for this purpose. Contrary to some of the other Indian Ocean countries, the Maldives did not suffer such severe damage. “No crashing wave washed over the 6 000 islands; the waters simply rose and fell,” he says. “These sand atolls are only about 3 m above sea level and there are no rivers or dams; their only water supply is gathered from groundwater which, after the surge, was contaminated with sea water. Apart from the conditions created by the tsunami, the danger of over-exploitation of groundwater is always present,” Martin explains. “We designed a course that equipped the various communities with an understanding of the conditions of their habitat: that because of the sandy soil a lens of fresh water sits on top of the sea water, and when you draw out too much fresh water you draw in sea water. As long as you don’t take out more than what is replenished by rain you maintain the balance,” he explains.

**BACK TO THE PRIVATE SECTOR**

Martin had spent five years at the Hydrological Research Institute, working mainly on the design of a national water quality monitoring system for South Africa, when he received a very attractive job offer from BKS. His first major project with them was a water quality management plan for the segment of the Jukskei River flowing from Johannesburg down to the Crocodile River, which runs into the Hartebeestpoort Dam. “Unfortunately it was one of those tasks where you come up with plans and actions, but after that the challenge lies with the people who have to implement it.”

A project he takes great pride in was heading the team who developed water quality guidelines for domestic supply, undertaken for the Water Research Commission and the Department of Water Affairs. Of the 5-part series titled *Quality of Domestic Water Supplies*, Volume 1: the *Assessment Guide*, received the SAICE Award for Water Engineering in 1998.

Most challenging, but thoroughly enjoyable, was an African Development Bank funded project, in 2001 in Uganda, where Martin took over mid-stream as project leader in order to ward off failure. After investigating the status quo on the strategic plans and design of projects for the water supply, sanitation, stormwater drainage and solid waste disposal of seven rural towns, Martin agreed to take responsibility. “Nobody argues with someone who says he’ll do the job,” he says stoically. His anchorman back at BKS in Pretoria was Kevin James, who remembers the circumstances well: “It is often said that working in Africa is not for ‘sissies’ and we were to find this out first hand on the Uganda project. Martin was heading up our Environmental Management Department at the time and volunteered his services to manage the project and to work closely with the client in Kampala, which was desperately needed. It turned into a most demanding endeavour, due to the logistics involved and the requirement that more work be done in Kampala and not out of South Africa. Martin took to the challenge, got the project on track and helped to turn the client around. We completed the project successfully and many a lesson was learnt along the way. On one occasion Martin was required to travel to one of the towns on the border with the DRC in the northern territories of Uganda. Martin still ‘fondly’ recalls enjoying the luxury of a room with an ‘en-suite’ pour-flush squat pan toilet with resident mosquitos at the local hotel.”

Other environment-related projects that formed part of his Africa exposure were an oil pipeline from Eldoret in Kenya to Kampala in Uganda, a drainage master plan for Kampala, the assessment of hydropower generation in Ethiopia, a 1 300 km toll road along the coast of Libya, a water supply and distribution scheme for Blantyre in Malawi, and the utilisation of the water resources of the Chobe/Zambezi River.

After 12 years with BKS, Martin left to take up the position of Director of the Environmental Management Division at Iliso Consulting. By this time he had also added a PhD in aquatic health to his academic qualifications. At Iliso he is currently involved in the preliminary design for a 520 km 2-m diameter pipeline in Botswana. “We started with an environmental impact study, then did the feasibility study and are now doing the preliminary design.” As team leader he does not have to ‘do the drawings himself’, an aspect of engineering he

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has never been keen on. “But I enjoy my work, especially if I’m the boss,” he says with the suggestion of a mischievous smile. A three-year assignment – a national groundwater management strategy – that Martin project-managed, was signed off in 2010. Last year, a major water reconciliation study for the Olifants River, from Witbank down to the Kruger National Park, on which he was the water quality specialist, was completed.

**STRUCTURED APPROACH TO DECISION-MAKING**

He recognised his heavy workload when he agreed to be President-Elect of SAICE and planned well in advance for the time when he would be tasked with the presidential responsibilities. For him there are no half measures: “You’re either in or you’re out,” he says in his quietly assertive way. He has been involved with SAICE in various capacities since 1989 and believes the first duty of the President is to provide leadership. “To me this means that decisions *have* to be taken. Everybody has his own decision-making style; my approach is as follows: if there is more than one person involved there’ll never be complete consensus. For me the recipe lies in creating the opportunity for everybody who is part of the decision-making process to contribute and speak his or her mind. While the people are speaking – and you insist upon hearing each one’s opinion – you start to see where the communalities lie. Then you say: ‘I have listened to all of you and it seems we agree on this, that and the other. So what is left?’ and you spell it out. Then you say: ‘Can we agree that the minority conforms to the majority?’ If you take it step by step, normally you find there’s no problem – people come to consensus very quickly. You mostly find that people are only too happy that somebody accepts the responsibility to drive the process to its conclusion. So, of major importance is that a decision be taken, otherwise you may as well go and drink coffee.”

Martin draws as much pleasure from his SAICE association as from his full-time job. The year 2012 also holds the prospect of following up on friendships made through his underwater activities. “I have a trip planned, with my family, to the Ukraine in March. The trainer of the Ukrainian national underwater orienteering team is celebrating his 60th birthday and we’ve been invited – we haven’t been to that country before.” His underwater sport has already taken him to Poland, Estonia, Hungary, Austria, Spain, Croatia and the Czech Republic, and a visit to Kazakhstan is likely some time in the future. “I’m living a wonderful life; I wouldn’t want to change anything about it,” he says.
Specialist skills and supportive services within ILISO and associated companies enable the group to:

- Quality guidelines and management plans, industrial wastewater treatment and disposal.
- Other competencies include Social Impact Assessments (SIAs), and public participation and consultation.

**ENVIRONMENTAL**

- Integrated Environmental Management (IEM) in general
- Environmental Impact Assessments (EIAs)
- Environmental Management Plans (EMPs)
- Environmental monitoring & auditing; Registration & licensing of water users
- Assessing water requirements for basic human needs & riverine ecology
- Determining stream-flow assimilative capacity for pollution loads
- Water quality guidelines & management plans
- Industrial wastewater treatment & disposal
- Social Impact Assessments (SIAs)
- Public participation & consultations.

**STRUCTURES**

- Multi-storey commercial buildings
- Multi-storey industrial buildings
- Reinforced concrete design
- Structural Steel design
- Timber design
- Composite Structural design
- Structural masonry & timber design
- Bridges & culverts
- Deep foundations design
- Building rehabilitation design
- Bridge assessments & rehabilitation
- Prestress design specialist

**MANAGEMENT SERVICES**

- Co-ordination of housing projects
- Management of urban infrastructure upgrade projects
- Management of rural & urban community based labour intensive projects
- Cost control of projects
- Management information systems for single multi-disciplinary projects
- Project facilitation & community empowerment
- Co-ordination of housing projects
- Project facilitation & community empowerment

**TRAFFIC & TRANSPORT**

- Major Roads & Highways
- Route selection, planning & geometric design
- Storm water drainage, etc/ Flood line Analysis
- Materials investigation & pavement design
- Design of major cuts & embankments
- Road rehabilitation using mechanistic design methods
- Road Safety Audits
- Traffic Signage & road Markings
- Transportation planning
- Transport economics
- Traffic impact Studies
- Transport facilities
- Major intermodal transport interchanges
- Public Transport Infrastructure design

**INFRASTRUCTURE**

- Gravel & Surface roads
- Pavement Management Systems for gravel & surfaced roads
- Stormwater drainage including open & piped drainage systems, stormwater detention ponds, etc.
- Subsoil drainage systems
- Sewerage reticulation design
- Water reticulation design

**Water & Sanitation.**

- Waterloss Management Systems
- Water & Sanitation.
Chairman’s Report 2011

Dr Ron Watermeyer
2011 Chairman ICE-SA
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NAME OF THE JOINT DIVISION
The year 2011 was a difficult one for the Division due to the uncertainty regarding the name of the Division. The SAICE Executive Board very recently tasked Sam Amod, president of SAICE in 2006, to investigate the issue and to make a recommendation on the matter to the SAICE Council. I am very pleased to report that SAICE’s Council unanimously accepted his recommendations to accept the name ICE-SA, a joint division of ICE and SAICE, i.e. the name that had been approved by ICE’s Council. This has now put this issue to bed and the Division can continue with its mandate obtained from both institutions in terms of the Agreement of Cooperation, namely:

- To perform learned society activities that are of mutual interest to ICE and SAICE, with particular emphasis on matters that are of international concern.
- To perform the normal ICE country representative services.
- To arrange ICE-SAICE presidential visits.
- To arrange Brunel International Lectures.
- To promote and communicate ICE and SAICE publications, programmes, best practices and initiatives.
- To provide developing country inputs into ICE initiatives and projects.

DIVISION ACTIVITIES
Panel of NEC adjudicators
The Chairman of the Division has been requested on several occasions to recommend the appointment of an adjudicator for disputes under various NEC contracts (NEC: New Engineering Contract), where the parties cannot agree on whom to appoint, or where the contract data of the contract states this requirement. The committee is seeking to expand and strengthen the panel of adjudicators, as the demand for adjudication seems to be increasing.

CESMM-SA
Industry representatives met during 2008 to discuss the way forward regarding a standard system of measurement should SABS 1200 be withdrawn. The Civil Engineering Standard Method of Measurement (CESMM3) published by the Institution of Civil Engineers (ICE) (London) became a logical choice as a base document for the successor to the current system of measurement embedded in the SABS 1200, as it is founded on the same thinking and philosophy as the system that has evolved in South Africa, and is widely used in Africa. There were, however, a number of issues relating to terminology, references to BS standards and regional earthworks practices (excavation of trenches and temporary earthworks) that needed to be addressed to make CESMM3 suitable for use in southern Africa. ICE granted permission for the customisation of CESMM3.

Work on the CESMM3 was suspended due to delays in the publication of SANS 2001, as it was felt that there needed to be a critical mass of SANS 2001 standards available before launching CESMM3.

A southern African version of CESMM3 was launched in June 2011, following its finalisation by industry during November 2010. This edition of CESMM3 aligns with the terminology used in the Construction Industry Development Board’s Standard for Uniformity in Construction Procurement, and may be used with any form of contract in use in South Africa. Copies of this document may be obtained from

ICE reviews
There has been a steady increase in applications for ICE membership during 2011 without going through the mutual exemption route established by ECSA (Engineering Council of South Africa), SAICE and ICE. Several applicants have now become ICE members and have become registered with the international body for the registration of engineers, namely the Engineering Council of UK.

The committee has during 2011 established what needs to be done to conduct interviews in South Africa. During 2012, the committee will be bringing ICE staff to South Africa and run road shows in two or three centres so that anyone wishing to apply for ICE membership can engage with those who run the process for ICE.

APPRECIATION
I wish to extend my personal appreciation to my committee for their support over the last year, and for the energy and enthusiasm displayed in undertaking their voluntary duties during a very trying time. I also commend to you the incoming chair, Dr Hylton MacDonald.
The mission of the Engineering Council (UK) is:

To maintain internationally recognised standards of competence and commitment for the engineering profession, and to license competent institutions to champion the standards.

The engineering profession in the United Kingdom is regulated by the Engineering Council (EC) through 36 engineering institutions (Licensed Members) who are licensed to place suitably qualified members on the EC's Register of Engineers. The Register has three sections: Chartered Engineer, Incorporated Engineer and Engineering Technician. These titles are protected by the Engineering Council's Royal Charter and may only be used by registrants.

The 36 engineering institutions are increasingly becoming international organisations which happen to have their head office in London. For example, the Institution of Civil Engineers has members in 150 countries, and the Institution of Structural Engineers has members in 105 countries. It is therefore not surprising that almost 20% of those registered with the EC are not UK citizens.

The EC has a strategy to extend the recognition of those registered with the Council and who are working outside of the UK, by reaching mutual recognition agreements with professional bodies and by inclining governmental organisations towards liberalisation of professional recognition, and by the provision of engineering services.

In carrying out this strategy the EC sees the world as being currently divided in two blocks. There are the countries whose education and engineering formation systems are built on a UK/USA model – for example all or most of North America, Asia, Pacific, Africa and China – and there are the European countries with a Napoleonic/Humboldtian system of education and formation. The UK (and Ireland) bridge these two blocks and actively engage with both systems in order to reconcile differences and enhance mobility.

Within Europe the EC is involved in two over-arching professional organisations – ENAEE and FEANI – and interacts with the European Commission. Outside Europe the EC is involved in the International Engineering Alliance, which comprises the Washington Accord, Sydney Accord, Dublin Accord, International Register of Professional Engineers, APEC Engineer Register and the International Register of Engineering Technologists.

ICE MEMBERSHIP - THE ROUTE TO EC REGISTRATION
ICE is a licensed member engineering institution of the Engineering Council. Provided that their educational qualifications are acceptable to the EC for the required grade, ICE Members are eligible to register as Chartered Engineers (CEng) or Incorporated Engineers (IEng). Similarly, a Technician Member is eligible to register with the Engineering Council as an Engineering Technician (EngTech). (ICE members have to pay a once-off entrance fee and annual subscription fee to the EC for these titles, in addition to the ICE fees.)

In contrast, SAICE Members (MSAICE) are required at the time of admission to be professionally registered with a South African statutory council or an international body recognised for this purpose by SAICE's Council. The Engineering Council of South Africa (ECSA) registers those engaged in civil engineering. (Those engaged in the management of civil engineering projects may alternatively be registered by the South African Council for the Project and Construction Management Professions (SACPCMP)). Accordingly, ICE membership is the route to registration with the EC. Registration with ECSA, SACPCPM or EC is the route to membership with SAICE.

An article setting out the equivalency of grades of membership between ICE and SAICE, the benefits of such membership, the details of the mutual exemption agreement, and particulars of the grades of membership was published in Civil Engineering.

**ROUTES TO ICE MEMBERSHIP**

The ICE website (http://www.ice.org.uk/joining/index.asp) contains a wealth of information on membership (see areas on membership downloads and non-UK qualified applicants). Anyone who wants to become a professionally qualified member must satisfy the requirements of the three stages to membership, whether they are UK or non-UK based:

- **Stage 1: Educational Base**
- **Stage 2: Initial Professional Development**
- **Stage 3: Professional Review**

The criteria for each stage are different depending on which grade of membership is sought. There are also different ways (routes) in which a potential member may complete each stage. There is great flexibility in how these can be achieved, and a lack of a formal academic qualification does not necessarily prevent an applicant from applying for membership. As well as being able to qualify into a membership grade directly, it is also possible to progress from one grade of membership to another.

ICE is an international organisation and therefore welcomes applicants from all over the world. Qualifying for membership requires the successful achievement of the three aforementioned stages. The standard route for those candidates who possess an accredited qualification is:

- Accredited qualifications
- Training agreement or career appraisal
- Professional review

An accredited course is one that has been assessed as having satisfied all or part of the required educational base. This includes qualifications accredited within the FEANI Index, and the Washington, Sydney and Dublin Accords, which provide for the mutual recognition of engineering degree courses between signatory countries. A course search facility is available to confirm if a qualification is accredited (see Figure 1). Candidates who do not have accredited courses may be eligible for Associate Membership (AMICE) or Membership (MICIE) without EC UK Registration (CEng or IEng). Alternatively, they may apply for Academic Assessment should they wish to attain Chartered Membership and registration with the EC UK.

A career appraisal is required if the applicant has not completed an ICE/HKIE Training Scheme and has self-managed his/her training. However, the requirements of the ICE Development Objectives must still be met and verified through this process. (The Career Appraisal (CA) is a means of demonstrating satisfactory completion of IPD (Initial Professional Development) by those who have not entered into nor completed a Training Agreement with a company operating a training scheme approved by ICE and are self-managing their own IPD. The CA will identify whether your experience has given you the same basic competencies as someone who has successfully completed their IPD via a training agreement. The appraisal is not intended as an obstacle to qualification, but is designed to provide an opportunity for assessment and counselling on how far you have progressed towards the Professional Review.)

An application for a Career Appraisal (ICE 3126) must be accompanied by the following supporting documents:

- A copy of academic qualifications
- A detailed CV
- A copy of the Core (ICE 2011B) or Development Objectives (ICE 3005) and, if applicable, any Specific Objectives which should ideally show your mentor’s assessment of the progressive levels and dates of achievement (self-certification is acceptable but obviously has less credibility)
- An Experience Report of not more than 2,000 words, cross-referenced to the Objectives, which must include a brief indication of your proposed route onwards to the Professional Review
- Documents produced during the normal course of your work as evidence that you have met the Core/Development and any Specific Objectives (these need to be selected with care as they must be relevant and referenced to the Report)
- A photocopy of your Development Action Plan (DAP) and Personal Development Record (PDR) (ICE 3006)

The outcome of the Career Appraisal is an indication of satisfactory progression to the next stage, or advice on any further study or training required.

The Professional Review is the final stage in becoming a Professionally Qualified Member. Graduates who have completed an ICE-approved training scheme, or candidates who have successfully undertaken a Career Appraisal, may apply for the Professional Review at the level appropriate to their grade of membership.

ICE is an international organisation and, as such, strives to accommodate applicants from all over the world. There is an established Professional Review Centre in Hong Kong. Depending on candidate numbers, Professional Reviews can also be arranged in China, the UAE, Brunei, New Zealand and India.

It is possible to sit your Professional Review in South Africa, depending on the numbers requiring an interview. Arrangements should be made with the ICE-SA Division secretary (secretary@jointcivils.co.za).

**ROUTE TO ICE MEMBERSHIP FOR SAICE MEMBERS**

Corporate SAICE members who are registered as professional engineers with the Engineering Council of South Africa (ECSA) may become members of ICE through the current Mutual Exemption Agreement (MEA) between ICE, ECSA and SAICE.
Applications for membership via the MEA route are considered by ICE’s Exemption and Recognition Panel, which meets four times a year. The review is conducted as a desktop exercise, but some applicants may be invited to attend an interview.

A candidate perusing this route to membership needs:
- to hold one or more of the academic qualifications covered by the Washington Accord or listed on the FEANI register (if the applicant’s qualifications are not accredited, the applicant needs to apply for an Academic Assessment to have these assessed prior to the application being submitted)
- to be a full corporate member of SAICE and have gained his/her registration as a Professional Engineer via ECSA’s standard review route. The application needs to be accompanied by:
  - a Membership Application Form (ICE 3105)
  - three Sponsors’ Questionnaires (ICE 3123) (at least one sponsor must be a Chartered ICE member; the other members may be ICE Chartered Members or SAICE members who are Professional Engineers)
  - the administration fee
  - a detailed CV (please include descriptions of the projects on which you have worked, including size, cost and positions of responsibility, as well as key achievements)
  - copy of your Professional Development Record and Development Action Plan
  - copy of SAICE Membership certificate and ECSA Registration
  - copy of Degree Certificate (if you are not already a Graduate member of ICE)

APPLICATIONS FOR ICE PROFESSIONAL REVIEW
Candidates wishing to undertake the ICE Professional Review in the next year or two should contact the secretary of ICE-SA (secretary@jointcivils.co.za) to have their names placed on a list. Should South Africa have sufficient candidates, ICE-SA will arrange to have the interviews done in South Africa, saving time and money.

