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Code of Ethics for SAICE Members

ETHICAL VALUES

Members must:
- discharge their professional responsibilities with integrity and not undertake work in areas in which they are not competent to perform;
- protect life and the environment and safeguard people;
- manage the Earth’s resources in a sustainable manner by minimising the adverse environmental impacts of their civil engineering works and technologies for both present and future generations;
- where possible, promote socio-economic development through their engineering works or application of technology that leads to a higher quality of life for the current generation, without compromising future generations;
- endeavor to deliver cost-effective solutions in a manner consistent with safety and other aspects of public interest;
- actively contribute to the well-being of society and, when involved in any civil engineering project or application of technology, where appropriate, recognise the need to identify, inform and consult affected parties;
- not agree to or comply with any instructions requiring dishonest action or the disregard of established norms of safety or levels of risk in design and construction;
- continue the development of their own and the profession’s knowledge, skill and expertise in the art and science of civil engineering and technology, and share and exchange advances for the benefit of society;
- understand and comply with the laws of the communities within which they practise and with international law; and
- continuously seek to promote and support the concept of creating value to society as a whole.

GUIDELINES

Members should:
- act with integrity and fairness;
- have regard for the public interest and for the interests of all those affected by their professional activities;
- maintain and broaden their competence, and assist others to do so;
- exercise appropriate skill and judgement;
- avoid conflict of interests;
- adopt a balanced, disciplined and comprehensive approach to problem solving;
- apply skill, judgement and initiative to contribute positively to the well-being of society;
- ensure that systematic reviews are undertaken of all aspects of a project that impact upon the environment, including the justification for the need of the project and economic, social and political factors in order to minimise any adverse effects;
- treat people with dignity and have consideration for the values and cultural sensitivities of all groups within the community who could be affected by their work;
- endeavour to be fully informed about relevant public bodies, community needs and perceptions, which may affect their work;
- not allow the serving of a client’s or community’s needs to take precedence over the needs of the wider society;
- take reasonable steps to minimise the risk of the loss of life, injury or suffering which may result from their work or the effects of their work, and to point out the level and significance of risk associated with their work to those affected;
- ensure, where engineering decisions, recommendations or opinions are ignored or rejected, that those affected are made aware of the possible consequences;
- accept personal responsibility for work done by or under their supervision or direction, and take reasonable steps to ensure that anyone working under their authority is both competent to carry out the assigned tasks and likewise accepts personal responsibility;
- not misrepresent their areas or levels of experience and responsibility;
- be committed to the efficient use of resources;
- minimise the generation of waste, and encourage environmentally sound re-use, recycling and disposal;
- seek and encourage excellence in their own and others’ practice of the art and science of civil engineering and technology;
- contribute to the collective wisdom of the profession and the art of civil engineering and technology in which they practise;
- seek solutions that are compatible with the principles of sustainable development, particularly those that relate to social development and poverty relief;
- take reasonable care to ensure the quality, safety and sustainability of the work entrusted to them;
- report any situation concerning the safety of the public or the degradation of the environment, that they become aware of and that is considered to be an unreasonable risk, to the appropriate organisation or authority;
- expose unprofessional or dishonest conduct through the appropriate channels; and
- reject any principle, proposal, action or thing which may prejudice independent and impartial judgement.

This is an abridged version; for the full Code of Ethics please visit SAICE’s website.
ON THE COVER

AVENG Ground Engineering was tasked with installing socketed bridge piles using the instrumented CFA method for a fully integral bridge as part of the N1 rehabilitation at Vanzylspruit River in the Free State. An uncommon bridge piling solution, where quality assurance was paramount, met with the latest technology to successfully complete the project.

CODE OF ETHICS

Code of Ethics for SAICE Members

ON THE COVER

AVENG Ground Engineering – updated CFA technology supports the road to the future.

RAILWAY AND HARBOUR ENGINEERING

Ballast management

Consideration of the elastic strain recovery rates of the formation layers of a railway track

The relationship between coal crushing and track condition on a heavy haul railway line

The construction of the Matola Dolphins: Maputo Harbour, Mozambique

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LEADING CONSTRUCTION COMPANY AVENG
Grinaker-LTA was awarded the contract for the rehabilitation of a 20 km section of the N1 between the Trompsburg Interchange and Fonteintjie in the Free State. The major structure along this route is a fully integral 90 m long five-span bridge over the Vanzylspruit River. AVENG Ground Engineering was responsible for constructing the foundation piles.

The client needed a cost-effective piling solution that could be achieved in the shortest possible time. The pile type opted for was concrete instrumented Continuous Flight Auger (CFA) piles. Even though this piling method is uncommon for bridges in South Africa, AVENG Ground Engineering responded to the challenge, and came out on top.

The project consisted of 70 No piles of 900 mm diameter, all of which had to be socketed into medium-hard rock. A limitation of CFA piling is that, once refusal is encountered, the pile cannot be advanced further. However, with Ground Engineering’s legendary Bauer MG 48 Piling Rig having the ability to drill through hard material with its 26 ton crowd force, this was not a problem. Ground Engineering site manager, Hendri van Zyl, comments: “This was the first project where we were required to construct socketed bridge piles using the CFA method, and our system worked extremely well. Our high production rates gave us the potential to gain time on the project programme, proving that CFA is a noteworthy alternative to SICA and Oscillator piles.”

The establishment of the main contractor’s concrete batch plant on site could not happen in time to be utilised by Ground Engineering. This resulted in concrete being supplied from...
Bloemfontein, approximately 120 km from site. The risks posed by such a long travel distance, especially to the CFA piling method, were mitigated through the implementation of good planning and communication practices.

To ensure a quality product the piling rig uses Bauer’s B-Tronic instrumentation. This allows the site crew to monitor, analyse and control drilling parameters, such as drilling and extraction speed, auger depth, concrete pressure and flow, as well as the number of rotations and the torque utilised. The system sets itself apart from traditional grout CFA piles notorious for questionable quality control. After construction the integrity of the piles were evaluated using the pile echo test method or ‘tap test’. The results indicated that the piles were of the highest quality.

Safety of employees is of utmost importance to AVENG Ground Engineering, and not one LTI (Lost Time Incident) was reported for the duration of the project. This is a big achievement, considering the close proximity of the work area to the busy N1 highway.

With the successful completion of this project, AVENG Ground Engineering has once again proved to be an industry leader in the geotechnical market. By incorporating the latest technology and technical expertise, AVENG Ground Engineering is able to deliver high quality project-specific products.
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Selecting the Right Tamping Machine is Essential for Productivity and Durability

Not all tamping machines are made equal. Plasser & Theurer has invested a great deal of research into creating the world’s highest production tamping machines which are renowned for their reliability, features and quality and durability of the tamped track.

Selecting the right machine supplier is however not the only important decision but further criteria for selecting the right machine is production, its position in the existing fleet whether it should be plain track or universal and if universal is selected, many different features must be considered such as 3rd rail lifting, split units etc.
RAILWAY AND HARBOUR ENGINEERING

INTRODUCTION
If one considers that the ballast bed contains approximately 1 200 to 1 600 m$^3$ of ballast stone per kilometre, there is approximately 42 000 000 m$^3$ of ballast in the South African railway network. At an estimated conservative price of approximately R150/m$^3$, the ballast asset value is in excess of R6 300 million, excluding equipment and labour for transportation, installation and regulating.

Managing this asset effectively could render enormous savings in track life cycle costs. Poor ballast management will not only lead to increased cost of ballast, but due to the knock-on effect of for example fouled ballast, will also lead to formation failure, amongst others, and unaffordable track infrastructure life cycle costs.

REQUIRED BALLAST STONE AND BALLAST BED CHARACTERISTICS

Ballast stone characteristics
Ballast material is specified by the Transnet specification S406. This specification prescribes how new ballast material should be selected and graded according to its shape, size and composition. In short, ballast can be defined according to minimum and maximum stone size – between 19 mm and 63 mm on general freight and passenger lines, and between 26 mm and 75 mm on heavy haul lines. Ballast material smaller than the minimum is referred to as ‘fines’ or ‘fine material’, and can be expressed as a percentage fouling being the percentage of fine material in the ballast bed. Fines can therefore not be recycled as part of a ballast screening process, but need to be removed from the ballast bed and disposed of.

Good ballast stone is also defined as angular, i.e. it should have as many sides as possible. This ensures that individual ballast stones can interlock and remain in that stable position. It therefore follows that rounded and flat (flaky) stones will not comply with the specification.

Ballast bed geometric profile
To fulfil its function the ballast bed must conform to a minimum geometric specification as illustrated by Figure 1. The ballast shoulder and the ballast in the cribs provide the track’s resistance to lateral and longitudinal...
Figure 1: Required ballast bed profile

Figure 2: Vertical alignment defect

Figure 3: Horizontal alignment defect on fouled ballast bed

Figure 4: 20% Fouling

Figure 5: 120% Fouling

Figure 6: A level formation visible behind the cutter bar
displacement, especially on gradients, curves and continuously welded rail. The ballast depth dissipates the loading from trains to acceptable stresses for the underlying formation.

The longitudinal geometry in terms of horizontal and vertical alignment (see Figures 2 and 3) is also related to the ballast bed, as such defects are corrected with ballast tamping which rearranges the ballast stone under the sleeper to create a homogeneously smooth track bed.

Over time the track geometry will deteriorate from the required standard, which is not only a major contributor to accelerated ballast degradation, but may also result in other unwanted and even dangerous consequences. During periodic ballast tamping to correct geometry the track is systematically lifted out of the ballast bed which requires ballast replenishment to ensure that the ballast cribs remain full and the ballast bed shoulders comply with standards.

Systematic maintenance lifting, tamping and ballast replenishment result in accumulation of large ballast volumes over time. Typically, volumes of 2 400 m³ per kilometre must be screened on the heavy haul lines at approximate cycles of 15 to 20 years. The increasing ballast bed volume will eventually cause clearance problems with regard to overhead traction equipment (OHTE), bridges and tunnels. Lowering the track then becomes necessary.

THE RECYCLING OF REUSABLE BALLAST STONE
When the ballast is fouled, it means that the percentage of fine material by mass of a representative ballast sample is reaching the outer envelope limit, as depicted by specification S406. Figures 4 and 5 illustrate the difference.

This increased percentage of fine material within the ballast bed stems mostly from the degradation and abrasion of ballast stones within the ballast bed due to various reasons, such as high dynamic loads from passing trains caused by (a) poor rolling stock wheel condition such as flat spots, and (b) poor rail running conditions.

Systematic maintenance lifting, tamping and ballast replenishment result in accumulation of large ballast volumes over time. Typically, volumes of 2 400 m³ per kilometre must be screened on the heavy haul lines at approximate cycles of 15 to 20 years. The increasing ballast bed volume will eventually cause clearance problems with regard to overhead traction equipment (OHTE), bridges and tunnels. Lowering the track then becomes necessary.

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surface condition such as wheel spin marks, etc. Other fine material can also be washed in during heavy rains, blown into the ballast bed by wind, or dropped from wagons (such as coal dust). Furthermore, if the bed formation becomes fatigued, interpenetration of formation material can also occur.

The fine material in the ballast makes the ballast bed very hard (non-resilient), resulting in damage to other track components, and also retains moisture, eventually resulting in formation failure. It becomes difficult to correct and maintain geometry, because tamping tines are not able to penetrate and tamp the ballast effectively.

To ensure that the ballast bed performs to requirements, the ballast must be screened to remove fine material before it loses its functionality and causes consequential damage to the rest of the track components. Ballast screening is normally carried out with ballast cleaning machines. If the track must be lowered at the same time, it is essential to use a ballast cleaning machine that is equipped to lower the track as part of the process.

The ballast cleaning machine consists of a cutterbar underneath the track which guides an endless excavating chain that loosens the encrusted ballast and transports it to the screen box. The cutting depth and cross fall of the formation is electronically controlled and reinstated (see Figure 6).

The vibrating screen box is fitted with screens of different mesh sizes. The screens will separate the fine material from the reusable ballast stones. The fine material screened out usually comprises about 30% of the ballast bed.

The reusable ballast, i.e. ballast stone larger than the minimum, is returned to the track (and is therefore being recycled). Additional ballast may be required to replace the fine material that has been removed to ensure that the required ballast volume is reinstated. Where the track has to be lowered due to excessive ballast, additional ballast is often not required.

The fine material that was separated from the reusable ballast during the screening process is unwanted material with no further use, i.e. waste as defined by the National Environmental Management Waste Act of 2010, and must be treated as such.

In the past screened ballast fouling material was deposited next to the track and is still visible all along railway lines in South Africa today (Figure 7). If one considers that mechanised ballast cleaning started in South Africa in 1980 with nine ballast cleaning machines (currently four ballast cleaning machines), with each machine screening approximately 120 km of track per annum and spoiling approximately 500 m³ of contaminated material per kilometre screened, there are millions
of cubic metres of contaminated material along the South African rail network. Continuing this practice without a management plan would be in contravention of the Act.

As depicted in Figure 8, contamination is not the only problem when discharging spoilt material alongside the track. In scenario 1 where the track is on a high bank, the spoil will lie on the side of the bank and the weight of the spoil material can actually cause the bank to slip. The same applies to cuttings in scenario 2, but here the slippage or flow of the waste material can flow into the drains, creating drainage problems. On multiple lines, there is no place to spoil the material. Past practice to spoil alongside the outside tracks have also created major drainage problems.

In 2001 Transnet Freight Rail (TFR) implemented conveying systems which are integrated with the ballast cleaning machine for the efficient removal of spoiled waste material to environmentally prepared spoil sites. The system had to match the spoil production rate of the...
highest production ballast cleaning machine without ever prematurely stopping the ballast cleaning process. Spoiling to the side is, however, still being done today due to a shortage of MFS ballast wagons (Figure 9). [MFS is a German abbreviation for ‘Materialförder- und Siloeinheit’ which translates into ‘material/mineral conveyor and storage unit’.]

The MFS is an open, high-sided hopper wagon with a storage capacity of up to 38 m³ and a floor-mounted main conveyor belt which covers the entire width of the hopper. The rotation speed of the conveyor belt can be controlled (Figures 10 and 11).

In addition, each hopper wagon is equipped with a slewing transfer conveyor belt at the one end, which operates independently from the floor conveyor belt to either transfer its load forward, or discharge its load to the side (Figure 12).

Proposal for the removal of ballast currently lying alongside the track

As had been mentioned earlier, there may be millions of tons of ballast waste lying alongside railway tracks in South Africa. It has been mentioned by TFR that huge volumes of coal and other material are also lying next to old derailment sites.

These sites may be inaccessible to heavy trucks, and the large number of truck movements that would be required to remove the material lying next to the track would cause irreparable damage to the environment. Figure 13 says it all. Up to fifty tipper truck loads per kilometre may be required to remove the waste. The damage to the environment would be unimaginable.

The versatility of the MFS wagons may provide an environmentally friendly solution to removing this material. If MFS wagons are used to remove this material, the only vehicles required would be a tractor loader and the loading station. The material can be loaded into the MFS wagons and it can be transported to prepared disposal sites. One MFS wagon could carry away the material for which four large tipper trucks would be required. The impact on the environment would therefore be minimal (Figure 14).