An accredited course is one that has been assessed as having satisfied all or part of the required educational base. This includes qualifications accredited within the FEANI Index, and the Washington, Sydney and Dublin Accords, which provide for the mutual recognition of engineering degree courses between signatory countries.

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**Selecting a suitable NEC3 form of contract**

**BACKGROUND**

ISO 6707-2 defines conditions of contract as “terms that collectively describe the rights and obligations of contracting parties and the agreed procedures for the administration of their contract; or document containing conditions of contract”.

A standard form of contract, or standard contract, is a contract between two parties that is published by an authoritative industry body with fixed terms and conditions which are deemed to be agreed and are not subject to further negotiation or amendment.

The NEC is a family of contracts that facilitates the implementation of sound project management principles and practices, as well as defining legal relationships. It is suitable for procuring a diverse range of engineering and construction works, services and goods, spanning major framework projects through to minor works and purchasing of goods. NEC is a division of Thomas Telford Ltd, which is a wholly-owned subsidiary of the Institution of Civil Engineers (ICE), the owner and developer of the NEC.

The NEC was originally known as the ‘New Engineering Contract’ when it was launched in 1993. The second edition, which added several new documents to the family, including a professional services and adjudicator’s contract, was launched in 1995. The NEC3, which incorporated the learning and industry feedback in using the second edition, was published in 2005. The NEC3 Term Service Short Contract (TSSC), NEC3 Supply Contract (SC) and NEC3 Supply Short Contract (SSC) were launched in 2009.

The NEC3 is drafted around three main objectives:

1. Stimulus to good project management
2. Clarity
3. Flexibility

It is drafted on a relational contracting basis, based on the belief that collaborative working across the entire supply chain optimises the likely project outcomes when compared with a typically fragmented and non-integrated approach to designing and constructing projects. The NEC3 contracts are accordingly designed to encourage collaboration and teamwork, rather than a confrontational approach to the management of a contract. The first clause in every contract requires the parties to the contract, and any project / services / supply manager appointed in accordance with the contract, to “act as stated in the contract and in a spirit of mutual trust and cooperation”.

The NEC3 contracts provide effective control of change, speedy agreement of time, quality and cost impacts of change, improved early forecasting of end costs, greater accuracy of end date forecasts, early warning of risks and potential change, and quick dispute resolution mechanisms. They also contain clear procedures with clear time limits for actions to be taken, which:

- are designed to reduce financial and decision-making chains, and
- make use of risk and value management tools.

**NEC3 DOCUMENTS**

The NEC3 set of contracts contains a whole family of interlocking documents covering engineering and construction works, professional services, term services, supply, framework and adjudicator’s contracts (see Table 1). This promotes a ‘best fit’ procurement route for a particular project. These standard forms of contracts are accompanied by guidance notes and flow charts which depict the procedures followed when using the NEC3 contracts (see Table 2). The flow charts are intended to assist users to see how the various clauses of an NEC3 contract are applied, and as such depict the sequences of actions that take place in terms of the contract.

**STRUCTURE OF THE NEC3 CONTRACTS**

Each contract in the family:

- uses a similar structure and terminology to promote ease of learning and back to back provisions for process integration and contractual cover, and
- is drafted around a modular structure so that a rapid assembly of ‘best fit’ procurement arrangements can be made for each transaction.

All contracts have Core clauses, while some have Main Option clauses, which enable different pricing mechanisms to be called up, and Secondary Option Clauses which provide for a range of optional conditions of contract to be called up if need be. Some of the contract types have short options which do not require sophisticated management techniques and impose only low risks on both the parties. These short contracts as such provide the drafter with very few options when compiling a contract and make no provision for a Project / Supply / Service Manager appointed by the Employer.

All the NEC3 contracts, with the exception of the Framework Contract (FC) and the Adjudicator’s Contract (AC), contain core clauses which are arranged in the following nine sections:

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>General</td>
</tr>
<tr>
<td>2</td>
<td>The Contractor’s (ECC, ECSC, TSC and TSSC) / Subcontractor’s (ECS and ECSS) / Parties’ (PSC) / Supplier’s (SC and SSC) main responsibilities</td>
</tr>
<tr>
<td>3</td>
<td>Time</td>
</tr>
<tr>
<td>4</td>
<td>Testing and defects (ECC, ECS, SC, SSC, TSC and TSSC) / Defects (ECSC and ECSS) / Quality (PSC)</td>
</tr>
<tr>
<td>5</td>
<td>Payment</td>
</tr>
<tr>
<td>6</td>
<td>Compensation events</td>
</tr>
<tr>
<td>7</td>
<td>Title (ECC, ECSC, ECS, ECSS, PSC, SC and SCC) / Use of equipment</td>
</tr>
</tbody>
</table>
### Table 1 Contracts in the NEC family

<table>
<thead>
<tr>
<th>NEC3 Document</th>
<th>Code</th>
<th>Recommended Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering and Construction Contracts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEC3 Engineering and Construction Contract *</td>
<td>ECC</td>
<td>Engineering and construction works, including any level of design responsibility</td>
</tr>
<tr>
<td>NEC3 Engineering and Construction Short Contract</td>
<td>ECSC</td>
<td>Engineering and construction works which do not require sophisticated management techniques, comprise straightforward work and impose only low risks on both the employer and contractor</td>
</tr>
<tr>
<td>NEC3 Engineering and Construction Subcontract</td>
<td>ECS</td>
<td>Engineering and construction works where the contractor has been appointed under the ECC and is written as a back-to-back set of terms and conditions</td>
</tr>
<tr>
<td>NEC3 Engineering and Construction Short Subcontract</td>
<td>ECSS</td>
<td>Engineering and construction works where the contractor has been appointed under the ECC or ECSC where sophisticated management techniques are not required and the works comprise straightforward work and impose only low risks on both the contractor and subcontractor</td>
</tr>
<tr>
<td>Professional Services Contracts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEC3 Professional Services Contract</td>
<td>PSC</td>
<td>Professional services, such as engineering, design or consultancy advice</td>
</tr>
<tr>
<td>Term Service Contracts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEC3 Term Service Contract</td>
<td>TSC</td>
<td>Manage and provide a service over a period of time</td>
</tr>
<tr>
<td>NEC3 Term Service Short Contract</td>
<td>TSSC</td>
<td>Manage and provide a service over a period of time or provide a service, which does not require sophisticated management techniques, comprises straightforward work and imposes only low risks on both the employer and contractor</td>
</tr>
<tr>
<td>Supply Contracts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEC3 Supply Contract</td>
<td>SC</td>
<td>Local and international procurement of high-value goods and related services, including design</td>
</tr>
<tr>
<td>NEC3 Supply Short Contract</td>
<td>SSC</td>
<td>Local and international procurement of goods under a single order or on a batch order basis and is suitable for use with contracts which do not require sophisticated management techniques and impose only low risks on both the Purchaser and the Supplier</td>
</tr>
<tr>
<td>Adjudicator’s Contract</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEC3 Adjudicator’s Contract</td>
<td>AC</td>
<td>Adjudication services to decide disputes under the NEC3 family of contracts</td>
</tr>
<tr>
<td>Framework Contract</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEC3 Framework Contract</td>
<td>FC</td>
<td>Construction works or design or advisory services on an ‘as instructed’ basis over a set term</td>
</tr>
</tbody>
</table>

*Also available separately as six separate documents – options A, B, C, D, E and F

### Table 2 NEC3 supporting documentation

<table>
<thead>
<tr>
<th>Category</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guidance on Contract Strategy</td>
<td>NEC3 Procurement and Contract Strategies</td>
</tr>
<tr>
<td>Engineering and Construction Contracts</td>
<td>NEC3 Engineering and Construction Contract Guidance Notes</td>
</tr>
<tr>
<td></td>
<td>NEC3 Engineering and Construction Contract Flow Charts</td>
</tr>
<tr>
<td></td>
<td>NEC3 Engineering and Construction Short Contract Guidance Notes and Flow Charts</td>
</tr>
<tr>
<td>Professional Services Contracts</td>
<td>NEC3 Professional Services Contract Guidance Notes and Flowcharts</td>
</tr>
<tr>
<td>Term Service Contracts</td>
<td>NEC3 Term Service Contract Guidance Notes</td>
</tr>
<tr>
<td></td>
<td>NEC3 Term Service Contract Flow Charts</td>
</tr>
<tr>
<td></td>
<td>NEC3 Term Service Short Contract Guidance Notes and Flow Chart</td>
</tr>
<tr>
<td>Supply Contracts</td>
<td>NEC3 Supply Contract Guidance Notes</td>
</tr>
<tr>
<td></td>
<td>NEC3 Supply Contract Flow Charts</td>
</tr>
<tr>
<td></td>
<td>NEC3 Supply Short Contract Guidance Notes</td>
</tr>
<tr>
<td>Adjudicator’s Contract</td>
<td>NEC3 Adjudicator’s Contract</td>
</tr>
<tr>
<td></td>
<td>NEC3 Adjudicator’s Contract Guidance Notes</td>
</tr>
<tr>
<td>Framework Contract</td>
<td>NEC3 Framework Contract Guidance Notes and Flow Charts</td>
</tr>
</tbody>
</table>
Plant and Materials (TSC) / Use of equipment and things (TSSC) / Indemnity, insurance and liability (ECSC, PSC, ECSS and TSSC) / Those contracts which have clause 9 as ‘Termination’ only contain a core clause W (Option W2) Dispute Resolution, which allows the compiler of the contract data to select one of two options for the

### Table 3 Main Options

<table>
<thead>
<tr>
<th>Main Option</th>
<th>ECC</th>
<th>ESC</th>
<th>PSC</th>
<th>TSC</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Priced contract with Activity Schedule</td>
<td>Priced contract with Activity Schedule</td>
<td>Priced contract with Activity Schedule</td>
<td>Priced contract with Price List</td>
</tr>
<tr>
<td>B</td>
<td>Priced contract with Bill of Quantities</td>
<td>Priced contract with Bill of Quantities</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>C</td>
<td>Target contract with Activity Schedule</td>
<td>Target contract with Activity Schedule</td>
<td>Target contract</td>
<td>Target contract with Price List</td>
</tr>
<tr>
<td>D</td>
<td>Target contract with Bill of Quantities</td>
<td>Target contract with Bill of Quantities</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>E</td>
<td>Cost reimbursable contract</td>
<td>Cost reimbursable contract</td>
<td>Time-based contract</td>
<td>Cost reimbursable contract</td>
</tr>
<tr>
<td>F</td>
<td>Management contract</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>G</td>
<td>–</td>
<td>–</td>
<td>Term contract</td>
<td>–</td>
</tr>
</tbody>
</table>

### Table 4 Payment due in the ECC, ECS, PSC and TS at each assessment day

<table>
<thead>
<tr>
<th>Main Option</th>
<th>What is included in the amount due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price-based</td>
<td></td>
</tr>
</tbody>
</table>
| A           | The total of the Prices for each of the activities which have been completed (PSC)  
|             | The total of Prices for each group of completed activities and each completed activity which is not in a group (ECC and ECS) |
| B           | The total (TSC):  
|             | The Price for each lump sum item in the Price List which the Contractor has completed, and  
|             | where a quantity is stated in the Price List, an amount calculated by multiplying the quantity which the Contractor has completed by the rate |
| C           | The total of (ECC and ESC):  
|             | The quantity of the work which the Contractor has completed for each item in the Bill of Quantities multiplied by the rate, and  
|             | a proportion of each lump sum which is the proportion of the work covered by the item which the Contractor has completed |
| Cost-based  |                                   |
| C           | The total Defined Cost which the Project Manager forecasts would have been paid by the Contractor before the next assessment date plus the Fee (ECC and ECS)  
|             | The Time Charge for the work which has been completed (PSC)  
|             | The Defined Cost which the Contractor has paid plus the Fee (TSC) |
| D           | The total Defined Cost which the Project Manager forecasts would have been paid by the Contractor before the next assessment date plus the Fee (ECC and ECS) |
| E           | The total Defined Cost which the Project Manager forecasts would have been paid by the Contractor before the next assessment date plus the Fee (ECC and ECS)  
|             | The Defined Cost which the Contractor has paid plus the Fee (TSC) |
| F           | The Time Charge for the work which has been completed (PSC)  
|             | The total Defined Cost which the Project Manager forecasts would have been paid by the Contractor before the next assessment date plus the Fee (ECC) |
| G           | The total of (PSC)  
|             | The Time Charge for work done which has been completed on time-based items in the Task Schedule, and  
|             | a proportion of the lump sum price for each other item on the Task Schedule which is the proportion of the work completed on that item |

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resolution of disputes (one of these options is aligned with the provisions of the United Kingdom’s Housing Grants, Construction and Regeneration Act of 1996).

The ECC, ESC, PSC and TS contracts make provision for the Main Options listed in Table 3, which can be activated in a particular contract through reference in the Contract Data. Payment in terms of these contracts is based on the Prices for Work Done to Date / Price for Services Provided to Date, as described in Table 4. In target contracts the ‘target’ is the Prices (i.e. the lump sum prices for each of the activities on the Activity Schedule (ECC, ECS and PSC), the amounts stated in the Price column of the Price List (TSC), or the lump sums and the amounts obtained by multiplying the rates by the quantities for the items in the Bill of Quantities (ECC)). The Consultant’s / Contractor’s / Subcontractor’s share (gain / pain) is the difference between the total of Prices and what is paid in terms of Time Charges or Defined Cost.

There are no Main Options in the ECSC, ECSS, SC, SSC and TSSC, as these contracts contain standard payment provisions as indicated in Table 5.

The Secondary Options that are provided in the ECC, ECS, PSC, TSC and SC are listed in Table 6.

---

**Table 5** Payment due in the ECSC, ECSS, SC, SSC and TSSC at each assessment day

<table>
<thead>
<tr>
<th>Contract</th>
<th>What is included in the amount due</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECSC and ECSS</td>
<td>- The Price for each lump sum item in the Price List which the Contractor / Subcontractor has completed, and where a quantity is stated in the Price List, an amount calculated by multiplying the quantity which the Contractor / Subcontractor has completed by the rate</td>
</tr>
<tr>
<td>SC and SSC</td>
<td>- The Price for each lump sum activity in the Price Schedule which the Supplier has completed, and where a quantity is stated for an item in the Price Schedule, an amount calculated by multiplying the quantity which the Supplier has completed by the rate</td>
</tr>
<tr>
<td>TSSC</td>
<td>- The Price for each lump sum item in the Price List or Task Order which the Contractor has completed, and where a quantity is stated in the Price List or Task Order, an amount calculated by multiplying the quantity which the Subcontractor has completed by the rate</td>
</tr>
</tbody>
</table>

---

**Table 6** Secondary Options provided for in ECC, ECS, PSC, TS and SC

<table>
<thead>
<tr>
<th>#</th>
<th>Clause title</th>
<th>ECC and ECS</th>
<th>PSC</th>
<th>TSC</th>
<th>SC</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>Price adjustment for inflation</td>
<td>Main Options A, D, C and D only</td>
<td>✓</td>
<td>Main Options A and C only</td>
<td>✓</td>
</tr>
<tr>
<td>X2</td>
<td>Changes in law</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>X3</td>
<td>Multiple currencies</td>
<td>Main Options A and B only</td>
<td>Main Options A and G only</td>
<td>Main Option A only</td>
<td>✓</td>
</tr>
<tr>
<td>X4</td>
<td>Parent company guarantee</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>X5</td>
<td>Sectional completion</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>x</td>
</tr>
<tr>
<td>X6</td>
<td>Bonus for early completion</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>x</td>
</tr>
<tr>
<td>X7</td>
<td>Delay damages</td>
<td>✓</td>
<td>✓</td>
<td>x</td>
<td>✓</td>
</tr>
<tr>
<td>X8</td>
<td>Collateral warrantee arrangements</td>
<td>x</td>
<td>✓</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>X9</td>
<td>Transfer of rights</td>
<td>x</td>
<td>✓</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>X10</td>
<td>Employer’s agent</td>
<td>x</td>
<td>✓</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>X11</td>
<td>Termination by Employer</td>
<td>x</td>
<td>✓</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>X12</td>
<td>Partnering</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>X13</td>
<td>Performance bond</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>X14</td>
<td>Advanced payment to the Contractor</td>
<td>✓</td>
<td>x</td>
<td>x</td>
<td>✓</td>
</tr>
<tr>
<td>X15</td>
<td>Limitation of the Contractor’s design liability to reasonable skill and care</td>
<td>✓</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>X16</td>
<td>Retention</td>
<td>Main Options A, B, C, D and E only</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>X17</td>
<td>Low performance damages</td>
<td>✓</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>X18</td>
<td>Limitation of liability</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>x</td>
</tr>
<tr>
<td>X19</td>
<td>Task order</td>
<td>x</td>
<td>✓</td>
<td>x</td>
<td>✓</td>
</tr>
<tr>
<td>X20</td>
<td>Key Performance Indicators (not used with option X12)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
SELECTING A PARTICULAR NEC3 FORM OF CONTRACT

The selection of an NEC3 form of contract for a particular contract is, in the last analysis, a matter of professional judgement and should only be considered after the scope of work has been developed and some consideration has been given to the remuneration of the contractor. The following practical considerations inform the specific contract that is decided upon.

1. What is the best fit for the contract working through the flow charts presented in Figure 1?
2. Does the identified NEC3 contract fit the recommended usage outlined in Table 1?
3. Does the identified NEC3 contract fit the payment mechanism envisaged (see Tables 3 to 5)?
4. Is the short form of NEC3 contract warranted, i.e. the Secondary Options (see Table 6), or not required?

**NOTE:** An order form type of contract may be more appropriate where low-value goods without any incidental work or services on or before a specified date are required.
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INTRODUCTION
Dr Martin Barnes, the originator of the NEC Engineering and Construction Contract, in his Smeaton Lecture (1999), pointed out that virtually no civil engineering was carried out in the UK after the Romans left until the seventeenth century; the two notable major works being the Exeter Ship Canal (1567) and the drainage of the Fens. This all changed between the 1760s and the 1850s. John Smeaton, who is often regarded as the founder of civil engineering and whose largest project was the Forth and Clyde Canal linking the East side of Scotland to the West, developed his approach to managing works. In 1768 he set down his management scheme for the construction phase with detailed tables of responsibility. His team comprised the engineer-in-chief, the resident engineer and the ‘surveyors’ for the various geographical sections working under him, and contractors (as opposed to direct labour). This ‘master-servant’ model has remained in use for the majority of civil engineering projects for more than two hundred years, and is still used on projects managed in the traditional way.