DEGRADING OF THE BALLAST BED PROFILE

Ballast spread over a wide area is a loss unless such material can be recovered. This may have been caused by people or animals walking across the track, or just as a result of ballast flow over time due to various causes. New ballast must either be offloaded, which would be a waste, or better still, a ballast regulating machine could be applied to recover unused ballast and reinstate the ballast cross-sectional profile.

Ballast regulating machines are available in various models, from the small unit in Figure 15 to very large high-production machines which may even incorporate MFS wagons to pick up, transport and offload very large volumes of ballast (Figure 16). Regulating machines may be equipped with a combination of working units, such as shoulder ploughs, a transfer plough, a nose plough, a broom box or sweeper unit, a ballast hopper, ballast distribution chutes to return some of the picked up ballast to the track where required, and rail-fastening brushes.

Depending on the machine model, regulating machines are used to box in ballast that is spread over a wide area to correct the ballast bed profile, to transfer ballast to the centre of the track or from left to right or vice versa, or by using the hopper to transfer the ballast to areas of deficit which may be over a short distance or even several kilometres away.

Not only will periodic maintenance regulating protect the track skeleton against longitudinal and lateral displacement, but recovered ballast that would have otherwise been lost could be recycled back into the system, bringing about big savings in ballast material.

Figure 13: Removing the waste next to the railway line may cause severe damage to the environment
Ballast regulating machines are also an essential part of the ballast cleaning package, working as a production-balanced, integrated unit together with the ballast cleaning machine, the MFS material conveyor systems, ballast tamping machine and stabilising machine.

EXTENDING THE LIFE OF THE BALLAST

Ultimately the best form of ballast management is to extend its life for as long as possible. The factors not related to the stone itself that influence the rate of degradation of ballast are the load that is applied to it and the amount of movement within the ballast bed.

The ballast is more than capable of sustaining the normal load from passing trains if the track is maintained to high standards. Any external forces on the track that will deteriorate the geometry or damage the track components must be controlled to prevent unnecessarily high tamping cycles.

To maintain the geometry means regular maintenance tamping to keep the vertical and horizontal alignment within standards. However, the tamping process also contributes to ballast breaking. This can be limited by using durable tamping machines that produce optimum quality work.

Also, after tamping the ballast bed loses its consolidated state, which means that there is more room for movement in the ballast bed until it is consolidated again by passing traffic. The less stable the ballast bed is, the higher the movement of the ballast stones within the ballast bed will be due to vibration. To address this, TFR contracted dynamic ballast stabilising machines to be integrated with ballast tamping.

The dynamic stabilising machine sets the track in horizontal oscillation directed crosswise/laterally to the track, while at the same time applying a static vertical load. The fluidisation induced by the vibration, together with the static vertical load, causes the ballast stones to settle closer together in a more homogeneous and compact grouping in the entire ballast bed, thereby increasing the durability of the geometry by approximately 30%, and subsequently increasing the required tamping cycle by the same.

REFERENCES


Transnet Freight Rail Manual for Track Maintenance (Annexure 4).

Transnet Freight Rail S406 Specification for the Supply of Stone Contents.
WHY TMT?

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Consideration of the elastic strain recovery rates of the formation layers of a railway track

BACKGROUND
Maintenance makes up a significant portion of the total life cycle costs of a railway track. The condition of the formation layers of a railway track dictates these maintenance costs to a large extent. The purpose of this study (a final-year BEng research project) was to aid the progression towards more cost-effective railway infrastructure by understanding the strain recovery process of the formation layers.

OBJECTIVE
It was surmised that the elastic strain recovery rate of the formation layers would change as ageing of the formation occurred in relation to cumulative loading over its lifetime. Thus, deformation data from different time periods had to be analysed to compare the formation recovery characteristics. For the purpose of this study, the strain recovery after the last wagon/locomotive had moved over the site was considered.

PROJECT DESCRIPTION
In order to analyse recovery of the formation, Multi-Depth Deflectometers (MDDs) were used. The MDDs were installed in 2004 by Transnet Freight Rail (TFR) at the Amandelbult test site near Northam in Limpopo Province. The test site is located at a Tubular Modular Track (TMT) section, as shown in Figure 1.

TFR conducted MDD tests at this site in 2004 after installation. In 2014 further tests were conducted as part of the study described here.

The railway line at the Amandelbult test site was built on a layer of black turf/clay. During the analysis of the elastic strain recovery this layer proved to be of particular interest, as it displayed the slowest recovery in both the 2004 and 2014 deformation measurements.

The layer works at the Amandelbult test site are shown in Figure 2 at each installation of MDDs. Stations 1, 2 and 3 are located on the TMT and are where the tests were conducted. Figure 3 shows the MDD connectors connected to the logging equipment on site.

PROBLEMS ENCOUNTERED
The biggest problem was the lack of continual data between 2004 and 2014. A trend could therefore not be established relating
The magnitude of the peak deformation for a respective formation layer was larger in 2004 than in 2014 for all the layers under consideration (crusher run, rockfill and clay), despite similar loading. This could be due to strain hardening of the formation. Furthermore, the percentage of elastic strain recovered after 18 seconds had on average reduced from 2004 to 2014 in the clay layer. This phenomenon could be ascribed to the change in elasticity of the clay, possibly due to fatigue and long-term changes in the stiffness and elasticity of the material.
to total cumulative loading and elastic strain recovery. With the data from only 2004 and 2014 available, the validity of the conclusions would have to be assessed by performing tests at other sites as well, or by establishing a long-term formation-deformation measurement project. Furthermore, in 2014 some of the MDDs were no longer working. Thus, certain layers at certain stations could not be analysed.

The TFR 2004 recorded data represented only the first 18 seconds after the last axle load had moved over the site. For realistic comparison, the 2014 analysis was therefore limited to data captured between t = 0 s and t = 18 s after the last axle load application.

CONCLUSIONS

The conclusions reached with regard to the elastic strain recovery of the formation are summarised as follows:

- The magnitude of the peak deformation for a respective formation layer was larger in 2004 than in 2014 for all the layers under consideration (crusher run, rockfill and clay), despite similar loading. This could be due to strain hardening of the formation. A typical strain recovery comparison graph is shown in Figure 4.

- The percentage of elastic strain recovered after 18 seconds had on average reduced from 2004 to 2014 in the clay layer (see Figure 5). This phenomenon could be ascribed to the change in elasticity of the clay, possibly due to fatigue and long-term changes in the stiffness and elasticity of the material.

RECOMMENDATIONS

Future research of a similar nature is encouraged. The following recommendations with regard to future research may prove beneficial:

- The formation layers at other railway test sites should be examined to determine if the trends displayed at the Amandelbult test site are displayed elsewhere, too.

- Data should be recorded on a regular basis at approximately 1–6 month intervals, such that a trend in the ageing of the formation layers may be identified.

- Data should be recorded for an extended period of time once the train has passed the test station in order to determine the elastic strain recovery characteristics for an extended period longer than 18 seconds. This data may serve to limit the time spacing between successive trains to allow proper recovery of the formation layers, such that the formation layers have a longer lifespan before maintenance is required.

- The differences between the elastic strain recovery rates of the formation layers of conventional track versus Tubular Modular Track may be investigated for the same formation design. This may provide a basis for selection criteria of one track system over another.

- The strain recovery rate may be analysed to determine if a relationship exists between the change in elastic strain recovery rate over time and the permanent deformation of the specific formation layer.

ACKNOWLEDGEMENT

Transnet Freight Rail (which kindly sponsors the Chair in Railway Engineering at the University of Pretoria) is gratefully acknowledged for giving access to the Amandelbult site, and for providing the necessary safety and security on site.
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The relationship between coal crushing and track condition on a heavy haul railway line

INTRODUCTION

South Africa is currently the seventh largest coal-producing country in the world, and annually roughly 70 million tons of coal (for export) are transported across the country by means of heavy haul train operations. Coal is used worldwide in a number of different applications, and each application demands a coal sample with very specific chemical, geological and physical properties. Chemical and geological properties of coal have been studied intensively over the last few decades, with physical properties – although important – rarely being included in these studies.

One of the important physical properties that determine the behaviour of a coal sample during the combustion process is the coal particle size. The physical size of coal particles within a specific sample will significantly influence the way in which the sample combusts, and burning profiles can change rapidly with only a slight change in coal particle size. Research has shown that a decrease in coal particle size will lower the burnout temperature of a sample, while producing more residue in the process. Not only does the burnout temperature of the sample decrease, but in some instances the peak temperature may also decrease when samples are crushed to a fine powder.

Since heavy haul train transportation remains the only viable option for transporting large quantities of coal, it is important to ensure that the physical coal quality is not affected during transportation cycles. It has been suggested that the geometry of the railway track could influence the physical properties and quality of the coal being transported, specifically the size of the coal particles. As a train progresses over certain sections of track, the train wagons and the coal inside the wagons experience intense...
vibration and acceleration forces due to imperfections in the track, as well as uneven vertical track profile. The intensity of the vibrations experienced on a certain section of track is dependent on the roughness of that specific section, and more coal particle breakdown can occur when a section of track has a high roughness value.

**AIMS AND OBJECTIVES**

The objectives of the study were as follows:
- To determine if coal crushing occurs inside train wagons during transportation cycles.
- If coal crushing does occur, to determine if a linear relationship exists between particle breakdown and applied acceleration forces.
- If coal crushing does occur, to determine which particle sizes experience the highest degree of degradation or crushing effects.

**EXPERIMENTAL PROCEDURE**

Two simple experiments were devised to study the relationship between vertical vehicle acceleration (instability) and the amount of coal particle breakdown achieved. The first experiment was carried out in the field, where an in-service Transnet Freight Rail (TFR) coal train was instrumented with accelerometers when travelling between Ermelo and Vryheid (roughly 210 km) so that the forces experienced by a typical CCR11 coal wagon could be recorded. A total of eight accelerometers were installed on four wagons, i.e. two devices per wagon. The devices were installed on small horizontal platforms on the back of Wagons 1 and 103, as well as on the front of Wagons 2 and 104. The wagons to be instrumented were not selected at random, but set up in order to measure acceleration at the front and in the middle of the train. Figures 1 and 2 show the setup used to measure acceleration on the train, as well as the placement of the instrumentation.
Once these acceleration forces had been recorded, the extreme values, as well as continuous acceleration frequencies (bandwidths), were identified and used in the second experiment. Here similar magnitude forces to those measured on the train were applied to coal samples in a controlled environment at the University of Pretoria’s Civil Engineering laboratory. Steel moulds accelerated on a vibration table were used in order to simulate the effect of applied acceleration on coal wagons due to high track roughness. Each mould contained either fine (<2 mm particles), intermediately-sized (particles 2 mm – 13.5 mm) or coarse-sized coal samples (particles > 13.5 mm), which were taken from a representative coal sample collected at the Ermelo train marshalling yard. Three tests were conducted in the laboratory, during which all three particle size categories were accelerated simultaneously, but separately, each test at a different frequency, namely 60 Hz, 40 Hz and 20 Hz respectively. A standard sieve analysis was conducted on each sample before and after the vibration test to monitor the change in particle size. These three tests each simulated a constant acceleration force of 2.1 g, 3.3 g and 7.8 g respectively. The laboratory setup and steel moulds containing different particle sizes are shown in Figure 3.

**DISCUSSION OF RESULTS**

The results obtained from the field experiment showed that the track section between Ermelo and Vryheid railway stations is maintained fairly well, since only isolated acceleration spikes were recorded at specific track locations. Although acceleration forces were recorded in three different directions – lateral, longitudinal and vertical – only the vertical accelerations were analysed. Data analysis becomes tedious when recording acceleration at 400 Hz for a long period of time, and it was found that the vertical acceleration component induces the breakdown effect of the particles, with lateral and longitudinal acceleration having little effect. Figure 4 shows the vertical acceleration component recorded by Accelerometer 5 on Wagon 103.

A statistical analysis of the data showed that 60% of the acceleration forces experienced by the coal wagons was within the range of 1 g – 1.2 g, with 30% of the forces in the range of 1.2 g – 1.4 g. Only 10% of the track distance produced vertical acceleration of wagons in excess of 1.4 g. It should be noted that
vehicle acceleration measurements are dependent on vehicle characteristics such as suspension, vehicle speed, wheel condition and vehicle mass.

The sieve analysis provided interesting results: At higher levels of acceleration, all particle size categories showed significant levels of particle breakdown. It proved a difficult task to accelerate the coal samples at the precise level of acceleration recorded on the train, hence fixed frequency levels were selected and the samples were accelerated at 2.1 g, 3.3 g and 8 g respectively. Figure 5 shows the change in the percentage of intermediate-sized material passing specified sieve sizes after the vibration test had been completed. In this specific particle size category, particles 9.5 mm in diameter were crushed to sizes of between 6.7 mm and 4.75 mm. Smaller particles of roughly 2 mm were broken down to sizes smaller than 1.7 mm and ended up in the fine particle size category. The compiled results for all particle size categories subjected to various acceleration forces are shown in Figure 6.

CONCLUSIONS
In conclusion, the following statements can be made in accordance with the aims and objectives set out earlier:

- Based on the research conducted, it was proved that a definite degree of coal crushing occurs inside wagons during transportation. The degree of coal crushing was determined as 0.5% – 3.8%, depending on the applied acceleration. The duration of the applied acceleration forces, as well as the magnitude of these forces, has an effect on the amount of coal crushing which occurs inside the wagons.
- A nonlinear relationship exists between coal crushing and track condition. Results from laboratory experiments show that there is a decrease in the amount of coal crushing at intermediate levels of particle acceleration compared to lower levels of particle acceleration. This is followed by a sharp increase in particle breakdown beyond this point.
- The fine material in a coal sample will achieve the largest degree of particle breakdown at high to mid-range frequencies. The intermediate-sized particles will also experience significant crushing effects, but these effects are not as severe as for the fine material. The coarse particles in a sample may or may not experience particle breakdown, depending on the shape and size of the particle, as well as on the applied acceleration level.

ACKNOWLEDGEMENT
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Based on the research conducted, it was proved that a definite degree of coal crushing occurs inside wagons during transportation.
BRIEF DESCRIPTION OF THE PORT OF MAPUTO

The Port of Maputo, situated in Maputo Bay in Mozambique, comprises two sections:

■ The Gorjão Quay, designated by Maputo Cargo Terminals – this quay, which has 13 berths, is adjacent to the city and has an extension of 3.3 km.
■ The Matola Section, designated by Maputo Bulk Terminals – this quay is situated upstream of the estuary where three rivers join (the Tembe, Umbelúzi and Matola Rivers).

The Matola Section of the harbour started in the 1930s with the construction of the Língamo Oil Terminal and today comprises, going from upstream to downstream, the Cereal Terminal, the Mozal Jetty, the old Língamo Oil Terminal (unused today), the dolphin berthing posts which include the present Oil Terminal, the Coal Terminal and two berthing dolphins (which were never used) placed downstream from the Coal Terminal. The Língamo Oil Terminal was deactivated after the construction of the present Coal Terminal, which had initially been built for the export of iron ore from Swaziland, but was changed to a coal terminal after the Swaziland iron ore mine became extinct.