Sir Joseph Bazalgette, who was responsible for constructing the major sewer projects and the embankments on the Thames in London, developed a standard form of contract in the 1860s which was adopted by the Metropolitan Board of Works. This form of contract remained as the principal model for contracts for more than a hundred years and was the model for the first edition of the ICE contract published in 1945. The 1945 ICE form of contract in turn served as a model for forms of contract in many parts of the world, including South Africa, entrenching the master-servant relationship into civil engineering practice.

THE 1970s APPROACH TO CIVIL ENGINEERING CONTRACTS
Overview
Civil engineering works were delivered during the 1970s using the traditional pre-planned approach to delivery, which required that the design and specifications be adequately developed and approved by clients before tenders were invited and contractors appointed.

The 1970s approach to civil engineering contracts is set out in a number of documents, all of which were published during the 1970s and early 1980s, namely:
- South African Association of Consulting Engineers Model Form 1 All Disciplines, Articles and Conditions of Agreement
- Civil Engineering Quantities (Third Edition) (CEQ73)
- SABS 1200, Standardised specification for civil engineering construction
- SABS 0120, Code of practice for use with standardised specifications for civil engineering and contract documents

GCC 1982
This form of contract reflected the master-servant thinking of the day. For example, the general obligations of the Contractor were to “execute, complete and (where specified) maintain the Works in strict accordance with the Contract and to the satisfaction of the Engineer and shall comply with and adhere strictly to the Engineer’s instructions and directions on any matter (whether mentioned..."
in the Contract or not!”. Another example of this philosophy may be found in the dispute resolution provisions which required disputes between the Employer or the Engineer and the Contractor to be referred to and settled in the first instance by the Engineer and thereafter through a mediator.

Monthly payments were based on the Engineer’s estimated value of the work, measured in terms of the schedule of quantities. The works were measured in accordance with the procedures set forth in the Standard System of Measurement of Civil Engineering Quantities, except where otherwise stated in the specifications or the detailed descriptions of the work items in the schedule of quantities.

SAACE Model Form 1
This Model Form of Agreement for engineering services established, amongst other things, the Consulting Engineer’s responsibilities to the client. This Model Form also reflected the thinking of the day – “the Consulting Engineer shall exercise two distinct and separate functions in terms of these Conditions. He is the Client’s agent employed to use his skill and knowledge to do what the Client himself chooses not to do, i.e. report on, design and to administer the construction of the Works. In terms of the Contract between the Client and the Contractor he is the Engineer who is to act as an adjudicator and the limitations of his power in this respect are defined by the terms of the contract. There is no contract between the Consulting Engineer and the Contractor. The Consulting Engineer is obliged to ‘hold the scales’ fairly between the Client and the Contractor and to act in accordance with the ethics and general practices of his profession”.

CEQ73
CEQ73 states that “The Schedule of Quantities is a list of items giving the estimated quantities and brief descriptions of the work to be performed and materials to be provided under the Contract, the quantities and the descriptions being derived from the drawings and specification and space being provided for the insertion of price rates against each item and the extension and totalling of the prices”.

Schedule of Quantities prepared in accordance with the CEQ73 were expected to provide:

- tenderers with adequate information regarding the extent of the work required to enable them to accurately and confidently prepare tenders which could then be readily compared with other tenders, and
- a sound basis for the valuation of work carried out at any stage of a contract.

CEQ73 makes it clear that the “Schedule of Quantities should be prepared on the understanding that, in the absence of specific directions to the contrary, the rates and prices that will be inserted will be considered as being the full inclusive rates and prices for the finished work described under the respective items as covering, not only all labour, materials, temporary work, plant, on-cost items and other overhead charges and profit, but also the general liabilities, obligations and risk arising out of the conditions of contract and specification”.

CEQ73 established units and methods of measurement in Chapter VII under the following headings: scope, general principles, units of measurement, separate items, descriptions, unit rates and general remarks. The section ‘unit rates’ itemised what should be included in the unit rates, i.e. it gave guidance on what the tenderer should include in his tendered rates.

SABS 1200 Standardised Specifications
The preface to SABS 1200 states that “the prime purpose in the production of these standardised specifications was to arrive at a set of standard and unambiguous documents acceptable to employer, engineering, and contractor bodies, and thereby to save money through lower contract prices and to reduce the number of engineering hours spent in administering contracts by establishing, for all classes of civil engineering construction, practical standards of workmanship and administrative control that would be adequate but not excessive and with which all parties would in due course become familiar”. Prior to the publication of SABS 1200, no standardised specifications for civil engineering works existed in South Africa. Each client or firm of consultants had their own bespoke set of specifications and applied their interpretation of the standard system of measurement for civil engineering quantities in the form of CEQ73.

Each part of SABS 1200 was drafted around the standard set of headings contained in SABS 0120-1. SABS 1200-A, General, or SABS 1200-AA, General (Small Works), were developed as supporting specifications for all other parts of SABS 1200. These parts of SABS 1200 establish the following general principles which apply to all parts:

- “The rate or price tendered by the Contractor for a scheduled item shall be deemed to cover the Contractor’s profit plus cost to him of all labour, materials, plant, equipment and facilities required by him to carry out the operations or activities stated in the relevant subclause of Clause 8 of the applicable standardised specification, in addition to the cost to the Contractor of carrying out such ancillary and associated activities as the Contractor deems necessary for the completion of the Works in accordance with the said specification, the conditions of contract and the drawings.”

- “The Contractor’s charges for completing an item scheduled in the preliminary and general section of the schedule shall be interpreted to be his rate or price to cover his direct cost plus overheads and to include his profit and all costs and expenses that he requires for the item specified and for all general risks, liabilities and obligations set forth or implied in the documents on which the tender is based.”

- Except where otherwise specified in Clause 8.1 of a standard specification or in the project specifications or in the preamble, all items in the schedule shall be measured and shall cover the operations as recommended in the standard system of measurement of civil engineering quantities for South Africa and South West Africa under the title Civil Engineering Quantities as approved and recommended for general use by the South African Institution of Civil Engineers …….”

The clauses on Measurement and Payment are divided into Principles and Scheduled Items. The scheduled items create standard text which may be readily included in a schedule of quantities. What is covered in the rate or sum for a scheduled item is specified in detail. Accordingly, any change to what is usually included in a scheduled item needs to be stated in the Project Specifications. This introduced uncertainties in the application of the measurement system – does one provide everything that is necessary to achieve the finished (permanent) work or does one provide what is
The International Federation of Consulting Engineers (FIDIC) brought out a new family of contracts in 1999. The role of the Engineer in these forms of contract was confined to performing duties assigned to him in terms of the contract, and duties were placed on the Contractor to promptly give notice to the Engineer of specific probable future events which may adversely affect the work, increase the contract price or delay completion. The FIDIC 1999 contracts also signalled a departure from the adversarial relationships embedded in the traditional master-servant relationship model specified for the item in clause 8 of SABS 1200? It also requires clause 8 of SABS 1200 to be read with the Project Specification.

SABS 1200 is based on the master-servant thinking of the day. The specifications assign duties to the Engineer and the Contractor. Terms such as “in the opinion of the Engineer”, “as the Engineer may direct”, “approved by the Engineer”, “the Engineer considers”, “obtain specific instructions from the Engineer before proceeding”, “the Engineer allows to be incorporated”, “the Engineer is satisfied”, “ordered by the Engineer” and “to the satisfaction of the Engineer” are frequently encountered in the standards. This introduces subjectivity and uncertainty as to what the actual requirements are. How can a Contractor price something for which he is at the mercy of the Engineer?

SABS 1200 was also developed around the design by employer strategy, i.e. a contracting strategy whereby a contractor undertakes only construction on the basis of full designs issued by the employer. The specifying of the responsibilities of the engineer and contractor not only locks the specifications into this contracting strategy, but also makes subcontracting difficult, as the Engineer is an agent of the Employer and not the Contractor.

SABS 0120 Code of Practice

SABS 0120 provides guidance on the compilation of contract documents where use of the SABS 1200 specification is made. This code of practice, which was first published in 1981, comprises five Parts, namely:

- Part 1, Format and contents
- Part 2, Project specification
- Part 3, Guidance for design
- Part 4, Typical schedule of quantities
- Part 5, Contract administration

SABS 0120-1 covers the format and contents of project specifications, standardised specifications and particular specifications which, together with schedules of quantities, are required in the preparation of contract documents. It requires that the headings in a standardised or particular specification be provided in a specific sequence, i.e. Scope, Interpretation, Materials, Plant, Construction, Tolerances, Testing and Measurement, and Payment.

SABS 0120-1 also requires contract documents to be developed using the following sequence:

- Cover and introductory pages
- Conditions of tender
- Schedule of drawings
- General conditions of contract
- Special conditions of contract
- Specifications
- Schedule of quantities
- Data sheets (details of certain materials which the contractor has to supply under the contract, or of the types of plant which he proposes to employ)
- Tender
- Appendix to tender
- Bonds

SABS 0120-2 provides guidance on the preparation of the two portions of a project specification – Portion 1 which covers the description of the works and includes general matters affecting the project, and Portion 2 which covers variations and additions to the standardised specifications which form part of a contract. SABS 0120-3 covers matters which should be dealt with by the project engineer or the senior design engineer, i.e. aspects of design that were assumed in the framing of the relevant SABS 1200 specifications, and aspects of the design which must be considered in the control of work executed in terms of a relevant SABS 1200 specification.

SABS 0120-4 covers typical schedules of quantities relating to the work covered by standardised specifications and provides a uniform framework within which a schedule of quantities may be developed. This part of SABS 0120 requires the following wording to be included in the preamble to a schedule of quantities:

Descriptions in the schedule of quantities are abbreviated and the schedule has been drawn up generally in accordance with the latest issue of Civil Engineering Quantities. Should any requirement of the measurement and payment clause of the applicable standardisation specification, or the project specifications, or the particular specification conflict with the terms of the schedule or, when relevant, Civil Engineering Quantities, the requirements of the standardised, project or particular specification, as applicable shall prevail.

SABS 0120-5 covers recommendations and suggestions intended to assist the...
engineer and the contractor in executing work covered by the standardised specifications.

**THE CHANGES BROUGHT INTO CIVIL ENGINEERING CONTRACTS DURING THE 1990s**

**GCC 1990**
The sixth edition of the General Conditions of Contract for Works of Civil Engineering Construction was published by SAICE in 1990. This document was sponsored by the Civil Engineering Advisory Council and prepared under the auspices of SAICE, the SA Association of Consulting Engineers (now CESA) and SAFCEC (SA Federation of Civil Engineering Contractors). GCC 1990 started to soften the master–servant relationship. The Engineer’s function was described as being to “administer the contract as agent of the Employer in accordance with the provisions of the Contract. Whenever the Engineer intends, in terms of the Contract, to exercise any discretion, or make or issue any ruling, contract interpretation or price determination, he shall firsts allow the Contractor a reasonable opportunity of submitting to him representations relating to the matter concerned and he shall decide thereon as agent of the Employer but by the application of his own independent judgement and professional standards”. It also changed the obligation of the Contractor regarding the provision of the works from “in strict accordance with the Contract and to the satisfaction of the Engineer” to as “specified in or reasonably inferred from the Contract”.

GCC 1990 made provision for the design of the permanent works by the Contractor, but retained monthly measurement by the Engineer based on a schedule of quantities. It required that the work be measured in accordance with the methods and procedures described in the contract, or failing which, in accordance with the standard systems of measurement laid down in the SABS 1200 Standardised Specifications.

**Civil Engineering Quantities 1990**
Civil Engineering Quantities 1990, *A Guide for Determining and Using Quantities for Civil Engineering and Construction Contracts*, was published in 1990 as a companion to SABS 1200, SABS 0120-4 and GCC 1982. CEQ90 became necessary, as the largest portion of CEQ73, namely Chapter VI (units and methods of measurement), were incorporated into SABS 1200 and needed to be removed. The bulk of CEQ90 was accordingly dedicated to the recommended method of booking dimensions from drawings, taking off quantities and listing the quantities in a formal schedule of quantities that quantifies the work to be done for a civil engineering works contract. Accordingly, CEQ 1990 is a companion document to the standard system of measurement embedded in Chapter 8 of each part of SABS 1200 and cannot stand as a standard system of measurement in its own right.

**Procurement reform**
The South African government embarked on a procurement reform process during 1995. The *Green Paper on Public Sector Procurement Reform in South Africa* (1997) recognised that “currently methods of measurement are incorporated in civil engineering construction standards and this presents a barrier to the standardisation of specifications”. It proposed that “there should be complete separation in contract documentation between conditions of tender, conditions of contract specifications and terms of payment (including methods of measurement)

The Recommendations on Refinements in Public Sector Procurement Policy, Practices and Procedures in the Construction Sector, made by Focus Group 6 (an industry group of interested parties) to the Inter-ministerial Task Team for Construction Industry Development, confirmed this position in 2000 following an intense series of meetings with the teams’ secretariat – “There must be a complete separation in such documentation between conditions of tender, conditions of contract specifications. Terms of payment must not be included in the specifications.”

**New international forms of contract**
The New Engineering Contract (NEC) was launched by the Institution of Civil Engineers (ICE) in 1995. This innovative form of contract was drafted on a relational contracting basis, based on the belief that collaborative working across the entire supply chain optimises the likely project outcomes when compared with a typically fragmented and non-integrated approach to designing and constructing projects. The NEC3 contracts are accordingly designed to encourage collaboration and teamwork rather than a confrontational approach to the management of a contract. This changed the master–servant relationship to a simple collaboration between two specialist contributors.

The International Federation of Consulting Engineers (FIDIC) brought out a new family of contracts in 1999. The role of the Engineer in these forms of contract was confined to performing duties assigned to him in terms of the contract, and duties were placed on the Contractor to promptly give notice to the Engineer of specific probable future events which may adversely affect the work, increase the contract price or delay completion. The FIDIC 1999 contracts also signalled a departure from the adversarial relationships embedded in the traditional master–servant relationship model.

Both these families of contracts allowed the Contractor to assume design responsibilities for the permanent work. These forms of contract provided alternative pricing strategies to enable design and construct, or develop and construct contracting strategies to be implemented, as a bill of quantities is not suitable for use in such contracting arrangements.

**Amendment to SABS 1200 and SABS 0120**
Very few amendments of a very minor nature were made to Parts D (earthworks), DA (earthworks – small works), H (structural steelwork) during 1990, whilst Parts DK (gabions and pitching), M (roads general), MFL (base light pavement structures) were either revised or published during 1996.

No amendments during the 1990s were made to the 1986 editions of the supporting specifications SABS 1200A and SABS 1200AA, which apply to all the other parts, despite the publication of CEQ90. The master–servant relationship embedded in GCC 1982 remained in the SABS 1200 standards, as well as the assigning of responsibilities to the Engineer and Contractor for a design by employer contracting strategy.

Very few revisions were made to parts of SABS 0120 during this period.

**THE CHANGES BROUGHT INTO CIVIL ENGINEERING CONTRACTS POST-2000**

**CIDB Standard for Uniformity in Construction Procurement**
The Construction Industry Development Board, drawing upon the work of the Inter-ministerial Task Team for...
Construction Industry Development, published the Standard for Uniformity in Construction Procurement during 2004. This standard confined the selection of a form of contract for construction works to the GCC and FIDIC, and JBCC and NEC families of contracts. It also established a standard for the formatting and compiling of procurement documents which was more fully described in SANS 10403 (2003), Formatting and compilation of construction procurement documents. This standard required that component documents be as follows:

- Tendering procedures (Tender Notice and Invitation to Tender and Tender Data)
- Returnable Documents (List of Tender Returnable Documents, Returnable Schedules)
- Contract (Agreements and Contract Data, Pricing Data, Scope of Work and Site Information)

The Pricing Data is broken down into Pricing Assumptions and Pricing Schedules / Activity Schedules / Bills of Quantities. The scope of work is defined as the “document that specifies and describes the goods, services, or engineering and construction works which are to be provided, and any other requirements and constraints relating to the manner in which the contract work is to be performed”.

Next generation of South African National Standards

The SANS 2001 and SANS 1921 families of standards were developed to replace SABS 1200. All reference to the responsibilities of the Engineer and the Contractor were removed from the text and no measurement and payment items were included. This enables these standards to be used with any pricing or contracting strategy at main or subcontract level, and with any conditions of contract in an objective manner.

The SANS 2001 family of standards, parts of which were published from 2005 onwards, provides technical descriptions of the standard of materials and workmanship that will be used in the works that are executed or in the performance of the works when completed (or both). These standards do not make reference to the actions of those responsible for executing the works or the parties to a contract, i.e. to the constraints relating to the manner in which contract work is to be performed. All the standards relating to structural materials (masonry, timber, concrete and steel), site clearance, general earthworks and pipelines have been published. These standards incorporate new standards that have been published since SABS 1200 was developed, e.g. cement and pipe standards. All that remains is the conversion of the piling and roadworks specifications to the new format, and the revision of these standards to reflect current standards and practices.

SANS 1921, all six parts of which were published in 2004, describe generic construction and management requirements for engineering and construction works, i.e. the constraints to providing the works.

Annex D of SANS 10403 provides comprehensive guidance on the items which should be addressed in the scope of work. Parts of SANS 1921 and SANS 2001 enable a large portion of the scope of work to be developed by reference to these standards and the completion of specification data which make these generic specifications contract-specific. Annex A of these standards provide comprehensive guidance on the preparation of specification data.

GCC 2004 and GCC 2010

In 2004, SAICE published the General Conditions of Contract for Construction Works which removed all reference to SABS 1200 and simply stated that “All the work shall be measured in accordance with the provisions of the Pricing Data.” This approach has been retained in the 2010 edition of this document. The adjudicator role of the Engineer has been retained, but the scope of matters being referred to the Engineer for resolution further diminishing in the 2010 edition.

CESMM3

Industry representatives met during 2008 to discuss the way forward regarding a standard system of measurement should SABS 1200 be withdrawn. The Civil Engineering Standard Method of Measurement published by the Institution of Civil Engineers (ICE) (London) (CESMM3) became a logical choice as a base document for the successor to the current system of measurement embedded in the SABS 1200, as it is a document founded on the same thinking and philosophy as the system that has evolved in South Africa and is widely used in Africa. There were, however, a number of issues relating to terminology, references to BS standards and regional earthworks practices (excavation of trenches and temporary earthworks) that needed to be addressed to make CESMM3 suitable for use in southern Africa. ICE granted permission for the customisation of CESMM3.

Work on the CESMM3 was suspended due to delays in the publication of SANS 2001, as it was felt that there needed to be a critical mass of SANS 2001 standards available before launching CESMM3. A southern African version of CESMM3 was launched in 2011 following its finalisation by industry. This edition of CESMM3 aligns with the terminology used in the CIDB Standard for Uniformity in Construction Procurement and may be used with any form of contract in use in South Africa.

CESMM3 is based on the philosophy that “a Bill of Quantities is no more than a price list for the permanent works. Items should be described in sufficient detail for it to be possible to distinguish between the different types of work and between work of the same nature carried out in different locations or in any other circumstances which may give rise to different pricing considerations. At the same time, all work that is required should be covered in the Bill of Quantities”. CESMM3 provides all the information relating to the measurement of items on two A4 pages which face each other – the three divisions for breaking items down are shown on the left-hand page, while the measurement rules, definition rules, coverage rules and additional description rules are located on the right-hand page.

THE FUTURE OF SABS 1200

The conversion of SABS 1200 to SANS 2001 and SANS 1921 has been a long and frustrating process. All six parts to SANS 1921 were published well before the first part of SANS 2001 was published in 2007. Most of the pipeline standards were stable and ready for processing during the early half of 2008, but were only finally published at the end of 2010 with very minor adjustments.

The foreword to the SANS 2001-CC1 (2007), Concrete works (structural), which was published in 2007, states that this standard replaced and cancelled SABS 1200G, GA, GB, GE and GF. This caused some confusion as the system of measurement was still embedded in SABS 1200, and until such time that an alternative system was in place, industry would have no access to these SABS standards. At the April
2009 meeting of the TC59 (SABS Technical Committee 59 – Construction Standards) “it was agreed that the SANS 1200 standards that are withdrawn will be re-published as technical specifications so that they will still be available to the industry”.

Issues were again raised during 2010 at a TC59 meeting. The TC59 agreed to meet and discuss these issues in detail. The SABS secretariat, however, decided not to convene a meeting with industry stakeholders and experts, but to rather conduct a straw poll without consulting TC59 on the matter or contextualising the issues – “SABS is now proposing that we continue to support, develop and maintain the SANS 1200 series of Standards. These would be developed in parallel with the SANS 2001 docs, so that end users have a choice of which to use.” This was done without considering what the new-look SANS 1200 would look like and without answering basic questions such as – would it continue with the master-servant approach, would it be sufficiently flexible to accommodate any contracting and pricing strategy, would it be suitable for use in subcontracts, how will the ever increasing constraints imposed to delivering the works be handled, will measurement and payment clauses be separately published in another document, will supporting documentation be required, etc? What also needs to be considered is SABS’s capability and capacity to undertake this work. It is not a simple matter of updating a few clauses, modifying a few references to standards and changing SABS to SANS. A fundamental overhaul is required.

It is clear that SABS 1200 has served its purpose and run its course. One must move on. The question is: Will industry move on or resist change?

Editor’s Note
The future of SABS 1200 is obviously an important debate in the civil engineering industry. Opinions held by various protagonists vary widely and are strongly held. If you would like to respond to the article or express your views on the subject, we would be happy to hear from you. You may send your views to the editor (verelene@saice.org.za). □

Work on the CESMM3 was suspended due to delays in the publication of SANS 2001, as it was felt that there needed to be a critical mass of SANS 2001 standards available before launching CESMM3. A southern African version of CESMM3 was launched in 2011 following its finalisation by industry. This edition of CESMM3 aligns with the terminology used in the CIDB Standard for Uniformity in Construction Procurement and may be used with any form of contract in use in South Africa.
BACKGROUND
The export jetty at Kenmare’s Mineral Sands Mine in Moma, northern Mozambique, required upgrading. The jetty is used to load mineral products onto a transhipment barge, which transports the product to bulk carriers anchored in deeper waters. This facility therefore forms an essential part of the mine’s operations, and the upgrading works had to be performed without limiting on-going export operations.

Group Five was awarded an EPC (Engineering, Procurement and Construction) contract in September 2010 to refurbish the facility. The new design for upgrades to the facility was based on FEED (Front End Engineering Design) engineering, which was completed by RLH Consulting Engineers, while the detail engineering for the project was carried out by WSP Africa Coastal Engineers.

The new design dictated that the entire existing berthing structure on the northern side of the jetty be replaced with a new, stronger berth. The design also included an additional berth on the southern side of the jetty as part of the mine’s expansion programme, and to allow loading on either side of the jetty, depending on prevailing weather and sea conditions.

The two new berths consist of twelve Ø1.2 m steel piles driven to approximately 21 m CD (Chart Datum) with connecting headstocks. Horizontal bracing members were installed between the two berths to form a braced dual-berth structure. The horizontal bracing members are designed to distribute the berthing loads over several piles.

Group Five selected Subtech and Dura Pile to provide the marine and piling plant and other necessary technical support. PMI (Project Management International) was appointed by Kenmare for the management and supervision of the project, and to ensure the works were carried out according to the contract.

THE WORKS
Refurbishment and upgrade works, as described in the contract, included the removal of the entire existing northern berth and replacing it with a new berth, the construction of a new full berth on the southern side of the jetty, and the installation of bracing members between the northern and southern berths to form a dual-berth structure.

Onsite preparation started in February 2011, and construction works commenced beginning March 2011 after the arrival of the crane barge and piling equipment.
The remoteness of the site made this project a challenging one. To transport heavy material and equipment to site by road was a daunting task, and custom clearance often took longer than anticipated.

To tackle the transport issue, all the requisite plant and prefabricated components were loaded onto two barges in Durban and towed to site. Good planning was essential as the remoteness of the site meant that additional or emergency supplies had to be driven to site or flown in, with major time and cost implications.

At the start of the project, one of the main challenges of the execution plan was to accommodate the mine’s export operations during construction. With the assistance of PMI, the sequence of construction activities was carefully developed to allow the mine to continue exporting material, while work on the berthing facilities continued.
The execution plan required that Group Five construct the new berth on the southern side of the jetty while the mine continued its loading activities on the existing northern berth. After the work on the new berth had been finalised, the facility was well equipped to deal with Kenmare’s export operations. This allowed Kenmare to shift its operations to the new berth and continue loading, while Group Five continued construction on the northern side.

To achieve continuous loading, the conveyor system had to remain fully operational throughout the entire construction period. The presence of the conveyor trestle and ship loader limited access to the working area, so that all marine and piling operations had to be carried out off a floating plant.

The execution plan was developed to utilise the existing structures as far as possible to facilitate construction. Several landing and assembly guides were pre-manufactured to facilitate piling and heavy lifting operations.

A piling guide frame was designed to be installed onto the existing jetty rails to support the piles during operations from the crane barge. This guide frame was modified several times on site to facilitate work at the various locations. For instance, the guide frame was modified to be wider and taller to allow clearance for the conveyor trestle when installing the landward piles.

Similarly, the rise of the conveyor trestle to the ship loader made it impractical to install the guide frame for the installation of certain piles. In this instance, two separate frames were installed and welded to the jetty underneath the conveyor system to facilitate work at these locations, so that the piles could be installed successfully.

The two berths were designed in such a manner that the various structural components would fit easily into one another and be bolted together. All steel components were prefabricated in South Africa and the construction methodology was developed to minimise the need for onsite welding.

The workability of the floating plant and equipment was dependent on wave height and sea conditions. Consequently work could only be done during calm weather. As the project started at the end of the good weather period, the weather was a major determining factor for workability. Seven-day weather forecasts were used to plan the work in advance. However, due to the nature of the plant and the construction methodology, weather limitations still resulted in long periods of standby time.

During bad weather periods, the floating plant was moved to a secure location in the lee of an island approximately 11 km offshore. During good weather periods, the construction team worked extended hours, often rotating day and night shifts to capitalise on the construction opportunity.

**PROJECT FINALISATION**

Work on the new southern berthing facility was finalised and taken over by the client in mid-August 2011.

By the end of August, all piles were
installed. Remaining work included the installation and grouting of headstocks, the installation and welding of the remaining cross brace members and the installation of all marine furniture.

Work on the northern berth was finalised by the end of September 2011 and the fully braced facility was handed over to Kenmare soon after. Kenmare has successfully loaded products on both sides of the jetty and both facilities are functioning well. Since the completion of the new facilities, Kenmare has increased its throughput capabilities.

The refurbishment and upgrading of the Moma export jetty was an unusually challenging marine project, mainly due to the harsh marine environment of northern Mozambique, and the fact that the project was undertaken entirely off a floating plant and on an open coastline.

Editor’s Note
This article follows on a previous article about this fascinating project that appeared in the July 2011 edition of Civil Engineering (pages 41-45).
ERP implementation is fundamentally an engineering endeavour

WHAT IS ERP?
ERP stands for Enterprise Resource Planning. Sounds impressive, but what is an ERP system really?

Fact is that many organisations only use their ERP as a glorified accounting package and then use diverse third-party or home-grown products for the specialised operational side of their business.

So, if you have an accounting package, you need to be careful when somebody tells you to replace it with an ERP, as you could end up spending a lot of money to recreate what you already have.

ERP is NOT magic, bottom line. It is just a collection of software that you use to run your business, which you may buy from one of the mainstream vendors or from a niche specialist (like ProMan) in the practice management space, or something your business developed years ago.

ENTER IBIS
Some time ago I coined a new acronym, IBIS, which stands for Integrated Business Information System – which is the mishmash of computer software that the average business uses to run its business.

This may comprise a big-brand ERP (let’s call yours FRED, which stands for Frightfully Ridiculous Electronic Device) or one of the other options mentioned above, plus whatever else you have.

I recently undertook a Pulse Measurement (diagnostic investigation) into the operations of a large, listed company running a big-brand FRED, only to discover that they are using it really badly, are using perhaps 10% of its functionality and have a plethora of engineering and other systems around it, some of which are there purely because FRED was so badly implemented.

Then there are all sorts of add-on bits and pieces, including a plethora of spreadsheets. Please keep in mind that spreadsheets also count as custom development. Accountants are extremely good at moving most of what is done out of the ERP into spreadsheets and then kidding themselves that they are NOT customising the ERP – which really is nonsense!

Some years ago I undertook a Pulse Measurement into another big-brand FRED installation which had cost R27 million to implement so badly it was useless. When I mentioned that the installation would have to be re-done the Financial Director was unfazed, as he was running the whole business on Excel anyway – at least the financials!

WHAT IS REQUIRED TO CONFIGURE AN IBIS OR ERP?
Anyone of these systems – whether you call it IBIS, ERP, FRED, Accounting System or whatever other name – is a machine.

Because the fundamental building blocks of business are remarkably similar, the building blocks of FRED are also remarkably similar, no matter which system you buy – which is why it is a pretty pointless exercise to trash FRED-X and replace it with FRED-Y, because the reason it is not working is because YOU are not using it right; it has nothing to do with the machine.

After all, Debtors and Creditors and General Ledger and Cashbook, or whatever labels you apply to them, are largely the same. A Debtor has an address, you send them invoices and they pay you. How much different can twenty different Debtors packages be?

But how you classify your Debtor accounts and your Chart of Accounts, and how you classify your products, and how you classify your accounting transactions – THAT is different. And there are as many different ways of doing that as there are people on the planet.

No two people will configure the same module in the same company the same way, and the same person (consultant) is unlikely to even configure the same module of the same software in two different companies the same way.

So, you can put in neatly ordered, logically structured data, or you can put in scrambled nonsense – what I call spaghetti.

Fact is that nearly all ERP implementers the world over make spaghetti the same way – they throw some text in a list, with no attempt to put structure or logic to it, and they sit back and bill the client in perpetuity to try and make sense of the spaghetti, while the client struggles to get answers to their most basic questions.

The problem is that an ERP should NOT be populated with spaghetti; it should be populated with neatly structured hierarchical descriptions and associated codes that accurately model and describe the business and make perfect sense to business executives, managers, and in fact anyone who understands the
REAL WORLD ENTERPRISE.

The reason most executives say to me that they do not understand ERP is because there is such rubbish in the system that NOBODY understands it. The IT ‘professionals’ pretend that they do because they make mountains of money out of reorganising junk data.

And, what is even more alarming, they think that is the ONLY way to do it!

If engineers designed and built bridges the way IT ‘professionals’ configure and implement most FREDs, the bridge would comprise dumping truckloads of reinforcing steel, concrete and whatever other junk the ‘engineers’ could find, until the valley was full, and they would then level some sort of deck on the top that would allow vehicles to wind their way over in first gear, constantly checking to make sure they did not fall off the edge.

Reason being that ERP implementation is FUNDAMENTALLY an ENGINEERING endeavour, while the industry is dominated by accountants and IT-trained people who do not understand engineering.

WHAT IS THE ENGINEERING APPROACH TO IBIS AND ERP?

I have spent 22 years seeking to bring the disciplines of engineering to the IT and ERP industry. So far I have failed dismally. I have pretty much sorted out myself how to do this engineered ERP thing, but I still have to figure out how to scale it, because it is so different to what the people in the industry are currently doing that almost none of them understand me.

Let us look at the engineering approach:
- Start with a problem statement – no problem, no project
- Analyse, analyse and analyse some more
- Precision and attention to detail
- Accountability
- Multi-disciplinary teams
- Check and double-check
- Meticulous documentation
- Design against failure
- Fundamental first principles
- Top-down bottom-up construction
- Practical
- Model the REAL world
- Critical analysis and dissection of each and every failure
- Talk about failure in order to understand and prevent failure
- Etcetera

We as engineers do this all the time, to the extent that we take it for granted – it was imbibed in our years at university or college, and during our time as engineers-in-training. It is so much part of who we are and what we do that we would have to really scratch our heads to figure out what we do and yet, guess what, the IT industry does virtually NONE of these things!

I could go on for hours about this thing I call ‘the engineering approach’. IT and ERP and IBIS and FRED projects fail constantly and the failures are getting bigger and more frequent and are damaging or trashing businesses. We are even starting to see public reporting of these failures, such as 26 BILLION British Pounds wasted in the UK in the last few years on failed and sub-optimal IT projects!

So we need to bring ‘the engineering approach’ (which is the same for bridges, buildings, subways … and ERPs) to the ERP space.

WHY ARE ENGINEERS NOT THE LEADERS WITH REGARD TO IBIS AND ERP?

Engineers are not the leaders because most engineers think that ERP is the domain of the accountants – which is roughly the same as engineers deciding not to build a bridge because they never use that road, and then leaving it to the road users to build the bridge since, after all, as they are the ones who will use the road they are best equipped to design and build the bridge.

Not so!

Accountants NEED engineers to help them design, configure, commission and operate ERP and IBIS systems, just like they need a plethora of other technicians and technical professionals.

I hold that it is time for the engineering profession to start investigating how to get involved in this field, as engineers DO know a lot about what is required – we just need to assemble a multi-disciplinary team like we do for other projects!

WHAT SHOULD SAICE AND ECSA DO ABOUT IT?

Not an easy call, but we need to start talking about the failures, and we need to start saying, “Hey guys, this ERP implementation thing you do is an engineering endeavour; don’t you think you should involve us?” or, if you are willing to be bold, “Hey guys, we do NOT have failures like you do; maybe you should drop by for coffee and a chat.”

And ECSA needs to start making noises like, “We think that the art and practice of business information systems implementation is an engineering endeavour and we think it should be brought under our umbrella, and we consider the failure rate of ERP implementations to be a national disgrace that needs intervention.”

It might take a few years, it might take twenty years, but I passionately believe that one day ERP implementation will be a proud engineering discipline with a track record of close to 100% project outcome success.
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INTRODUCTION
All the time we learn more about how climate change will affect our physical environment. The first UN African meeting on climate change in October 2011 in Addis Ababa was a wake-up call for many participants about the considerable impacts they would have to face in their respective countries. At the University of the Witwatersrand we subsequently received a number of queries about how South Africa is going about addressing this issue, and whether the University would be able to offer advice on how to plan effectively. A month later the Intergovernmental Panel on Climate Change (IPCC) issued a report predicting further flood calamities and coastal storms for East Africa, and frequent periods of severe drought for West Africa. In East Africa cyclones, floods and landslides will become much more severe and will occur more frequently, while in West Africa increasing droughts will result in expanding deserts and extensive wildfires. South Africa could also expect to experience these hazards in the future.

In the January/February 2010 edition of Civil Engineering (pages 9–11 “Climate change engineering”) I argued that the subject ‘Climate Change’ should be included in the curriculum of physical planners. The necessity of this is becoming clearer and this article wishes to elaborate on the subject.

One has to question whether our coastal cities can absorb and discharge the devastating floods that persistent rain may cause. Are the recent terrifying flood images from Thailand and Pakistan relevant for our region, too, or are our coastal settlements invulnerable to massive rains? Did the flood lessons from the year 2000 translate into substantial vulnerability reduction in the coastal cities? With the Indian Ocean soon a full degree warmer than before, how much water will evaporate and blow in over Africa’s east coast? Are the settlements in the west all protected by wide fuel-free zones to stop large wildfires? Indications are that present planning and building regulations may not offer enough protection against these growing threats from nature, leaving our cities vulnerable.

The question that dominated the Durban UN conference in early December 2011 was how much more funds Africa could gain from ‘carbon trading’ and adaptation subsidies – the old struggle that we have already seen before in the Bali and Copenhagen conferences, i.e. whether the main polluters would be willing to reduce their emissions. The upcoming US presidential elections effectively put a cap on those hopes, as did the economic crisis in Europe. The rich countries are at present little inclined to promise new financial contributions, and rather encourage all countries to reduce emissions and protect themselves from rising hazards. Tree planting and forest preservation in Africa would be a cheap solution for the polluting countries to continue their heavy emissions. However, the financial difficulties of the US, Japan and Europe do not suggest that any significant amounts will anytime soon reach Africa to award it for its tree-planting efforts. A Kenyan paper presented at the UN African conference in Addis Ababa had calculated that women active in reforesting in West Kenya could expect to receive one dollar per annum.

It seems practical therefore to start making efforts towards improving adaptation knowledge, rather than focusing on subsidies from the rich countries. It is obvious that, for Africa, prevention should come first. Without appropriate structural provisions, and without mitigation management, cities in vulnerable areas could become the scenes of utter destruction. The technical knowledge on how to prevent floods and landslides is available at universities and research institutes in South Africa. This should be the priority, rather than the present focus on the mobilisation of a passive public. Community participation is essential in mitigation, but only when information about the structural measures that are needed to provide protection have been clearly defined and disseminated.
It is politically convenient to say that climate change is poorly defined. Indeed, around the world, and also in South Africa, there are still many in denial about climate change. The environmental crisis seems to get overshadowed again by political agendas. Although Africa emits less than 4% of the global atmospheric pollution, it will bear the brunt of climate change impacts. For Africa the focus should therefore be on damage prevention. South Africa pollutes the atmosphere with only as much as about 2% of global emissions, while the emissions of the rest of the African continent are barely detectable. Nevertheless, the technologies needed to withstand the predicted persistent heavy rains, landslides and droughts have so far not been discussed seriously at any of the climate change conferences. In the coming decades an important challenge for African physical planners will be to develop urban options which would protect their cities from increasing natural hazards.