Before the construction of the present Coal Terminal, the Matola Section was

The Língamo Oil Terminal was deactivated after the construction of the present Coal Terminal, which had initially been built for the export of iron ore from Swaziland, but was changed to a coal terminal after the Swaziland iron ore mine became extinct.
used by oil tankers, and by vessels carrying mainly timber. After the construction of the Iron Ore/Coal Terminal the oil tankers used the new quay. The timber carriers dropped anchor in the estuary, and the timber was offloaded to barges that were towed to the wall built in the meantime between the Língamo Oil Jetty and the new Iron Ore/Coal Terminal, with an extension of about 850 m. The barges berthed at the wall, where they were offloaded to timber warehouses from where the timber was exported by rail to neighbouring countries.

This area of the port is narrow and shallow, which limited access to ships not longer than 200 m in order to allow safe manoeuvrability. From time to time the Matola section is subjected to violent storms, which, when coinciding with strong low-tide currents, presented a danger to the timber vessels anchored in the estuary. Also, the increase in the size of the ships accessing this area, led the Mozambique Railways and Harbours (CFM) to improve shipping safety conditions, particularly for the timber carriers, hence the decision to construct three dolphin berthing posts, placed between the old Língamo Oil Jetty and the present Coal Terminal, in front of the barge berthing wall. The three berthing posts would comprise six berthing dolphins and three mooring dolphins, with one of the berthing dolphins converted and strengthened from an existing mooring dolphin.

Since then two new terminals have been built upstream of the dolphin berthing posts, namely the Cereal Terminal Jetty, which is upstream of the new Mozal Aluminium Terminal. The old Oil Terminal, situated between the Cereal Terminal and the Mozal Jetty, is now derelict.

THE MATOLA DOLPHIN BERTHING POSTS

The berthing dolphins are disposed along a straight line, which became the berthing line, at regular spacing. The berthing line is defined by the downstream corner of the old Oil Terminal and the upstream corner of the Coal Terminal quay, on the water side, and the three mooring dolphins are disposed also along a straight line, parallel and about 10 m behind the berthing line. With this option, beside considerations of economy, the barge traffic between the timber carriers and the barge berthing wall was maintained and facilitated by the considerable reduction in the travelling distance between the ship anchored about 500 m away from the barge berth. A new quay was then considered between the old Oil Jetty and the Coal Terminal quay, running over and using the dolphins as berthing and mooring structures.

Beginning from upstream to down-stream, these berthing posts were designated Berthing Posts No 1, No 2 and No 3. Posts No 1 and No 2 would be designed to receive the timber carriers and oil tankers in ballast, and Post No 3, which would be a dedicated oil terminal, would be used by oil tankers and ore carriers in ballast, waiting for a place at the Iron Ore/Coal Terminal quay.

The dolphin berthing posts were planned for ore carriers displacing up to 80 000 tdw (ton dead weight), oil tankers displacing up to 40 000 tdw and timber carriers displacing up to 20 000 tdw.

Posts No 1 and No 2 were designed for ships not longer than 180 m, with a maximum draught of 9.6 m, while Post No 3 was designed for ships not longer than 260 m, with a maximum draught of 11.7 m.

Between the berthing dolphins of Post No 3, a platform for four loading arms to connect to the ship manifold would be constructed, linked to the Iron Ore/Coal Terminal embankment by an access bridge 175 m long, bringing the pipelines from the nearby fuel tank farm and refinery.

Both the bridge and the platform are founded on vertical bored percussion piles. Before the start of dolphin construction, a band 60 m wide between the old oil terminal and the Coal Terminal was dredged to bring the depth at Berthing Posts No 1 and No 2 to -10 m below chart datum, and -12 m below chart datum at Berthing Post No 3. By providing these three berthing posts, the shipping manoeuvring and berthing safety conditions in this area were considerably improved.

The construction contract was extended later with the construction of two extra similar berthing dolphins, placed downstream of the Coal Terminal.

THE DESIGN SPECIFICATION FOR THE MATOLA DOLPHINS

The original design considered for the dolphins would entail the construction of reinforced concrete cylinders, about 9 m in diameter, covered with a mass concrete cap about 1 m thick, where the bollards and quick-release hooks would be installed. The tallest cylinder would be about 17 m high, at Post No 3.

The successful tenderer, however, submitted an alternative design on steel caisson piles, linked by a reinforced concrete cap about 3 m deep where the bollards and quick-release hooks would be installed. The main reason for the alternative design submission was the concern about the long-term stability of the reinforced concrete cylinders.

The CFM’s specification called for two berthing dolphins at Post No 3, capable of withstanding, with fenders, a berthing force of 450 metric tons, acting at level +3.5 m above chart datum, corresponding to a ship berthing at a velocity of 0.15 m/s, with a maximum approach angle of 10° about the berthing line. These dolphins were equipped with two bollards with a mooring rope tension capacity of 50 metric tons each.

The same specifications called for berthing dolphins at Posts No 1 and No 2 to be capable of withstanding, with fenders, a berthing force of 400 tons, acting at level +3.5 m above chart datum, corresponding to a ship berthing at a velocity of 0.15 m/s, with a maximum angle of approach of 10° about the berthing line. These dolphins were also equipped with two 50 metric ton bollards each. The Post No 1 upstream berthing dolphin, which was a mooring dolphin reinforced concrete cylinder, would be converted into a berthing dolphin, with the same specifications.

The berthing dolphins, being rigid, needed to be equipped with rubber fenders which had to take into account, besides the berthing ship force, the wind velocity, the tidal range and tidal currents, the angle to the berthing line of the approaching ship, the ship hull maximum allowable pressure, the ship hull curvature, and for smaller vessels, the possibility of hull projections.

The two new mooring dolphins were designed for a mooring rope pulling force of 200 metric tons, at an angle of 30°/45° about the berthing line.

All dolphins were provided with an access cat ladder.

The loading-arms platform had to withstand the pumping thrust from the pipeline liquid flow, of the order
of 60 metric tons, acting at level +5.5 m above chart datum.

**DESIGN OF THE MATOLA DOLPHIN BERTHING POSTS**

Two types of berthing dolphins existed at the Matola Section of Maputo Harbour.

One type consisted of an existing reinforced concrete cylinder about 9 m in diameter and 11 m tall, designed originally as a mooring dolphin and during this contract strengthened and converted into a berthing dolphin, capable of withstanding a berthing force of 400 tons.

The other type (the new berthing dolphins) was designed to withstand, with fenders, a berthing force of 450 tons, and consisted of bored piles inclined to 1 in 4 to the vertical. These piles were disposed in such a way that they could withstand the force normal to the berthing line and the torsion created by a ship berthing at an angle of 10° about the berthing line.

Each of these piles could also act as anchor in the estuary bottom, reaching depths of about 25 m below the estuary bottom. Two piles in the berthing dolphins of Post No 3 were tested to a tensile force of 110 metric tons.

The caissons were formed from Larssen profiles, and the steel had a percentage of copper in its composition to reduce the rate of corrosion in the marine environment.

The set of dolphin piles was capped with a mass concrete pile cap of about 3 m deep.

The mooring dolphins consisted of piles bored into the estuary bottom at an angle of 1 in 4 to the vertical, and could also handle compression and tensile forces. In this case, too, each set of dolphin piles was capped with a mass concrete pile cap of about 3 m deep.

All the dolphin pile cap tops were at level +5 m above chart datum.

At the loading-arms platform, and in order to withstand the hydraulic thrust of the liquid flow, besides the vertical piles, two sets of inclined piles, each forming a tripod, were sunk from the completed platform deck.

**CONSTRUCTION OF THE MATOLA DOLPHIN BERTHING POSTS**

In the construction of the berthing posts, three types of piles were bored and/or driven.