NATURAL HAZARDS AND URBAN PLANNING CHANGES
Climate change brings two new types of planning elements: firstly, natural hazards will increase in severity, and secondly, water and energy supplies to future cities will be much lower than what is the case today. In addition, new transport solutions would have to be developed to render future cities viable. While the eastern seaboards could see more floods and landslides, the expected increase in droughts and wildfires in West Africa could change its topography, with forests giving way to savannahs, and savannahs shrinking because of expanding deserts, all of which is likely to reduce Africa’s food production capacity.

Storms will increase in general, with the eastern seaboards experiencing more storm surges, and the tropical zone more cyclones. A slight increase in sea temperatures will give rise to greatly increased evaporation, which will drift westwards and bring rain to the eastern seaboards. The devastating floods in the cities of Pakistan and Thailand in 2011 showed the utter destruction and suffering that urban populations are subjected to following such massive rains. It is an illusion to believe that South African cities are immune to the increased force of these threats. There are not only many vulnerable townships in our country, but even middle- and upper-class neighborhoods have been allowed to develop on vulnerable land.

PLANNING SKILLS
Do planners, architects and engineers know how to protect vulnerable areas against these threats? The answer is both yes and no. They surely have heard some lectures about structural measures to resist floods, wind and fires, but it is unlikely that they have been taught which measures should be taken to avoid the ravages of extreme conditions. Very few have learned how to retrofit houses and public buildings in cyclone-prone areas. The existing building codes in most African countries do not offer any protection against the deadly threats from serious natural hazards. In very exposed countries people have learned to shield their buildings from floods, landslides, fires and storms. They have over time adapted their building methods to the adverse forces of nature. But these strategies did not spread to other areas that are less exposed. However, we now have the means of finding and disseminating effective mitigation systems, and since the threats are now also a reality in formerly secure areas, a review of mitigation knowledge is needed. Climate change adaptation indeed needs to become part of the curriculum at our universities. In Africa prevention should have the highest priority, rather than emission reduction.

It is not only increased hazards that urban planners need to take into account for the African cities of the future, but also the increasingly limited availability of water and energy for those cities. In addition, the urban transport options need to be reviewed from a collective rather than from an individual point of view. The environmental destruction caused by the conventional expansion of Beijing, with rapidly expanding car ownership, stands in sharp contrast with the car-free city centre and mass transport systems favoured in Singapore. These stark lessons from Asia cannot be ignored in Africa.
river retention and diversions. Similarly, it is argued that by changing the shape and positions of buildings, comfortable indoor conditions can be created without excessive cooling and heating costs. Water supply would have to be regulated and water would have to be re-used. It is inconceivable that within a few decades half of Africa’s people will be living in cities, while still utilising the same wasteful individual transport system of today. However, if cars could be banned from these African cities, as is already the case in Stockholm and Singapore, so that we no longer need massive urban motor arteries, what would the new land use principle be in these cities? All this requires fundamental rethinking of urban planning and development.

At the University of the Witwatersrand this matter is receiving serious attention. The university has a number of disciplines concerned with related issues, such as environmental engineering, civil engineering, geography, climate studies, architecture and planning, water management and energy management. The academics responsible for these subjects are contemplating how climate change considerations would impact the development of their work, and especially the future curricula for their students. There is a growing belief that architects, engineers and planners in the near future would have to take climate change into account in the design of human settlements. If there are indeed going to be more frequent and severe coastal storms, it is doubtful that the present housing stock would survive the damage caused by nature. It is therefore no surprise that the United Nations University, in conjunction with UNhabitat, has called on universities to contribute to a global curriculum development effort aiming at establishing climate change as a new academic discipline.

This comes at a time when there is international consensus that we must expect rapid urbanisation in Africa. The growing population of Africa will need jobs which rural areas are unable to provide. The combination of rapid urbanisation and increasing natural hazards will force the continent to rethink what kind of new cities would be needed. Will we grow conventional cities and allow huge fleets of cars to spoil the air, as we are witnessing in Beijing? Or will we learn from Copenhagen, Singapore and Curitiba that public mass transport, water recycling and new urban planning methods may offer alternatives? Planning cities from scratch would allow us to combine the best ideas for sustainable development, resulting in cities with low energy consumption (and hence low emissions), low water supply, efficient transport and friendly environments. Once the best practices have been formulated, existing cities may benefit by developing retrofitting strategies.

**CLIMATE CHANGE EDUCATION PROGRAMME**

With climate change in mind, the School of Architecture and Planning at the University of the Witwatersrand has developed a score of continued education modules to prepare future architects and planners with adaptation skills in urban settlement development. These short courses also serve to collect information on how alternative planning approaches may improve the cities of the future. Protecting future cities against the growing threats of floods, storms, landslides, droughts and wildfires will be a major element in the pursuit of sustainability. The last decade has brought us many startling examples of how nature can wreak havoc on human settlements – floods in Mozambique, China, Pakistan and Thailand; cyclone Katrina in New Orleans; repeated droughts in east and southern Africa; and landslides in Brazil, all of which suggest that the intensity of these hazards is increasing. Few urban areas in Africa have efficient protection against such threats, and indeed, while our cities will soon require greatly improved mitigation planning, few engineers and planners have the knowledge to develop adequate urban protection systems. This is the challenge we hope to address with the new continued education programme.

**NOTES**

1. CNN 2012.12.06
2. Copenhagen also built a comprehensive bicycle road network, protected from motorised traffic. Car ownership went down and a plethora of bicycle and tricycle variations appeared with rain-protected child trailers, goods platforms, etc. Indeed, surprisingly many middle-class families in Scandinavian cities do not own cars anymore.
INTRODUCTION

Water services in South Africa are in a crisis, despite the government spending billions of Rands on the improvement of water services in the country. Regrettably, the government and the communities are not receiving value for the money spent. As was experienced recently in some areas of South Africa (Delmas, Mpumalanga, Durban area), drinking water became a source of infectious diseases, such as diarrhoea and cholera.

The inadequacies of our drinking water supply systems create very serious problems which require urgent attention by the authorities and the water professional industry. There are a number of reasons for this. One of the reasons is that most of the municipalities do not enter into a proper and effective contract with their consulting engineers, which results in the appointment of unskilled consultants. Another reason is the lack of adequately knowledgeable and competent water purification specialists among consulting engineers. Yet another very important reason is the lack of a good standard for drinking water quality (DWQ).

Municipalities often do not include sufficient information in their letter of appointment, i.e. in particular the consulting engineers’ Scope of Work in adequate detail and Terms of Reference, because they do not have the capacity to do so. Consequently, consulting engineers’ duties, required skills and experience are nowhere clearly defined or referred to. Such a situation is prone to exploitation, especially because the waterworks designs in South Africa are not typically subjected to Value Engineering Assessment, unlike in other parts of the world. Commonly the waterworks are not designed as user-friendly plants which are capable of purifying water to its best attainable quality most efficiently and economically at all times, and hence often cannot be efficiently operated even by the most experienced and knowledgeable of process controllers. Furthermore, the consulting engineers do not provide services for which they are responsible, such as:

- The submission of a Technical Design Report in adequate detail, which contains all relevant design data, operational information and performance efficiency data for which the works is designed.
- The submission of a comprehensive O&M Manual.
- Carrying out proper Plant Commissioning and Acceptance Tests aimed at verifying that all project objectives and design performance efficiencies are met (the purpose of these tests is to ensure that the plant is capable of purifying water to its best attainable quality and to do so most effectively and economically), or alternatively identifying bottlenecks which are preventing the plant from meeting the project objectives, i.e. shortcomings inherent in the plant design.
- The submission of a Plant Commissioning Report incorporating all results obtained during Plant Commissioning and Acceptance Tests.

Some time ago the design of dams was classified as a specialised field, calling for appropriate experience before an engineer may accept such a responsibility. The time has come that water purification should be placed in such a category, too, due to the necessity of acquiring knowledge in microbiology and chemistry – these subjects are currently rather scant in engineering courses.

The above-mentioned aspects are not dealt with in this article. This article deals with the lack of a good DWQ standard, which is a very serious problem. Water is the most common consumable and hence its quality affects every one of us. The intention of this article is to stimulate public discussion about SANS 241/2011 and the need for its amendment. The quality of the national DWQ standard (i.e. the selection and number of determinants and their permissible limits) is instrumental in determining the engineering level of water purification in the country and is a precondition for the sustainable purification of water to a wholesome quality.

SANS 241/2011 and its effect on the water supply environment

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MANAGEMENT: DRINKING WATER QUALITY
IMPORTANCE AND PURPOSE OF ADEQUATELY STRINGENT LIMITS IN THE DRINKING WATER QUALITY STANDARD

As mentioned above, one of the prime causes of our current DWQ crisis is the lack of an adequately stringent drinking water quality standard. In such a standard, stringency of permissible limits must be derived from the socio-economic development of our country, quality of water in our water sources, health care aspects, etc. Without such a standard there is no incentive for the waterworks designers to strive to improve their skills in order to become competent water purification specialists. They should be capable of designing waterworks which can cope with the continuously deteriorating raw water quality, and purifying such water to its best attainable quality most efficiently and economically, and not only to comply with the DWQ standard.

An inadequate DWQ standard allows the installation of waterworks that provides only the appearance of water improvement, and does not call for the purification of the water to its best attainable quality. The common perception is that if the water is clear it is unpolluted. Continued use of such an inadequate standard is undesirable, as it will only escalate the current problems around the quality of drinking water.

The lack of a suitable DWQ standard has its origin in the not too distant past (SABS 241). At that time it was not considered important to purify the gradually deteriorating surface waters to their best attainable quality. It is the author’s opinion that the authorities did not appreciate the importance of a stringent standard (for health care, etc), and solved the deteriorating water quality problem by lowering the standard level of our drinking water quality. Consequently, every updated edition of SABS 241 has been less stringent than the previous one (Polasek, Mangeot 1988).

This approach enabled every waterworks to claim that it supplies good quality drinking water (as it was meeting the requirements of SABS 241), but without actually producing it. Regrettably, this practice has now been revived in SANS 241/2011.

The purpose of a stringent standard is to set out target limits that would ensure the supply of wholesome drinking water. As soon as such a standard is in place, all Water Service Authorities (WSAs) have to strive to produce such water quality. However, an exceedance of such target limits would not mean that the respective WSA would be considered incompetent, or that the operation of waterworks should be stopped and the municipality prosecuted. Instead, it would serve to induce the WSA and DWA (Department of Water Affairs) to investigate the reasons for not meeting the target limits. Often the operational shortcomings are the result of process shortcomings inherent in the waterworks design, and in many cases it should not be difficult or very expensive to rectify these. The common process design shortcomings are the following (Polasek 2009 & 2010; Polasek, Mutt 2006; Polasek, Pivokonsky 2008):

- use of an unsuitable chemical
- use of a correct chemical which is incorrectly applied
- sequence in which individual chemicals are applied
- inadequate time delay between application of individual chemicals
- non-optimised reaction conditions

- selection of unsuitable and/or inefficient types of operation units, and/or
- a combination of the above.

These shortcomings can prevent a waterworks from producing drinking water of a quality that would meet even non-stringent limits. Under the Blue Drop Certification programme, the monitoring of correct DWQ determinants will alert DWA controllers that intervention by water purification experts is required when the concentration at any particular waterworks repeatedly or continuously exceeds the target limits.

TREATABILITY OF WATER

The treatability of water is defined as a level of quality to which the water is treatable by chemical purification using any destabilisation agent (coagulant) which is applied under optimised reaction conditions. The best attainable treatability is defined as the best attainable level of quality to which the water is treatable using the most efficient destabilisation agent (coagulant). The optimised reaction conditions mean the optimised dosage of the most efficient destabilisation agent (coagulant) and optimised reaction pH value at which the water is treatable to its best attainable quality (Polasek, Mutt 2005).

The attainable efficiency of any water purification process is judged by comparing the value of individual determinants measured in the purified water with their required or permissible limits as stipulated in the DWQ standard. Evaluation of the treatability of water attainable with different destabilisation agents (coagulants) is facilitated by mutual comparison of values of individual determinants measured in the purified water.

COMMENTS ON SANS 241

During the DWQ conference in Cape Town in June 2011 a new update of SANS 241/2011 was submitted as a final draft. This edition of SANS is already under revision to reduce the stringency of permissible limits of certain determinants in order to comply with the new limits of the WHO (World Health Organisation) drinking water quality standard.

The WHO standard for DWQ is designed for the poorest of the poor, such as in Burkina Faso, Mauretania, Somalia and the like, and does not reflect the requirements of a socio-economically developed country such as South Africa. This is also clearly stated in the WHO Drinking Water Quality Guidelines (WHO 2009) as follows: “Although the Guidelines describe a quality of water that is acceptable for lifelong consumption, the establishment of these Guidelines, including guideline values, should not be regarded as implying that the quality of drinking water may be degraded to the recommended level. Indeed, a continuous effort should be made to maintain drinking water quality at the highest possible level.” SANS 241 should not be a copy of the WHO standard. In other words, South Africa needs to develop its own DWQ standard which reflects the true needs of its socio-economic development and health care objectives.

Currently SANS 241 consists of only certain of the determinants set out in the WHO DWQ standard. There seems to be an attempt among the water authorities to set permissible limits for these determinants to either meet or be less stringent than the target limits in WHO DWQ standard.

In general two basic rules should apply for SANS 241, namely:

- Maximum target limit of any determinant should not exceed that of the previous SANS 241 edition.
- Maximum target limit of any determinant in SANS 241 should not exceed that of the WHO standard.

Some of the permissible limits set out in SANS 241/2011 are commented on in the following paragraphs. In the process of compiling some of these comments, DWQ expert opinion, as expressed in the WHO Guidelines for DWQ (WHO 2009 & 2011),
was used. Furthermore, suggested recommendations on how to improve and address some of the omissions and ambiguities that exist in SANS 241/2011 are also included.

Ambiguity in permissible limits – what constitutes the operational limit?
A plant designer and process controller is interested only in one set of permissible limits which may not be exceeded in the purified water, instead of various permissible limits identified for many different risks, such as Operational, Aesthetic, Chronic Health and Acute Health. Hence, two questions arise:

a) Which one of these limits is the permissible operational limit that may not be exceeded in the purified water?
b) When two limits are stated for the same determinant, such as for turbidity, sulphate, iron and manganese, then which one is operationally binding?

This is very confusing for the process controller. Undoubtedly, when two limits are stated, the less stringent one will be considered as applicable. This ambiguity should be addressed in the SANS 241 version currently under review and only one permissible operational limit should be stated.

Omission to address acid neutralisation capacity (alkalinity) and hardness (total and carbonate)
Many water resources in South Africa provide soft water. Regrettably, SANS 241 does not address the need for optimisation of water chemistry during the purification process so as to minimise the corrosiveness, or in case of hard waters, the scale forming of the purified water. In contrast to SANS 241, the WHO DWQ Guidelines address this as follows: “Depending on the interaction of other factors, such as pH and alkalinity, water with hardness above approximately 200 mg/l may cause scale deposition in the treatment works, distribution system and pipework, tanks within buildings and consumer appliances. It will also result in excessive soap consumption and subsequent ‘scum’ formation. On heating, hard waters form deposits of calcium carbonate scale. Soft water, with a hardness of less than 100 mg/l, may, on the other hand, have a low buffering capacity and so be more corrosive for water pipes.”

Desalinated / demineralised or low mineral water (bottled) water:
In the late 1970s the WHO commissioned a study to provide some background information for issuing guidelines for desalinated water. The final report, published as an internal working document of WHO (WHO 1980), concluded that, “not only does completely demineralised water (distillate) have unsatisfactory organoleptic properties, but it also has a definite adverse influence on the animal and human organism. It has been adequately demonstrated that consuming water of low mineral content has a negative effect on homeostasis mechanisms, compromising the mineral and water metabolism in the body.” Health consequences of low mineral content water consumption are well documented (Kozisek 2004).

In view of the above it is suggested that the following be added to SANS 241:

*The water chemistry should be optimised during the purification process in order to produce drinking water around calcium carbonate equilibrium in order to minimise health risk as well as corrosiveness / aggressiveness or scale forming in the reticulation network.*

pH value
The WHO DWQ Guidelines (WHO 2009) deal with pH as follows: “Although pH usually has no direct impact on consumers, it is one of the most important operational water quality para-meters. Careful attention to pH control is necessary at all stages of water treatment to ensure satisfactory water clarification and disinfection. For effective disinfection with chlorine, the pH should preferably be less than 8; however, lower-pH water is likely to be corrosive. The pH of the water entering the distribution system must be controlled to minimize the corrosion of water mains and pipes in household water systems. Alkalinity and calcium management also contribute to the stability of water and control its aggressiveness to pipe and appliance. Failure to minimize corrosion can result in the contamination of drinking-water and in adverse effects on its taste and appearance. The optimum pH required will vary in different supplies according to the composition of the water and the nature of the construction materials used in the distribution system, but it is usually in the range 6.5–8. Extreme values of pH can result from accidental spills, treatment breakdowns and insufficiently cured cement mortar pipe linings or cement mortar linings applied when the alkalinity of the water is low. No health-based guideline value has been proposed for pH.”

The permissible pH range is specified in SANS 241/2011 as between 5 and 9.7. This is too broad a range for a safe and palatable quality drinking water. Most of our drinking waters, which are purified from surface waters, have a pH between 8.5 and 9.5. In contrast, drinking waters produced by reverse osmosis generally have a highly negative index of saturation (their remineralisation is not carried out) and their pH is around or below 7.0. The water having a low pH is usually highly corrosive. Similarly, water having a high pH is of a very poor and ‘dull’ taste. Some concerns with higher pH values include higher trihalomethane formation potentials at pH values greater than 8.1, increased formation of other disinfection by-products at pH levels above 7.8, and a higher potential for calcium carbonate scaling in the distribution pipe system at pH above 7.9. The optimum pH is in the range of 7.2 to 7.5, at which water has a fresh taste. Another reason for this pH range is disinfection by chlorination. Chlorine, whether in the form of chlorine gas, sodium hypochlorite or calcium hypochlorite, dissolves in water to form hypochlorous acid (HOCl) and hypochlorite ion (OCl-). Chlorine in the form of HOCl, which exists at pH < 7.5, is biologically more efficient than in the form ClO-, which exists at pH > 7.5. In view of the above, the following note should be included in the SANS 241 under review: *The preferred pH value of drinking water is in the range of 7.2 to 7.5.*

Pollution with dissolved organic matter
The organic pollution in most of our surface waters is well below the total organic carbon level of TOC = 10 mg C/L which is the permissible limit set out in SANS 241/2011. There are not many of our water sources in which the organic pollution exceeds the level of TOC = 10 mg C/L. One exception is the Cape Coast surface waters, which are commonly polluted by an organic mono-pollutant which is easy to remove by coagulation under optimised reaction conditions (often referred to as enhanced coagulation). Another exception could be water sources which are receiving raw sewage during a crisis situation.