For the loading-arms platform of Post No 3, and for the piers of the access bridge to the platform, 350 mm diameter percussion vertical piles were sunk into the estuary sandstone bottom. A steel pipe served as permanent formwork for the reinforced concrete shaft. A percussion boring machine was installed on a U-shaped spud barge.

At the platform, two tripods of inclined percussion piles were bored into the ground, from the completed platform deck.

For all the new dolphins, bored piles inclined at 1 to 4 to the vertical were sunk into the estuary bottom.

The bored holes were 600 mm in diameter, enlarged at the bottom by six enlargements of 750 mm in diameter, 0.5 m long and interspaced by 0.5 m.

After the hole reached 6 m into the hard and solid sandstone layer, which in a number of piles could only be found at 25 m under the sea bed, a round-bar high-tensile reinforcement cage welded to a steel caisson was lowered into the hole and the concrete poured underwater from the working fixed-level platform, by means of a tremie.

The holes were cut into the sandstone estuary bottom by means of a reverse circulation boring machine weighing 15 tons, using sea water as the drilling medium.

The boring machine was installed on a jack-up platform, having to work from a fixed level as all the piles were inclined and had to be free from the
local tidal range between 3 m to 4 m. This platform could float with 50 metric tons of piling equipment and weighed about 200 tons.

A number of problems were encountered during hole boring for the installation of the dolphin piles, due to the lack of uniformity of the sandstone founding ground. The boring machine had to cross layers of sand where the hole had to be sleeved to prevent the collapse of its wall, and in other occasions had to cross layers of clay where the drill rate was very slow.

The boring tool was guided from the platform chariot to the sea bottom, by a guide pipe 650 mm in diameter, inclined at 1 to 4 to the vertical, supported on the highest end on the platform and sunk about 1 m into the estuary sea bed. This guide pipe was later recovered after the pile construction had been completed, and reused in the next pile.

The jack-up platform consisted of three steel caissons about 25 m long, joined to form a triangle and supported on three steel tube legs about 1 m in diameter and 25 m long at each corner of the triangle. The platform could be raised from or lowered into the water by a set of three pairs of 50 metric ton hydraulic jacks, each pair installed on the platform deck corners acting on each leg. The platform was fitted with a chariot where the piling rig was installed, allowing the piling rig to reach any point within the open triangular area defined by the platform caissons. The platform was equipped with mooring bollards and winches, placed at each corner of the triangle, which permitted anchoring and adjusting its position at each dolphin construction site.

To strengthen the existing reinforced concrete mooring dolphin and convert it into a berthing dolphin, nine steel caissons placed around the perimeter of the cylinder concrete cap at regular intervals were driven into the estuary bottom, at 45° by means of a diesel pile driver standing on the cylinder concrete cap.

This project was successfully completed in the early 1970s, but some of the dolphins in Posts No 1 and No 2 were later demolished to allow for the construction of the Mozal Jetty, or badly damaged by ships trying to berth at the dolphins from where the fenders had been removed. The two berthing dolphins placed downstream of the Coal Terminal were never used.
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Construction of the Prieska–Kalkfontein railway line 1914–15

Part 2: A major obstacle - the Orange River at Upington

THE LINE MUST MARCH ON ...

When Parliament sanctioned the railway line from Prieska to Upington, the endpoint of the line was precisely defined: "... the town of Upington is situated on the north side of the Orange River, and I [Engineer-in-Chief William Tippett] have, therefore, considered it out of the question to carry the railway into the town as this would necessitate the erection of a very costly bridge. The proposal is to bring the line in a direction suitable for the ultimate erection of a bridge across the Orange River, but to bend it round temporarily to a station site as near as possible to Upington on the south side of the river."

The town of Upington was therefore fixed as the main launching pad for the overland invasion of German South-West Africa (GSWA) to support the Union forces landed by sea at Lüderitz and Walvis Bay. But Upington is still 277 km from the German railhead at Kalkfontein – a formidable gap remaining across dry, barren country. Sir Thomas Price, the chairman of the Railway Board controlling the construction of new lines, wisely anticipated that the line soon would have to be continued from Upington and convinced the Railway Board to make provisional arrangements. On 29 September, General Manager Hoy was authorised to continue the survey from Upington onwards to GSWA, and Price undertook to get Cabinet approval for the construction of a temporary bridge over the Orange River at Upington. Two days later Price reported that Cabinet would like the Board to proceed with the bridge "as early as possible". There was some initial uncertainty whether the extension would be a regular railway line or a "defence line". All costs beyond the original terminus were therefore booked on a separate account. On 11 December, General Smuts assured Price personally that these funds would be reimbursed by the Department of Defence.

One hundred years ago South Africa, as part of the British Empire, was at war with Germany. The first objective of the Union Defence Force was to take control of German South-West Africa (GSWA, today Namibia). A part of this offensive was to bridge the gap between the two national railway systems, from Prieska in South Africa to Kalkfontein (today Karasburg) in GSWA. This was a daunting challenge delegated to a newly formed South African Railways (SAR) and was executed successfully under trying conditions. This article (part two of three) describes the bridging, within five months, of the formidable Orange River at Upington. The first article in this series appeared on pages 50–63 in the March 2015 edition of Civil Engineering.
Although Cabinet approved the crossing of the Orange River on 1 October, it was not made public immediately. On 2 October, for example, the Town Council of Upington enquired from the Railway Board whether a bridge was to be built over the Orange River. (The Town Council had earlier applied for a government loan to erect a municipal pontoon over the Orange River, as the existing one belonged to a private operator. If the bridge was to be built, the need for a municipal pontoon would obviously fall away and the Town Council could withdraw their loan application.) On 15 October, the Railway Board responded evasively: “...at the moment it is not possible to give any definite intimation as to whether it is the intention to construct a bridge across the Orange River at Upington, but I am to suggest that your Council should allow the question of a loan from Government for the purpose of erecting a pontoon to remain in abeyance for a month.”
The reason for this deliberate misrepresentation was probably connected to the declaration of martial law on 15 October, prompted by the Rebellion which then had broken out in a few different areas. Under martial law, alternative and speedier channels of approval could be used. After 15 October there was no need for further secrecy, and bridge construction started before October was out. Resident Engineer Prettejohn was instructed by Engineer-in-Chief Tippett on 5 November to provide temporary sidings on the south bank of the Orange River for the stockpiling of track material required for the construction of the line beyond Upington. On 11 November, General Manager Hoy confirmed the urgency of building a stockpile of track material at Upington to “minimise the possibility of delay to construction work beyond Upington owing to the shortage of material”. The preparation of the line to GSWA was thus firmly under way by the middle of November. So when the weary construction team, all the way from Prieska, reached Upington on 20 November, their instructions were waiting for the next, even more demanding stretch to Kalkfontein. But first, the Orange River had to be crossed.

CROSSING THE RIVER BY PONTOON

Before the war, the Orange River at Upington could only be crossed by pontoon, operated by a local concessionaire. As more goods had to be moved across the river due to wartime needs, it was soon “found quite unequal to the traffic”. Moreover, the southern approach to the old pontoon was compromised during the flood period on account of flooded channels running parallel to the main stream. The SAR had to improve the existing arrangement and Assistant Engineer James Merriman Greathead, who later supervised the construction of the train ferry and bridges discussed in the rest of this part, was put in charge. He reported to Resident Engineer-in-Charge Nicholas Prettejohn and Bridge Engineer James Mackenzie. Greathead made a number of improvements:

■ Two ordinary pontoons, “such as are in common use on South African rivers”, were installed for military purposes, each capable of carrying 15.2 metric tonnes.

■ To ferry passengers and smaller goods, four large motor boats and ten large rowing boats were placed on the river alongside the pontoons.

■ The point of crossing the river (roughly opposite the current CBD of Upington) was moved to a more favourable position 2.4 km above Upington, where there was one wide main channel and a small subsidiary channel.

■ The rail was extended on the south bank from the end of the railhead to the point of crossing, including a siding of about 914 m in length, and a trestle bridge 46 m long and 6.1 m high across the subsidiary channel (since filled in).

The two 15.2 tonne pontoons were built in Durban and transported to Upington with great haste. They left Durban on 23 November with the instruction that the pontoons were “very urgently required and continuous transit to be arranged if practicable” and that “all examining centres should be instructed [to] adjust lashing if necessary.” The pontoons constituted a large load, 3.0 m wide at the top and 3.5 m above rail. General Manager Hoy followed its progress through Newcastle (24 November), Johannesburg (25 November), Klerksdorp (26 November) and Kimberley (27 November). Once on site, the public of Upington naturally also wished to use the new pontoons to cross the river, but permission was denied “while
Figure 4: The train ferry approaching the north bank, showing the guide cabling (Transnet Heritage Library photograph 49505)

Figure 5: The first locomotive to cross the river is mounted on the cradle as it is lowered down the slipway of the southern pier; the photograph was taken on 14 March 1915 (Transnet Heritage Library photograph 49503)
military operations are in progress” and they continued to use the old pontoon. Figure 1 shows one of the pontoons crossing the Orange River.

THE TEMPORARY BRIDGE – FIRST ATTEMPT
The pontoons had a weight limit of 15.2 metric tonnes which could not be exceeded. But a locomotive weighed 44.7 metric tonnes, and ordinary rail trucks loaded with rails or sleepers had a gross weight of about 35.6 metric tonnes. To get rolling stock across the river, something more substantial had to be devised. An obvious answer was to construct a temporary railway bridge: “This was to be at low level, and it was hoped that as the usual time for floods was not sooner than January, traffic might be run over that bridge for six or eight weeks before it was submerged, and that thus it might have been possible to take over large quantities of supplies, including rolling stock and material for building the railway to the border.”

The Orange River at Upington is intersected by a large dolerite outcrop, shown in Figures 2 and 3. The SAR engineers capitalised on this outcrop to break the crossing into a series of numerous small bridges. By early November, the work on the temporary bridge “across the then narrow stream, with subsidiary openings at some of the larger flood-channels”, started.

The hopes for a flood-free window of opportunity, however, were soon dashed. By the middle of November: “… exceptionally heavy rains fell in the Transvaal, Orange Free State and Northern Cape Colony, and as all this huge area drains into the Orange River it very soon rose at Upington from being a stream of about 152 m wide and 0.6 m deep to being nearly 1.6 km wide, 4.6 m deep and flowing at a velocity of 2.7 m/s – the latter considered to be high for a large river.”

The flood surge arrived at Upington on 1 December, the river described as a “raging torrent a mile in width” which abruptly stopped construction. The flooding continued during early summer. “On several occasions there were 4.9 to 5.4 m of flood water in the river, and no sooner did it drop sufficiently to permit operations being resumed than the river came down again in heavy flood.” It would be three long, frustrating months before the engineers could resume their work. See Figure 8 for the water levels during this period.

THE TRAIN FERRY
The need to get heavier rolling stock across the river for the continuation of the railway to Kalkfontein became more urgent by the day as the military build-up for the GSWA campaign continued. As the work on the temporary bridge had to be suspended due to flooding, an idea was hatched at the beginning of January 1915 to build a train ferry capable of transferring locomotives and a regular supply of track materials in trucks to the north bank. It was anticipated that such a ferry could transfer 20 trucks every 24 hours, with “empties” returned at night. The necessary material and equipment were ordered forthwith. The train ferry was to be installed alongside the existing pontoons where the main river channel, at that time, was 335 m wide.

The train ferry itself floated on four wooden pontoons, specially built in Cape Town. Each pontoon was 14 m long, 2.7 m wide and 1.4 m in depth – a size convenient for rail transport. On arrival at the south bank they were separately launched before connected in pairs. A platform, built in Durban and sent by rail to Upington in sections, formed the superstructure of the ferry.
The platform was formed by steel I-beams at right angles to the direction of travel, connected by jarrah timbers laid longitudinally. Rails at standard gauge were laid on top. The platform on its own weighed 17 tonnes. (The original idea was to transfer the platform from the bank onto the pontoons at every crossing, but it proved too difficult and the platform was eventually permanently fixed onto the pontoons.) The ferry was guided on its way across the river by two heavy wire cables, 32 mm in diameter. The cables spanned 402 m across the river, with a dip of 6.1 m, from 6.1 m tall masts on both ends, properly strutted and guyed. The ferry was connected to the cables by means of six tackles – from ringbolts on the deck of the ferry to carriers travelling on the cables. A second set of cables were used for hauling the ferry to and fro, connected to a ring on either end of the nose of the upstream pair of pontoons. The train ferry with its guiding cables is shown in Figure 4.

It was a major civil engineering undertaking to construct slipways on both banks, extending far enough into the river to ensure adequate water depth at the end pier to float the ferry. The southern slipway (the two slipways were roughly similar), originally planned for a gradient of 1:8, was eventually built at a gradient of 1:19 over a distance of 47 m, later extended by another 18 m at 1:27 when the water level dropped. The slipways were built on about 60 timber piles running out into the river like inclined jetties. The top structures of the slipways were constructed with steel I-beams. (The beams were conveniently already on site, ordered and waiting for the construction of the permanent bridge, and “borrowed” for the train ferry during the flood period.) For each slipway, a cradle was designed to provide a level top as it ran up and down the slipway on rails at 10 feet gauge. Pile-driving for the slipway started on the south bank by the middle of January until complete, and then continued from the north bank.

River hydraulics continued to harass the project, in three ways. First, the fluctuating river level slowed down the piling as the pile-driving equipment had to be moved up and down the river bank as it followed the water level (there was not enough time to build coffer dams around the areas to be piled). Second, the required length of the slipways depended on the river level, causing frequent design and construction changes. Third, the heavy silt load in the river dropped out at the ends of the slipways, compromising the depth required for the ferry. Pumps had to be permanently run to maintain enough turbulence at these critical points to prevent sedimentation.

The operation of the train ferry involved a number of critical steps. For a locomotive crossing from south to north (the locomotive boiler emptied first to avoid surging from end to end), the cradle on the southern bank was drawn to the top of the slipway and fished to the end of the regular rail. After the dead locomotive was shunted onto the cradle, the connecting fishplates were removed and the cradle lowered until the rails on the cradle aligned with those on the ferry. The ferry was then steadied by jacks on the pier to counter the sinking of the ferry and the rails of the ferry and the cradle fished together. Then came a delicate
The engine is run off the cradle onto the pont which dips her nose well into the water, while her shoreward end is firmly supported by the jacks. The engine is scotched in position as soon as its centre of gravity comes to the centre of the pont and the connecting fishplates are removed. The shoreward end is jacked down until the pont rests upon an even keel.

After the ferry was hauled across to the north bank, the rails of the ferry were fished to the cradle rails once more, but this time steadied by chaining it down onto the pier to prevent it from popping up as the locomotive weight is removed. The hauling of the cradles up and down the slipways, and the hauling of the ferry across the river were done with steam-driven winding engines. Using this procedure, it took about two hours to take a locomotive across and 30 minutes for an ordinary rail truck loaded with rails or sleepers. Once a rhythm was established, the actual trip over the water occupied only about four minutes, but the careful loading and unloading took considerably longer. “The best day’s work performed was the transfer of 24 loaded trucks in the day shift … followed by the return of 16 empties during the night.”