Dissolved organic matter pollution is of technological significance in water purification. It is the most important and abundant water pollutant comprising a broad spectrum
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The presence of organic matter influences the chemical, biological and hygienic properties of water. Some of them have toxicogenic, mutagenic, allergic and teratogenic effects (Hocman 1986). Others are not toxic on their own, but can influence the taste and odour of water and may become toxic during the water purification process, for instance after chlorination. Some organic matter is capable of forming complexes with metals (humic matter, amino acids, polysaccharides) which prevent their removal from water. From a hygienic point of view, the products of living and decaying organisms such as actinomycetes, algae, etc, also represent an undesirable group of organic matter. Furthermore, most organic matter, if not removed during the purification process, can become a source of secondary pollution because, due to their nature, they are a source of carbon and therefore facilitate the development of micro-organisms in the reticulation systems. It should be pointed out that dissolved organic pollution remaining in the purified water contributes significantly also to undesirable taste and odour of the purified water. Furthermore, it should be realised that more trihalomethanes can form when the chlorine residual reacts with organic matter in the distribution system. Therefore, this is yet another very important reason for the need to remove organic matter (trihalomethane precursors – humic substances) most effectively during the purification process before the trihalomethanes have a chance to form.

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Pesticides

There is no limit in SANS 241/2011 at all for pesticides. Since most of the pollution originates from agricultural activities which generally contribute to water pollution by more than 70%, there should be limits set out for pesticides.

Pesticides are organic insecticides, herbicides, fungicides, pediculicides, biocides, nematicides, acaricides, algacides, rodenticides, slimicides, related products (for instant growth regulators) and their metabolites, decay or reaction products. In accordance with WHO Guidelines (WHO 2009), the permissible limit of 10 μg/l should apply to each individual pesticide with the exception of aldrine, dieldrine, heptachlor and heptachlor epoxide for which the permissible limit should be 0.03 μg/l each. The total threshold for all pesticides should be 50 μg/l.

Only the pesticides with probable occurrence in the water source should be analysed, and such pesticide compounds must be identified in the water analysis.

Aluminium

In SANS 241/2011 the permissible limit for aluminium ion is 0.3 mg/l. It is stated in the WHO Guidelines (WHO 2009) that the presence of aluminium at concentrations in excess of 0.1–0.2 mg/l often leads to consumer complaints as a result of deposition of hydroxide floc in distribution systems and the exacerbation of discoloration of water by iron. It is therefore important to optimise purification processes in order to minimise residual aluminium entering the reticulation network.

Under optimised reaction conditions, aluminium concentration of less than 0.1 mg/l is achievable in many circumstances.

Aluminium is also an important operational parameter in process control when aluminium salt is used as a destabilisation agent (coagulant). Its high residual value is an indication of problems with reaction pH under which the purification process takes place.

In view of the above, the aluminium ion permissible limit of 0.3 mg/l should be conditioned as follows: The raw water shall be purified to its best attainable quality in order to minimise the residual concentration of aluminium ion in the purified water well below the permissible limit.

Manganese

In SANS 241/2005 the operational limit was 0.1 mg/l, while in SANS 241/2011 there are two values – 0.1 mg/l and 0.5 mg/l. At levels exceeding 0.1 mg/l, manganese in water supplies causes an undesirable taste in beverages, and stains sanitary ware and laundry. The presence of manganese in drinking water, like that of iron, may lead to the accumulation of deposits in the distribution system. Concentrations below 0.1 mg/l are usually acceptable to consumers. Even at a concentration of 0.2 mg/l, manganese will often form a coating on pipes, which may slough off as a black precipitate (WHO 2009) as it is experienced in some water supply systems in South Africa. Therefore, it is expected that the aesthetic threshold of 0.1 mg/l as set out in SANS 241/2011 will remain the operational limit.

Turbidity

Turbidity and its changes are an important operational process control parameter. Total turbidity is the condition produced by two different groups of particles, namely non-aggregated (non-separable) particles and aggregated (separable) particles. Low reduction in turbidity, produced by the non-separable portion of particles, indicates problems with the destabilisation (coagulation) process, namely reaction conditions. Higher total turbidity indicates problems with purification processes, particularly flocculation, sedimentation/floation and filtration. The total turbidity of the purified water should be below 0.3 NTU.

In view of the above, the turbidity permissible limit of 1.0 NTU should be conditioned as follows: The raw water shall be purified to its best attainable quality in order to minimise the residual turbidity in the purified water well below the permissible limit.

Hydrogen sulphide

This pollutant is not addressed in SANS 241 at all. The taste and odour thresholds of hydrogen sulphide in water are estimated to be between 0.05 and 0.1 mg/l. The ‘rotten eggs’ odour of hydrogen sulphide is particularly noticeable in some ground waters and in stagnant drinking water in the distribution system as a result of oxygen depletion and the subsequent reduction of sulphate by bacterial activity (WHO 2009).

Sulphide is oxidised rapidly to sulphate in well aerated or chlorinated water, and hydrogen sulphide levels in oxygenated water supplies are normally very low. The presence of hydrogen sulphide in drinking water can be detected easily by the consumer and requires immediate corrective action. Therefore, SANS 241 should include hydrogen sulphide among its determinants with an appropriately set out permissible limit.
Uranium
SANS 241 of 2011 incorporates uranium as a new determinant. This is very welcome and appreciated. However, its threshold is set out at 15 μg/l. This limit is extremely and intolerably high in view of the information provided by Dr Carl Albrecht of the Cancer Association of South Africa at the UASA Water Seminar (September 2010), who stated that 2 μg/l is already a proven health hazard for infants. Uranium is removable by a suitable chemical treatment to a concentration below 0.001 mg/l (WHO 2009). Hence, the uranium target limit should be modified accordingly in the SANS 241 under review.

Mercury
In spite of mercury being an extremely dangerous health hazard element, its permissible concentration has increased from 1 μg/l in SANS 241/2005 to 6 μg/l in SANS 241/2011. The threshold of 6 μg/l is unjustifiably high from a health perspective, and exceeds the WHO recommended limit and, therefore, should remain at 1 μg/l.

DRINKING WATER QUALITY MONITORING
The DWQ should be monitored at the waterworks, as well as throughout the reticulation network in order to establish any leakages and other problems affecting the quality of the drinking water supplied to consumers. The following points summarise the DWQ monitoring guidelines:
■ Operational monitoring is the conduct of planned observations and/or measurements to assess whether the control measures in a drinking water system are operating properly (WHO 2011).
■ It is possible to set limits for control measures, monitor those limits and take corrective action in response to a detected deviation before the water becomes unsafe (WHO 2011).
■ The samples of drinking water for its quality monitoring must be so taken that they are representative of the quality of drinking water being consumed throughout the whole year and throughout the entire reticulation system. The samples of drinking water should be taken at the outlet from the waterworks and any other suitable location in the distribution network. Furthermore, the sampling points in the reticulation network should be so selected throughout the supplied area that more than 50% cannot be considered permanent, but change every year. The changes of sampling points are determined by the method of random selection, or other suitable method, which ensures that none of the supplied objects is excluded from the monitoring possibility.
■ The sampling points are located in such places where water quality requirements must be met. Determinants (such as antimony, arsenic, benzene, beryllium, boron, mercury, selenium, uranium, bromides, chlorides, cyanides, fluorides, nitrates, pesticides and sulphates) which are assumed to retain their concentration during distribution between the waterworks and the point of consumption, do not need to be monitored throughout the reticulation network.
■ The frequency of sampling can be reduced when the values of physical, chemical and organoleptic parameters are considered acceptable, i.e. such values are free of abnormal changes with the results lower than 50% of permissible limits. The above does not apply to colour, turbidity, cation of destabilisation agent (coagulant), conductivity and pH, which must have a steady value. Taste and odour must also always be acceptable to consumers.

CONCLUSIONS
■ A suitable DWQ standard containing adequately stringent limits for individual water quality determinants which are based on the socio-economic development of our country, quality of water in our water sources, health care aspects, etc, should be developed without any undue delay, and the next edition of SANS 241, incorporating such thresholds, should be issued as soon as possible. We define our own reality through the choices we make.
■ All the target limits as suggested are achievable by conventional purification processes in operation under optimised reaction conditions. When the permissible limits, as set out in SANS 241, cannot be met with the existing system, then an upgrade of the waterworks processes or additional treatment may need to be considered, or water should be obtained from alternative sources.

ACKNOWLEDGEMENTS
Contributions to this article by Claude Mangeot Pr Eng, Justin Xantho C Eng, and Paul Chilton Pr Eng are gratefully acknowledged.

REFERENCES
The list of references is available from the editor.
BACKGROUND
Road maintenance remains a challenge with increasing usage as businesses and communities expand over time. This article focuses on the maintenance of gravel roads, which are often neglected in terms of fund availability, as they are viewed as low priority roads within a given road network. In the South African context each province is mandated to maintain its road network, thereby ensuring safe conditions for all users. As such, in order to adequately maintain gravel roads, it is a prerequisite to have appropriate quality material to provide a wearing course for the roads. This requirement necessitates securing material from borrow pits. Borrow pits are regulated by the Minerals and Petroleum Resources Development Act (M&PRDA, Act No 28 of 2002), with the decision-making authority being the Department of Mineral Resources (DMR). According to the requirements of the M&PRDA, all mining activities, including the extraction of material from borrow pits and quarries, require authorisation from the DMR. Section 106(2) of the M&PRDA requires that an Environmental Management Programme (EMProg) be submitted in order to obtain a mining right.

Since the utilisation of material sources is in essence about the management of assets and risks, the approach adopted should be underpinned by a risk management philosophy. In recent years there has been an increased focus on risk management, which is evidenced by the need for broad standards upon which to benchmark operational performance. For example, standards such as the International Organisation for Standardisation (ISO) 31000 Risk Management – Principles and Guidelines have been developed, furthering the belief that risk management provides the appropriate tool for balancing the conflicts inherent in exploring opportunities on the one hand, and avoiding losses, accidents and disasters on the other (Aven 2011). Opportunities include, amongst others, a better understanding of the operational risks for road users and the province. Measurement of risks allows management to appropriately plan and mitigate risks where feasible and practicable, as well as demonstrating to stakeholders that the road network is appropriately maintained.

Risk management is best described as the process of measuring/assessing risk and then developing strategies to address the identified risks. As such it represents a logical and systematic approach to the identification, analysis, assessment, treatment, monitoring, and communication of the risks inherent to the use of material sources. For strategic level decision-making in road maintenance management, the condition of the road network has to be described, using indicators that summarise the vast information obtained from measurements (Hudson et al 1997). The objective is also to introduce a tool for using road network conditions as an input to strategic level decision-making.

MANAGEMENT: RISK PROFILING

The value of risk profiling: case study on strategic borrow pits Beaufort West, Western Cape

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(Ruotoistenmäki, Seppälä 2007). As Box and Draper (1987) stated, “all models are wrong, but some are useful”. In order to address a sound risk management approach to road maintenance, risk profiling is used for borrow pits that are envisaged to be required to maintain gravel roads.

METHODS
Risk register

The risk assessment tool is founded upon a risk register, comprising potential risks, and covering the full range of activities associated with the identification, planning, operation and closure of gravel material sources. These risks are divided into the following logical structure of risk categories:

- Health and safety risks
- Technical risks
- Natural environment risks
- Built environment risks
- Economic risks, and
- Legal and authorisation risks.

Evaluation of risk

Risk is possibly best viewed as a condition involving exposure to EVENTS that MAY have an ADVERSE IMPACT on a particular objective. As such, risks comprise two key components, namely probability and consequence. The assessment of risk should embody an expression of both of these components. Accordingly, this has been provided for in the evaluation of risks associated with the risk assessment tool.

Risk probability

Risk probability refers to the likelihood of an event occurring. It is important to evaluate this likelihood in the context of the anticipated use of the borrow pit(s) and with the anticipated controls in place. In other words, this is the likelihood that, under the anticipated mining conditions, the event described in the risk register will occur at some time in the future. It is evaluated on a semi-quantitative scale of 0 to 5:

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Impossible</td>
</tr>
<tr>
<td>1</td>
<td>Unlikely</td>
</tr>
<tr>
<td>2</td>
<td>Possible</td>
</tr>
<tr>
<td>3</td>
<td>Probable</td>
</tr>
<tr>
<td>4</td>
<td>Highly probable</td>
</tr>
<tr>
<td>5</td>
<td>Almost certain</td>
</tr>
</tbody>
</table>

The consequences of certain of the risks in the risk register can be predetermined to an extent. For example, the consequence of an injury or death of a person falling down a steep slope will never be “insignificant”. Rather, it will always be a “major” or “catastrophic” consequence. In such cases, the risk evaluation sheet is blanked out for inapplicable selections. This reduces the degree of subjectivity of the evaluation and streamlines the process.

Mapping of risk

The total elimination of all risks is typically not financially or technically feasible. A degree of risk will always exist and the intention of risk management is to reduce that risk in a systematic and cost-effective manner. It is therefore important that the treatment of risks is undertaken by prioritising and addressing risk in a systematic manner. This is the role of risk mapping.

The mapping of risks enables not only the comparative assessment of different material sources in terms of risk, but also facilitates the visualisation of the relative levels of different risks within a specific borrow pit. As such, it is an invaluable tool in the identification and prioritisation of risk treatments.

The risk assessment tool used for an investigation includes a graphic risk-mapping instrument to guide the identification and prioritisation of risk treatments within specific material sources (represented as a risk profile). This instrument distinguishes between high, medium and low risk.

It is important to emphasise that the risk assessment tool represents a semi-quantitative approach. The numerical values simply aid in the integration of the various variables comprising risk (namely risk probability and consequence) and facilitate the interpretation and prioritisation of this risk. The risk values are not absolute and are thus not meaningful beyond the comparative assessment reflected in an EMProg. The objective is simply to produce a more detailed prioritisation than is usually achieved in pure qualitative analysis, not to suggest any realistic values for risk such as would be presented in a truly quantitative analysis.

Case study: borrow pits on DR02308, Beaufort West, Western Cape

This is a proposed site for a strategic borrow pit located in an existing dam, to the south of DR02308 (at kilometre 12.9), at the intersection with DR02306, 65 km west-southwest of Beaufort West. The geology consists of dark grey, thickly bedded mudstone of the Abrahamskraal Formation, which is highly suitable as gravel wearing course.

The vegetation consists of grasses and shrubs of the Gamka Karoo (NK1) vegetation unit, part of the Nama-Karoo biome. This is generally in good condition and not threatened (Mucina and Rutherford 2006). A significant area of this vegetation type is conserved in the nearby Karoo National Park, and mining of this borrow pit will not endanger any plant species present in the area.

Figure 2 provides a Pareto chart for the total risk scores of the various borrow pits. From this chart it is clear that all borrow pits considered have a low overall risk associated with their exploitation.

Figure 3 provides the overall risk profile for all of the material sources under consideration. The mean total risks score for all of the assessed material sources was 66.6 ± 1.82 (n = 5) with slight increase in score between the lowest and highest total risk scores (65 for BP DR02308/44.4/0.1L to 69 for BP DR02308/36.6/0.05L).

CONCLUDING REMARKS

A rigorous base-line assessment will often be sufficient to identify, analyse and evaluate potential safety, health and environmental risks. It will also provide consistent outputs from risk studies and allow risk treatments to be determined. However, some risks may require more detailed analysis before the need for treatment, or the nature of appropriate treatment measures, can be determined.
While qualitative methods cannot generally be excluded for detailed analysis, it is more likely that semi-quantitative or quantitative methods would be used at this stage. However, time and effort expended in detailed analysis is time and effort diverted from treating the risk and will sometimes result in the same decisions. Detailed analysis should focus on risks, for which the initial qualitative analysis does not provide sufficient information for a reasonable decision to be made on the level of risk or the efficacy of proposed treatment strategies.

Key conclusions that are drawn from this risk assessment methodology are the following:

■ The risk profile provides management with an effective graphical tool which categorises the assessed risks in a form that allows management to plan mitigatory measures.
■ The probability and consequence criteria are simple and uncomplicated, yet practical and relevant, which aids governments in assessing risks in an efficient manner.
■ The methodology provides a structured approach to formalise borrow pit risks through a process of identification, assessment, evaluation and treatment which is in line with international best practice (ISO 31000:2009).

ACKNOWLEDGEMENTS

The author would like to acknowledge Dr Andrew Spinks and Tinka Shapiro, for the risk assessment approach and methodology presented, as well as Dr Elretha Louw and Dave Rose of Aurecon for reviewing the content of this article.

NOTES

1 A borrow pit is a term used in construction and civil engineering. It describes an area where material (usually soil, gravel or sand) has been dug for use at another location.
2 The Pareto chart is used to graphically summarise and display the relative importance of the differences between groups of data, and simply involves arranging the subject data in descending order and plotting it as a bar chart.

REFERENCES

The list of references is available from the editor.
The question of copyright arises in almost every design, drawing or document prepared by the design professional in the execution of a consulting assignment for his or her client, and it is not always made clear who owns the copyright in the created work – the design professional or the client. Over the past 20 years there has been a significant shift to the ‘design and build’ approach, where the construction contractor undertakes the design and the construction of the project, for operation by the owner/employer. Again it is not always clear who owns the copyright. When the question is asked the response is invariably that, having paid for the design, the ownership of the copyright vests in the client in the case of the design professional, or the employer in the ‘design and build’ contract. This is not correct. Ownership of copyright in most countries is governed by legislation. In South Africa this is the Copyright Act of 1978. The implications of the Act for design professionals and construction contractors are explained in this article.

Copyright as it affects the design professional and the contractor

Copyright protects creativity in the choice and arrangements of words, musical notes, shapes (including technical drawings and diagrams) etc, i.e. only the form in which ideas, concepts and information are expressed, but not the ideas, concepts and information themselves. It primarily protects against those who copy original works of authorship, i.e. who take and use the form in which the original work was expressed by the author.

Generally copyright is the right which vests in the author of an original ‘work’ (or a person having acquired rights from or through him) the exclusive right to do or to authorise the doing of certain acts set out in the Copyright Act of 1978. This enables him to prevent unauthorised copying or reproduction of that work. By definition an ‘artistic work’ includes a drawing of a technical nature or any diagram, map, chart or plan and ‘works of architecture’ in the form of buildings or models of buildings. In relation to an artistic work ‘reproduction’ includes a version produced by converting it into a three-dimensional form, or if it is in three dimensions, by converting it into a two-dimensional form, and includes a reproduction made from a reproduction of that work. Thus copyright in a drawing can be infringed by copying an article made from that drawing (i.e. ‘reverse engineering’), subject to the exemption in terms of section 15(3A) in respect of reverse engineered reproduction of articles having a utilitarian purpose and made by an industrial process (e.g. spare parts).

The ‘author’ is the person who creates the work in its material form rather than the originator of the ideas which the work contains. The work must be the product of the author’s own independent mental effort, skill and labour and must not be copied from other sources.

The author of a drawing is the maker or creator thereof, but in the case of a computer-generated drawing it is the person by whom the arrangements necessary for the creation of that drawing are undertaken. Unlike patents, designs and trademarks, registration of copyright is not required. In the case of a drawing, copyright lasts for 50 years from the end of the year in which the author dies, or if the state owns the copyright, 50 years from when it is first published.
Contrary to widespread belief, it usually does not follow that because the client or employer pays for the creation of a drawing, it will own the copyright in that drawing (i.e. the right to prevent others from copying or reproducing it). Usually the client or employer would obtain only a licence to use that drawing, leaving its author free to license its use to others (including the competitors of the client or employer). For this reason, if the client or employer wishes to own the copyright he/she should expect to pay for it as the previous owner would no longer be entitled to exploit it. Whether taking ‘assignment’ (i.e. becoming the owner) of the copyright or only licensing it, the client or employer should ensure that he/she contracts with the copyright owner – usually the author of the work or, in terms of section 21(1)(d), the employer of the author of the work if the work was made within the course and scope of a contract of service (i.e. employment in the sense of an employer-employee relationship) or apprenticeship with such employer. Where a work is made by or under the direction or control of the state, the state (represented by the government printer for administrative purposes) is the copyright owner. Be vigilant in this regard. If a sub-contractor or independent professional creates a drawing or diagram, he must be a contracting party so as to transfer to, or confer on, the client or employer the right which that party requires. An assignment of copyright must be in writing signed by or on behalf of the assignor.

If no such agreement is expressly entered into, and an architect is engaged to draw plans only, the client would probably have an implied licence to erect a building from those plans on the intended site.

Although the purchaser of a drawing may become the owner of the (physical) drawing upon its delivery to him, without a formal assignment of copyright he would not become the owner of the (intangible) copyright therein, as ownership and copyright are separate and distinct rights.

The copyright owner’s remedies for infringement are an award of damages (which at his option may amount to a reasonable royalty payable by a licensee in respect of the work concerned), an interdict, and delivery up of infringing copies, plus such additional damages as the court deems fit in the circumstances.

In terms of section 24(2) of the Copyright Act no damages may be awarded if at the time of infringement the infringer was not aware, and had no reasonable grounds for suspecting, that copyright subsisted in the work concerned, but the copyright owner’s other remedies remain available.

In terms of section 24(4) it is not possible to obtain an interdict or other order restraining the completion of a building after construction has begun, or requiring its demolition, where that building constitutes an infringement of the copyright in a work of architecture or the architectural plans on which it is based.

Usually the design professional or the contractor, as the case may be, owns the copyright in respect of drawings and other materials created by him, unless this has been transferred (‘assigned’) to the client or the employer. This is reflected in many contracts which include a clause to the effect that the client or the employer, and any other person in proper possession of the works, are granted a non-terminable, transferable, non-exclusive, royalty-free licence to use, copy and communicate the design professional’s or the contractor’s drawings and other materials to complete, maintain, rectify, repair, modify, extend, operate and demolish the works, and to make and use modifications thereof for these purposes.

References

Are you ...
... protecting your Copyright?

The construction industry constantly requires the production of designs, drawings and documentation in the execution of their consulting assignments or the implementation of construction projects. Invariably this involves the creation of original designs and drawings.

Copyright in these created works is often, but not always, owned by the author. Its misuse is protected by the Copyright Act, but the copyright may need to be transferred or acquired. This must be done through contractual arrangements which are properly documented.

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Plato said that knowledge was justified true belief – in other words, in order to ‘know’, one simply has to believe that something is real and be able to justify it with sufficient conviction for it to be so.

This human ability to ‘create’ knowledge, based simply on a strong belief and an equally strong reason for that belief to be real, has been at the centre of the ‘science versus faith’ debate since the earliest philosophers and astronomers began to question the status quo of their time, and were more often than not brutally persecuted and even put to death for having the audacity to question indoctrinated beliefs.

If we fast-forward several thousand years to 2012, the ‘science versus faith’ debate rages on, as experts at both ends of the spectrum continue to make spectacular discoveries, or claims, which completely overturn and nullify everything we took to be indisputable, de facto justified true belief only 10 to 15 years ago. The most recent ‘game changing’ discovery, that neutrinos traverse the universe at speeds in excess of the speed of light, has shattered the 100-year absolute of this being a constant and has opened a massive debate around the most cherished hypothesis in relativistic physics.

And so, as the simple harmonic dance of convergence and divergence amongst these experts continues through the millennia, we find ourselves in a similarly elastic quandary, or impasse, when it comes to effectively managing and transferring knowledge in the engineering world. Whether in the consulting or contracting environments (the challenge is very similar to the historical one above), do we continue to transfer ‘more of the same’ to the next generation (it is after all justifiable true belief, as it has worked for us for so long and must therefore, by implication, be the only way!), or do we engage in developing a ‘co-visioneered’ version of the future, using experience and past success as a respected benchmark only and not an absolute destination, allowing a process of ‘engaged discovery’ to unfold to the benefit and sustainable advantage of all participants and their organisations?

This latter option is the domain of effective knowledge transfer through relationships forged in an earned trust and a common vision of the ‘knowledge objectives’ of the relationship.

As we have observed above, we are often just as likely to pass on mediocre knowledge and bad habits, as we are to pass on the nuggets of wisdom that create true sustainable value – just as long as we can justify our belief in the particular practice.

So, if effective knowledge transfer involves a sharing relationship, which is based on a high degree of TRUST, and as trust is a bond, or covenant which must usually be earned over time through consistency, commitment and action, how do we fast-track this essential ingredient into our organisations, in order to ensure the optimal sharing and transfer of sound engineering judgement and essential technical expertise, garnered over many years and at great cost, to the future generation of engineers and leaders in our profession?

There is a way – structured mentoring. Structured mentoring involves a harmonious inter-dependency between people, process and programme, focused on achieving specific job function, career or specialist knowledge objectives or learning outcomes of the potential mentee.

So, the starting point is agreeing about the knowledge objectives of the structured mentoring programme (this will be covered more comprehensively in a future article).

Once the direction and objectives of the knowledge transfer are agreed, the second focus area (and arguably the number one critical success factor) is the relationship building process. Bearing in mind that this is a work-related initiative and that, with ‘billable hours’ being consistently crowbarred into our subconscious thought processes, how do we
ensure that we are able to spend enough time and effective effort to nurture the critical element of trust, in order to get the knowledge to flow?

One way is to use the following relatively simple relationship-building technique which has proved to be very effective over many years:

**Commitment:** Ensure that both potential mentors and mentees are fully committed to participating in the process of knowledge transfer and the overall learning objectives of the programme – commitment helps overcome all the obstacles that may get in the way from time to time. The partnership should develop a clear ‘route map’ of what they want to achieve and how they plan to go about it – *clarity builds commitment* and there are proven ways to assess and motivate participant commitment before any investment is made.

**Openness:** The mentors and mentees should engage in a process of discussing their mutual expectations, of not only the outcome of the process, but of each other as well. Potential obstacles, such as generational differences in behavioural competencies (like time management and accountability), or differences in cultural values and norms, or even lofty expectations of rapid entitlement, should be openly discussed and dealt with to the mutual satisfaction of both parties – as the saying goes, “don’t pass Go” until the mutual expectations or agendas of both participants are thoroughly discussed and agreed.

**Honesty:** As with our private and personal relationships, honesty is an essential ingredient of building a trust relationship. The mentors and mentees should ensure that they are paired with someone with whom they are comfortable and prepared to be completely honest. Effective structured mentoring will involve a lot more than discussing the ‘square root of minus 1’ and should therefore allow both the mentors and mentees the space to discuss their feelings, fears and futures with absolute honesty. If these are shrouded in hierarchical or positional uncertainty, fabricated ideals or smoke screens, the relationship cannot deal with the ‘truth’ and will therefore be less productive.

**Mutual respect:** In a multi-cultural society, spanning several generational epochs, it is highly likely that the pairing of mentors and mentees will be fraught with potential obstacles, relating to mutual respect and understanding. The use of scientifically validated and diversity-friendly self-assessment instruments adds huge value to this component of the relationship-building process. Mutually shared insights gained from a Behavioural Style Analysis, a Workplace Motivators Report or an Emotional Intelligence Assessment, provide a wonderful platform to have open dialogue between mentor and mentee. Ideally this dialogue should be expertly guided using a pre-determined set of questioning techniques which keep the mentor and mentee focused on building respect in line with achieving their knowledge or learning objectives, and not necessarily moving in together.

**Confidentiality:** Arguably the most difficult challenge faced by mentors and mentees in a business-based relationship of knowledge sharing and development, is how much do you, or can you share with each other about how you feel about how the business is run, or how the managers conduct themselves, etc. The mentor is almost invariably a senior engineer, departmental manager or even an executive, so how can the confidential conversations in a structured mentoring relationship be ‘ring-fenced’ from, say, the Performance Management System or upcoming vacancy or promotion that has been advertised. A mutually agreed Code of Conduct and discussion on ‘relationship boundaries’ is essential for any real confidence to be gained in “what we discuss in this relationship stays in this relationship”. A typical challenge encountered is, what happens when the mentor discovers that the mentee is in the process of looking for, or has found a new, more lucrative or rewarding job, or the mentor feels that an intervention is required with the mentee’s manager due to some form of inappropriate business practice. How does the mentor manage this?

**Fun:** Significant brain-based research by people such as the Neuroscience Leadership Institute, FunTheory.com and a host of publishing psychologists and developmental researchers, confirm that we learn faster and more effectively (retention and recall capability) if there is an element of fun in our learning. Mentors and mentees must ensure that they give a high degree of attention to having fun in their interactions. One way is to create interesting learning ‘challenges’ and ‘rewards’, or to facilitate the development of self-esteem and personal worth by creating ‘show and tell’ knowledge sharing opportunities for the
mentees and their colleagues – proven knowledge sharing techniques such as the Retrospective Analysis, Expert Profiling, Knowledge Mapping or Intentional Story Telling add not only fun to the sharing process, but also contribute to the organisation via the creation of re-usable knowledge assets. Structured mentoring is not a training initiative – it is the development of a sustainable and pervasive organisational culture and competency of sharing and learning whereby both the experienced and inexperienced learn from each other and from others, and the quality of the sharing and learning will be directly proportional to the quality of the relationship.

Forced partnerships, coerced relationships and ‘marriages from hell’ leave a trail of devastation in our personal and private lives, and can be hugely destructive in the business environment as well, often leading to the wholesale loss of significant corporate value in terms of the negative effects and impact that poorly selected relationships can have on young staff morale and management commitment.

So, if you find that your experienced senior engineers or technical specialists are struggling to retain or transfer ‘mission critical’ operational and technical competencies to your new generation of younger engineers and technicians, and that key-man dependency features high on your Organisational Risk Profile, then it may be a good time to consider the benefits of structured mentoring, bearing in mind that effective knowledge transfer will only take place in an environment of trust, and that trust is something that is earned and not delegated and takes time to develop. So, engage with the potential knowledge stakeholders and let them co-elect the optimal relationships involving mentors, mentees and technical experts, and then spend sufficient time and effort building these Relationships of Trust.

NOTE

As with our private and personal relationships, honesty is an essential ingredient of building a trust relationship. The mentors and mentees should ensure that they are paired with someone with whom they are comfortable and prepared to be completely honest. Effective structured mentoring will involve a lot more than discussing the ‘square root of minus 1’ and should therefore allow both the mentors and mentees the space to discuss their feelings, fears and futures with absolute honesty.

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UPGRADING THE BEIRA PORT COAL-LOADING TERMINAL

A MAJOR OPERATION to upgrade and deepen coal-loading berths at the Beira port in Mozambique is under way using a specially designed and strengthened version of Technicrete’s Armorflex erosion-protection block to combat the scouring force of Indian Ocean tides.

A total of about 35,000 blocks, assembled into 230 separate articulated concrete ‘mattresses’, and covering an area of more than 3,200 m², are being laid on the sea bed at the Mozambique port to facilitate the movement of larger vessels using the coal terminal.

Manufactured at Technicrete’s White River plant to a specification set by the Dutch engineering consultancy DHV, it is the first time that the new Armorflex 405 block has been put into service.

The mattresses are being laid eight metres below mean sea level in two separate areas near the Beira river mouth.

A heavyweight adaptation of smaller and lighter blocks widely used for flood water and erosion protection, these blocks are 220 mm thick compared with the standard Armorflex thickness of 115 mm, and will provide scour protection from tidal forces and the wash from manoeuvring ships’ propellers and bow-thrusters.

For the Beira project, individual blocks have been laced together with polyrene, a rope made from an exceptionally strong chafe-resistant mix of polyester and nylon, to form articulated concrete block mats. In all, 230 mats, each made up of 152 blocks and weighing 5.8 tons, are to be laid.

Delicate exercise

“It’s very important that each mattress is correctly laid to fit snugly against its neighbour to ensure maximum effect,” says Technicrete product development manager Taco Voogt, who has been consulting on the project with DHV and the contractor Odebrecht International.

Voogt, a professional engineer, talks of the extensive pre-planning exercises that went into the operation – delicate exercises which could only be performed during each ‘quiet water’ turn of the tide.

Voogt says, “The decision to use the Armorflex mats followed lengthy discussions, and the option was considered from all angles. It was agreed that the mats were to be made 5.89 m (19 units) long and 2.40 m (8 units) wide, these sizes being based on a 12 m x 2.4 m truck bed.

“The area where the mats are being placed is divided into an area 75 m along and 22.3 m out in front of Quay 7, and 60 m along and 22.3 m out in front of Quay 9. To cover these areas, Quay 7 needs 13 mats running parallel to the quay wall and 10 mats out, requiring a total of 130 mats. Quay 9 needs 10 mats parallel to the quay wall and 10 mats out, requiring altogether 100 mats. Thus a total of 230 mats are required.

Strong currents

According to Voogt the water in front of Quays 7, 8 and 9 is very muddy and the use of divers was therefore not advised. There is also a strong current sweeping along the quay walls at outgoing tide and a lesser current at incoming tide.

“Laying all mats individually means performing the same operation 240 times without the aid of divers, obviously a very time-consuming exercise. The possibility was therefore investigated of linking the mats together to assemble bigger units, which could be laid in one operation or in a limited number of operations.”

This would require the use of a very large lifting frame, which could accommodate a large number of mats, which could then be craned to the placing area with a shore-based crawler crane. Alternatively, the mats could be assembled on a flat-deck barge into large single units, each 10 mats wide, and launched from the barge into the final position.
**Dredging problems**

Voogt continues: “We also inspected locally available dredging equipment, but unfortunately the crane dredger was out of action. The accompanying split barges seemed to be operational, as well as the tugboat. A trailer suction dredger, which was operational, would not be released by the owner to execute the dredging operations, since the spoil contained a substantial amount of large-size rip-rap. A crane dredger with a clamshell bucket achieves a far superior surface finish to a trailer suction dredger.”

As mentioned above, 230 mats with a standard size of 5.89 m long x 2.40 m wide were required. To facilitate joining the individual mats, four half-blocks would be omitted on each side to be able to access the binding rope. To link the mats longitudinally (to a maximum length of two mats) a Y16 rebar could be threaded through end-loops protruding from the mats.

Linking together the adjacent mats required a special technique. In a mattress of 5.89 m long (i.e. 19 separate blocks), each side has nine half blocks. Four of these half blocks are now omitted with the assembly of the mattress, namely numbers 2, 4, 6 and 8, on each side. At the assembly of a double mattress a piece of 12 mmØ polyurene rope is used to connect the main 20 mmØ rope in the mattress with the 20 mmØ rope in the next mattress in each void left by the omitted half blocks.”

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**FUTURE CITIES NEED INTEGRATED SOLUTIONS**

OVER THE NEXT 50 years the world’s population is expected to grow by 2.6 billion, from 6.5 billion people in 2000 to 9.6 billion in 2060. Cities will grow at an unprecedented rate, presenting a significant challenge for town planners and city authorities alike to ensure on-going service delivery and functionality.

GIBB director Urban and Rural Planning, Nico Kriek, says there are five critical challenges which urban planners need to consider with regard to this growth. “The first factor is **scale and size**. Cities are becoming massive. For example, the population of Sao Paulo in South America is equivalent to the entire population of Australia. In 2030 the urban population of Africa will be greater than the total population of Europe,” he says.

The second factor to consider is the **speed of urbanisation**. “While it is estimated that the world population will grow by 2.6 billion over the next 50 years, the urban population (people moving from outlying areas into the cities) is expected to grow by 5 billion over the next 30 years. Such explosive growth in cities will undoubtedly outstrip the ability of authorities to deliver services,” says Kriek.

**Mobility and migration of diverse populations** is a third factor to consider. Due to an increase in mobility from city to city and from one country to the next, cities are becoming increasingly diverse in terms of population and cultural mix.
Fourthly, cities are becoming increasingly complex. “Because of their diversity and the gap between various socio-economic groupings, our cities have become increasingly complex to manage – there is no universal template that applies to all cities,” says Kriek.

The fifth factor relates to unprecedented levels of connectivity. In the past people did not move around with as much ease as they do today. For example, the Gautrain allows for easy inter-city movement. Access to transport systems will have implications for how cities will develop in the future.

Given these challenges, what does the future hold for cities, specifically in Africa and South Africa?

Kriek believes the path to prosperity runs through cities. “In order for African cities to become global players, we have to make them work better. Organisations (like GIBB) need to take a multi-disciplinary and integrated approach to planning cities – urban planning, roads, water, etc., all need to work together.”

According to Kriek, South Africa will respond differently – spatially and physically – to other cities around the globe, and there will not be dramatic changes. “Informal areas will become larger on the periphery of the cities and there will be some informal movement into the cities. We can’t stop it, so we may as well plan for it. We can expect a decline in delivery of services, but it is here that GIBB can play a significant role in finding ways to improve the status quo,” he says.

“Essentially,” continues Kriek, “South Africa needs to bring back vital components of the city that were destroyed in the 20th century, such as complexity and density. The 20th century was all about compartmentalisation – we had industrial areas, commercial areas, and residential areas. This is problematic, because now we don’t have the required density for an effective public transport system. If you look at old cities, there is a lot of complexity. Residences, boutiques, motor dealers and supermarkets are in the same area. Cities need ‘messy intersections of activity’ or mixed-use areas.”

Kriek predicts an emergence of transport-oriented development areas, parallel to growth of the public transport system. “Public transport areas will gradually become focus areas for investment and development. The cities will eventually incorporate investment ‘nodes’ and ‘corridors’ (like Sandton and Rosebank), connected to transport routes.”

Another critical factor will be the ability to manage security in cities. “Public spaces will become increasingly hostile if we don’t manage security effectively. A high degree of crime inhibits our growth. For example, we have to over-provide parking space because leaving vehicles in the street is not an option,” says Kriek.

In future South African cities will experience a greater mix of formal and informal, as well as a greater income mix and cultural mix. “Physically, the cities will not look dramatically different, but their operational success will be determined by our ability to provide effective integrated planning and development solutions.”

The global report of the Carbon Disclosure Project on water clearly shows “that water is a significant and pressing issue for the world’s largest companies, many of which report both detrimental business impacts from water and significant water-related business opportunities”.

Scientific developments over the last ten years have highlighted the shortcomings of the more traditional approaches to the management of water resources. Driven by the worsening water crises, innovations have
led to the more comprehensive and sophisticated Water Footprinting Methodology developed by the Water Footprint Network (WFN). This approach advocates a broader understanding of the impacts of consumption and leads to a more holistic water strategy for industries, factoring in supply chain demands and recognising three different types of water use: blue, green and grey. These three categories distinguish between consumption of water from surface waters and aquifers (blue), evaporative flows or rainwater that is stored in the soil as moisture (green) and volumes of water impacted by pollution (grey). By considering these various categories, together with both direct (operational) and indirect (supply chain) water use, water footprinting provides a means of accurately dimensioning the true water use of an activity.

Through water footprinting companies are able to better understand their current and future risks and construct a holistic water strategy to manage for, and mitigate against, these risks. The Global Water Footprint Standard, developed by the WFN and its partners of scientists, NGOs and large international companies, is rapidly gaining acceptance as the definitive

Globally, water demand is expected to outstrip availability by a staggering 40% by 2030.
methodology for defining, measuring and interpreting water use by industry. In many parts of Africa, including South Africa, water footprinting can be expected to offer the licence for industries to operate by providing a means to understand their usage pattern, and solve water conflicts that are anticipated to occur in the future.

Talbot & Talbot can help you to determine and reduce your water footprint, as they specialise in industrial and municipal water and wastewater management.

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N12 EXPANSION:
BUILDING A NEW SUPER-CLASS HIGHWAY

PART OF AN extensive motorway network measuring some 185 km, the ongoing Gauteng Freeway Improvement Project (GIFP) is being implemented in stages by the South African National Roads Agency Limited (SANRAL), creating a modern, world-class toll route system in South Africa’s most populous and commercially active region.

National Route 12 (N12) is one of SANRAL’s strategic priorities and it is here that civil engineering contractor, Raubex Construction, has been awarded the task of implementing a complete overhaul on Section 19. The scope of works involves an intensive programme running over 30 months and calls for an emulsion and cement stabilisation mix for the sub-base layers.

Three major new interchanges, successive bridge widenings and an east and westbound three-lane highway in both directions will replace the existing N12 dual-carriageway system along approximately 10 km between the current Tom Jones and Daveyton on and off-ramps.

For both the existing and new lanes, full-depth reclamation and soil stabilisation will be carried out by Raubex’s recently acquired Cat RM500 rotary mixer. The design of the RM500 incorporates separate water and emulsion pumps, which are simultaneously monitored in the cab via two separate flow meters.

With an operating weight of 28 145 kg, the RM500’s Cat C15 ACERT engine has a gross power output of 403 kW. Width of cut is 2 438 mm, whilst the maximum depth of cut is 457 mm.

“We needed a high power-to-weight ratio on the N12 to cope with the existing varied in situ premix materials, plus the dual-mix stabilisation design makes the RM500 the optimal choice,” explains Raubex Construction operations manager, Wouter van der Merwe. With the RM500, Raubex will reclaim and stabilise the 300 mm sub-base in one go along the demarcated sections.

The equipment team on the ETB section will comprise the Cat RM500, in addition to a Cat fleet that includes the latest generation Cat 140K motor grader, plus Cat CS76 single-drum 20 tonne vibratory rollers.

This will be a construction road train with the RM500 pushing ahead two tankers, one carrying 18 000 litres of emulsion and the other 18 000 litres of water for the sub-base phase. The emulsion ratio will be between 2 to 3% and cement around 1.5 to 2%.

From a quantity perspective, the volumes on Section 19 are substantial. Raubex’s RM500 will be deployed for the sub-base component, amounting to 135 000 m$^3$, whilst the selected 300 mm layer comprises some 102 000 m$^3$. Some 9 million litres of emulsion will be used, together with 5 000 tonnes of cement and 114 000 tonnes of BTB.

“What makes the N12 project particularly noteworthy is that all materials will be worked in situ or sourced from cuttings that will make way for the new lanes and interchanges along the route,” adds van der Merwe. “Achieving this requires very complex planning to meet incremental timeframes.”

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Full depth reclamation and soil stabilisation will be carried out on the N12 by Raubex’s recently acquired Cat RM500 rotary mixer

A section showing the existing varied in situ premix materials
CESA APPOINTS NEW PRESIDENT

NEWLY APPOINTED President of CESA (Consulting Engineers South Africa), Naren Bhojaram, says that he has come into office at an interesting time for the Consulting Engineering Sector.

“The World Cup 2010 euphoria is now over and all the exciting projects in which our members participated are past, if not glorious, memories that made us proud! Today the outlook is uncertain with turbulent economic times in both Europe and the US. Global economic uncertainty affects African and South African economies, and our member firms are not immune to this.

“We are encouraged by moves by the South African government, together with civil society and business, in signing an accord to promote local procurement and job creation for our people. We are also anxious about just how the new Preferential Procurement Policy Framework Act and Regulations, which came into effect on 7 December 2011, will be embraced by our various client bodies.

“Against this cautious optimism the blight of corruption hangs heavy – business integrity is steadily worsening and it is with disappointment that I note that just about every country on the African continent has moved backwards on the Transparency International® Index over the past two years. South Africa has moved from number 43 (in 2006) to number 54 (in 2010).

“My focus in the next two years as President of CESA will therefore be procurement and business integrity. If we get these two elements right in our industry then various things, including service delivery, job creation, poverty alleviation, economic growth, sustainability and capacity building will all fall into place.”

Naren Bhojaram is a Professional Civil Engineer, having obtained a BSc Engineering degree at the University Of KwaZulu-Natal in 1984. His speciality is water supply, sanitation and municipal service delivery optimisation. After having spent a few years at a local authority, he moved on to SSI Engineers and

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The two top men of CESA - President Naren Bhojaram (left) and Deputy President Abe Théla
DR CORNELIUS RUITERS TO LEAD CSIR BUILT ENVIRONMENT

DR CORNELIUS RUITERS has been appointed to the leadership team of the Council for Scientific and Industrial Research (CSIR). He joined the organisation as Executive Director: CSIR Built Environment on 1 December 2011.

As both a civil engineer and a scientist, Ruiters brings diverse skills and experience to the CSIR. He held the position of Deputy Director-General: National Water Resources Infrastructure at the Department of Water Affairs (DWA) before joining the CSIR. He took over from his predecessor, Hans Ittmann, who retired from the CSIR at the end of November.

Ruiters holds an MEng degree in civil engineering: water and environmental engineering from the University of the Witwatersrand, and a PhD in natural sciences from the University of the Western Cape and the San Diego State University, USA, where he was an adjunct professor. He furthermore holds an MBA from the University of South Africa.

His career has spanned several sectors, including academia, the private and public sectors, and he has engaged with top stakeholders on mega-projects. At the DWA, Ruiters managed a budget of over R7 billion, and his portfolio of projects before joining the CSIR was worth about R30 billion. He is a member of the International Water Association, the Water Institute of Southern Africa, and a registered natural scientist with the South African Council for Natural Scientific Professions.

Ruiters has extensive experience in water resources infrastructure and has achieved considerable success in the environmental, built environment and engineering sectors.
FORMER CITY Engineer of Cape Town, Johannes Gerhardus (Jan) Brand, has passed away in Sydney.

He was born in Mossel Bay on the Ides of March (15 March) in 1925. Educated at the dual-medium (English and Afrikaans) Point High School in the town, he obtained a first class Senior Certificate, and won a scholarship to study at the University of Cape Town, graduating with a BSc (civil engineering) in 1946. After short spells with the contractor Christiani and Nielsen, and the Cape Provincial Roads Department, he was appointed Assistant Town Engineer of Parow Municipality. At Parow he designed the town's first stormwater and sewerage systems, and was in charge of the construction of the latter system. In his privately published autobiography he states that he pioneered, at least in South Africa, the design of round precast concrete manholes, with cast iron frames, and persuaded local firms to manufacture these.

In 1954, newly married to Yvonne Pelteret (the daughter of a building contractor and hotelier in Worcester), he moved to Welkom for further municipal experience as Assistant Town Engineer. Among other duties, he was in charge of the construction of a large part of Thabong. In 1956, at the very young age of 31, he was appointed City Engineer of Windhoek.

During his tenure there, Jan initiated research in partnership with the CSIR into the direct recycling of treated sewage effluent for potable reuse. The Windhoek Reclamation Works, commissioned in 1968, was the first plant in the world to recycle directly to consumers, effluent that had been treated to potable water standards.

He won a Commonwealth Scholarship for postgraduate studies which he utilised to study for the MSc (Eng) degree
in highway and traffic engineering at Birmingham University, distinguishing himself by topping the 1961 class.

In 1965 he joined the City of Cape Town as Senior Assistant City Engineer (Planning). Six years later he was promoted to Deputy City Engineer. In 1975, when Dr Solly Morris retired, he was appointed City Engineer.

In the finest tradition of the traditional ‘strong’ City Engineer, he saw his role as one of leading the municipality’s service delivery. His view of that responsibility involved, at times, not necessarily waiting for Council to take strategic decisions, but to take the initiative himself to present a proposal to government or to Council (and to actively lobby for it), and to get Council to retrospectively approve his initiative. Often this required him asking councillors and fellow departmental heads to trust him to an unprecedented degree – which became easier as time went by and they realised that he would keep his word and, indeed, deliver services.

A very good example of this was the initiative that he conceived and drove during the second half of the 1970s, transforming Council’s housing programme. His foresight and leadership is illustrated by his boldness in making an initial direct approach to the Director-General of the national government department then responsible for housing funding – without Council’s authorisation or even knowledge, and indeed some months before he had even been appointed City Engineer!

In those days, the City Engineer’s Department was responsible not only for all infrastructure and engineering functions, but also for, among other things, city planning, city architecture and new housing construction. Jan’s remarkable eleven years as City Engineer are remembered particularly for Mitchells Plain and its radical departure from the type of housing development that the City had sponsored previously. For the first time in the history of mass housing schemes in South Africa, houses were built together with the full package of amenities, including schools, libraries, parks, civic halls, clinics, sports facilities and public transport. Also built were a town centre and suburban shops, the then largest tidal pool in the southern hemisphere, and a wastewater treatment works. Houses of various types were built to improved standards, and offered for sale.

But it was the scale and pace of this development that was most remarkable. More than 25 000 houses – together with the amenities – were built over the course of five years. Delivery of homes peaked at the tempo of one every 12 minutes of a working day. Tenders called for were generally for a fixed price, inclusive of everything from reshaping the sites to selling the completed houses.

Other particular achievements of his tenure include:
- construction of the Cape Town Civic Centre (now the Metro Centre) – completed in 1979
- construction of the Good Hope Centre exhibition hall
- completion of the Golden Acre commercial development, the shopping mall underneath the intersection of Adderley and Strand Streets, and the extension of Strand Street to link up with the Eastern Boulevard
- expansion of Cape Town’s sewerage facilities, including construction of the Cape Flats wastewater treatment works (final commissioning in 1981) and Mitchells Plain wastewater treatment works, and the Camps Bay and Green Point marine outfall sewers
- construction of the pipeline from Theewaterskloof Dam and the water...
treatment works at Blackheath – completed in 1981
■ completion of the Kromboom Parkway (M5)
■ construction of regional beach amenities along the False Bay coastline, at Muizenberg, Strandfontein and Mnandi
■ commissioning of the then most advanced local authority computer-aided design system and engineering and scientific computer network in South Africa, and
■ launching the ‘Greening the City’ initiative.
In 1982 Jan tabled a comprehensive and forward-thinking report recommending the creation of a metropolitan services authority. He motivated that this should have responsibility for those specific services that could be delivered more efficiently and effectively at metropolitan level than by the existing separate municipalities. The latter, he recommended, should retain responsibility for all other services. This report was not adopted by Council, but many of its recommendations were taken up in the regional services councils subsequently formed in all the metropolitan areas of South Africa.

Not the least controversial aspect of his report was a recommendation that people of all races should be brought onto the voters roll of the new authority.

Foremost among the many awards that the City Engineer’s Department and Council won during his tenure was the SAICE award for the ‘Most Outstanding Civil Engineering Achievement of 1979’, awarded to the Mitchells Plain project.

Jan was active in a number of professional institutions, in particular the Institute of Municipal Engineering of Southern Africa (IMESA), serving as President in 1965/1966.

He was both a Professional Engineer and a Chartered Engineer (UK), as well as a Fellow of SAICE, the Institute of Traffic Engineers, and the Institution of Highway and Transport, and a corporate member of the American Society of Civil Engineers (elected Life Member in 1990) and the Institution of Municipal Engineers (UK).

In 1985, in recognition firstly of his contribution to urban engineering and to improving the quality of life of many South African citizens, and secondly of his role in strengthening the economic and technological links between France and South Africa, the French government made him an Officer of France’s National Order of Merit (Officier de l’Ordre national du Merite). Three years later he received the South African government’s Order for Meritorious Service (Silver), the first time this award had been given to a municipal councillor or official.

In 1986, Jan retired from his position as City Engineer, but continued to make important contributions to engineering and planning. In the ensuing years he served on, among other bodies, the City of Cape Town’s Municipal Services Commission; the Housing Development Board of the House of Delegates (eventually serving as its chairman); the Western Cape Demarcation Board (also serving as its chairman); the Building Industries Advisory Council; Agrément Board; and the Louw commission of enquiry into delivery of low-cost housing. He was also a non-executive director of two civil engineering companies. In 1996, by then 70 years old, he had retired from the last of these roles.

In his spare time from work and family responsibilities, Jan’s hobbies were photography (in Windhoek he would develop and print his photographs) and carpentry – from intricate cabinets through to wall units and dining tables. In Windhoek he chaired the local Lions Club.

In 2005, Jan and Yvonne – neither of them in the best of health – moved to Sydney, Australia, to join their children, all of whom had relocated there earlier.

He is survived by his wife, Yvonne, daughters Anne, Jenny and Clair, and six grandchildren.

Inevitably someone as strong and direct as this rubbed some people up the wrong way. But there is no doubt that, through strong leadership and his 100% support of his staff, he got things done.

Jan had an ability to identify talented individuals, and he would then advance their careers within the city. He also attracted to municipal service people who would not otherwise have considered this career path. An outstanding example of the latter was David Jack, an architect and planner who was in 1974 persuaded by Jan to leave Anglo-American. Many years later, David was appointed by Transnet as the first managing director of the Victoria and Alfred Waterfront Company. The splendid Waterfront in Cape Town owes much to qualities that had much earlier been recognised by Jan, namely David’s creative vision, sense of the practical, and programme management skill.

Jan’s professional colleagues will long remember him not only for his outstanding professionalism, and his legacy of soundly designed and built infrastructure, but also for his view of the responsibility of a City Engineer. To quote from his autobiography:

“The City Engineer was, I believe, the very best post that any person could have wished for.”

Kevin Wall and Anne Brand
kwall@csir.co.za

With thanks to Jan’s former colleagues David Bradley, Arthur Clayton and Mike Marsden, and to Johannes Haarhoff. (Photographs courtesy of the Brand family)
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THE CURRENT process of registration with the Engineering Council of South Africa (ECSA) was implemented in January 1998. The ECSA "Discipline-Specific Guidelines for Civil Engineering” of February 2003, Clause 6.5, indicates that two essays will have to be written by candidates:

1. The first essay will be on one of two technical subjects set by the reviewers in the context of the training report and the interview.

2. The second essay will be on one of two topics selected by the interviewers from a list published in advance by SAICE.

Guidance notes for the assessment of essays are set out in the Guidelines for Professional Registration of Civil Engineers, available from the Institution.

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

1. Discuss the most significant influences, attitudes and strategic issues relevant to the total project cycle.

2. In projects for developing countries emphasis is often placed on the need for transfer of technology. How can this best be achieved in practice?

3. Discuss the importance of environmental regulations on the design, documentation and construction of civil engineering projects. Use your own experience to illustrate your argument.

4. Although failures may be a disaster for the individuals concerned, many have led to advances in theory, design and construction methods. Discuss how failures should be dealt with so as to ensure the maximum benefit to society and the engineering community.

5. Discuss the opportunities and threats inherent in industrial and infrastructure projects which impact on local communities and the role civil engineers can play in delivering value to society through their involvement in such projects. Use your own experience where appropriate.

6. Discuss the difference between 'Quality Control ’ and 'Quality Assurance'. Discuss the requirements for quality management by clients, designers and contractors, and their respective contributions to the success of a project.

7. Describe how you have implemented health and safety legislation on the projects you have worked on, and detail what opportunities you think there are for improving health and safety performance.

8. Discuss the principle of whole life asset management with specific respect to municipal infrastructure, using a single service to illustrate your argument.

9. Risk is inherent in most civil engineering work. Discuss the ways in which such risks can affect the employer and the contractor, and how they can influence the form of contract and the contract price.

10. "The estimation of costs of schemes and their budgetary control is one of the key functions of the engineer.” Discuss how engineers should be trained to fulfil this function in design and construction.

11. Identify the areas in which disagreement between a Resident Engineer's staff and the Contractor's staff may develop. How can good relations be achieved between these parties? Illustrate where possible from your own experience.

12. Describe the authority of the Engineer to delegate decisions to the Engineer’s Representative under the General Conditions of Contract (GCC) for construction works (the 2004 and 2010 versions have reference). In what circumstances could an Engineer vary the level of delegation during the construction period?

13. Discuss how the application of ethics in civil engineering projects or contracts should be regulated in order to ensure that the negative impact of corruption and similar practices are eliminated or at least minimised.

14. Discuss the role that the civil engineering profession has to play with respect to poverty alleviation.

15. Discuss the impact the National Environmental Management Act and its regulations have on the planning, design and construction of a civil engineering project.

16. What can civil engineers do to raise the profile of maintenance of capital infrastructure?

17. Why should a Registered Professional Engineer not undertake work of a nature for which their education, training and experience have not rendered them competent to perform? What in your view ought to be the punishment for contravening this competency prescription in the Code of Conduct?
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