The train ferry was completed on 14 March 1915 and put into operation without delay. The first engine to cross was No 1042 7th Class with driver Van Rensburg. A week later, on 21 March, a second locomotive (No 972 7th Class with driver Davies) was transferred to the north bank. The ferry remained in operation until 16 April 1915, when the temporary bridge came into operation, which allowed the train ferry, the wagon pontoons, motor launches and whaleboats...
to be dispensed with. The Resident Engineer, however, kept the ferry “in readiness to resume work should the low level bridge be in danger from further floods in the late autumn.”

The train ferry remained in service for 33 days and was only interrupted for three nights (26 to 29 March, when the southern pier had to be extended, necessitated by a drop in water level). During this time, the ferry transferred 64 km of track material, 56 km of telegraph material, 3 locomotives, 6 travelling tanks, 6 cabooses, and large quantities of supplies and coal.

The train ferry was designed and built by Engineer Greathead under the supervision of Bridge Engineer James Mackenzie, the latter singled out for the “successful ingenuity”, “skillful designing of the work, plant and all details” and the “careful personal supervision” brought to his task. Adding to the difficulties to overcome, was the excessive heat in Upington from January to March: “Climatic conditions were unfavourable for rapid work on account of the extreme heat. The thermometer would daily indicate a maximum of from 100 to 120°F [38 to 49°C] in the shade. This could not fail to affect men brought from more temperate parts of the country.”

The construction of the train ferry was a rather unusual project for the newly formed SAR, requiring a variety of specialised tools and materials not normally held in stock. The role of the Stores Department, to procure and supply these items at short notice, was recognised: “... the important and very valuable services of the Stores Department of the SAR deserve more than a passing notice. To cross the Orange River at Upington a considerable quantity of material such as wire rope, tackle, launching gear, etc., had to be supplied and also supplies of pitch pine logs and other timber, with bolts, etc., for use in the construction of the temporary bridge. In addition to permanent way material, very large quantities of tools and stores of a general nature were requisitioned, these including water tanks, water carts, pumps, marquees, tents, harnesses, trolleys, wheelbarrows, picks, shovels and hammers, and a host of miscellaneous but equally necessary articles.”

Was the great expense and effort invested in the train ferry justified, given its limited time of operation? Engineer Greathead provided his own contemporary perspective: “It may appear that the efforts involved in the provision of the temporary train ferry were hardly called for, seeing that it may appear that the efforts involved in the provision of the temporary bridge footings could still be observed in 2014. The bridge was designed and its construction supervised by James Mackenzie, the same engineer in charge of the train ferry. Again, his contribution was singled out – this time for the “speed with which ... [it was] constructed”.

The first train crossed the bridge a mere 31 days after construction resumed, on 16 April 1915. This time, fortune smiled on the low-level bridge and no more flooding occurred after its completion. It remained in operation until a permanent bridge at higher level came into operation a few months later. Figure 7 shows its first test crossing.

**FINALLY - THE PERMANENT BRIDGE**

The temporary low-level bridge was not designed to withstand floods like those experienced a few months earlier. A new permanent low-level bridge of concrete and steel was therefore designed “high enough to be clear of such floods as those of the last season and strong enough to withstand even higher floods”. As before, advantage was taken of the dyke in the river bed, separating the bridge in two sections of 94 m and 811 m respectively, for a total length of 905 m. In total, there are 101 spans consisting of concrete piers from 2.4 m to 3.0 m high and rolled steel beams from 7.6 m to 12.2 m spans.

The permanent bridge was completed on 30 August 1915. It was the longest railway bridge in South Africa. The bridge was replaced in 1938 with a new bridge of 1 067 m long at a higher level running close to the permanent bridge of 1915. (The bridges at Upington held the record for the longest railway bridges in South Africa from 1915, until overtaken in 1970 by the 1 200 m rail bridge over the Orange River at Bethulie).

The normally quiet, isolated town of Upington was a hub of activity and anxiety during the period when the SAR engineers were trying to get improved access over the Orange River. The Rebellion was at its height, with Upington right in the middle of it. Frantic military operations were under way to protect the town from a rebel attack, which came on 24 January 1915. The attackers were successfully repelled, which effectively brought the Rebellion to an end as the Rebels surrendered early in February. The Rebellion was not the only military threat – a German contingent and Union forces clashed at the same time (4 February) at the nearby town of Kakamas, with the attackers also successfully repelled. Figure 8 provides some context of the military turmoil at the time.

The construction of the railway line from Upington, apart from survey and earthworks, could obviously not proceed without track material and rolling stock. The completion of the train ferry marked the official start of the 277 km dash to Kalkfontein across hostile and enemy territory, which is the theme of the third and final part of this series.

**ACKNOWLEDGEMENTS**

The three parts of this series relied heavily on material obtained through Yolanda Meyer of the Transnet Heritage Library. Footnotes and referencing were omitted in this version, but a fully referenced copy is deposited with the Transnet Heritage Library and is also available from the author. Further useful material was found in early copies of the SAICE magazine/journal – a valuable resource for all interested in the history of civil engineering in South Africa.

Johan de Koker, Francis Legge, Bill James and Chris James provided pleasant company and stimulating conversation in a sweltering Upington where we hunted for, and found, relics of the earlier attempts to cross the Orange River.
James Mackenzie was born in Blairgowrie, Scotland, on 1 September 1862. He trained in Scotland and worked on the reconstruction of the Tay River Bridge at Dundee between 1883 and 1887. He came to South Africa in 1889 to join the Cape Government Railways (CGR) and was put in charge of the construction of the Don Pedro Jetty at the harbour in Port Elizabeth. After completing the jetty, he joined the Natal Government Railways (NGR) in 1890 to build the railway line from Ladysmith to Harrismith up Van Reenens Pass, where reversing stations were used in South Africa for the first time. Hereafter he joined a private contractor to build the Pretoria–Pietersburg line. Here he disagreed with the contractor on the method of construction. Rather than allowing his specifications to be altered, he resigned. He soon joined another contractor to build the Dundee–Vryheid line.

This project was interrupted by the hostilities of the Anglo-Boer war and Mackenzie had to get out in such a hurry with his wife and children that he sacrificed most of his furniture. He returned to the employ of the CGR to build the Kalabas Kraal–Hopefield and Amabele–Butterworth lines. His interest in, and early experience in bridge design and construction, was rewarded in 1905 when he was appointed as Engineer-in-Charge (Bridges) of the CGR. After Unification in 1910, he retained his position as bridge expert and became Bridge Engineer of the SAR. At this time, many of the old bridges had to be strengthened due to heavier locomotives and increased axle loads. Mackenzie’s experience in this regard led to his paper, *The strengthening of wrought-iron bridges on the Cape Government Railways*, in the January 1913 *Proceedings of the ICE* (Institution of Civil Engineers) in London, and its subsequent award with the coveted Telford Medal. During his time in office, he was responsible for the design and construction of a great many bridges, the most spectacular being the Sauer Bridge over the Gamtoos River. Mackenzie was a keen protagonist of bulk handling of coal and maize, and did much to focus attention on the value and importance of grain elevators for bulk storage.

After his retirement in 1922 at the age of 65, he remained active as engineer. He was consulted to design the bridge across the Limpopo River north of Messina, which he completed. However, a competing design of a rival engineer was selected for construction, and Mackenzie took on the job as Engineer-in-Charge for supervising the construction of his competitor’s bridge. He then undertook a trying survey of 300 miles near the present border between Zambia and Malawi along the Luangwe River. He was the only white man, assisted by a single interpreter, in a deadly climate and a country infested with lions and other wild animals, where he often had to sleep without shelter. He pulled off “a first class job” and was handsomely paid.

Mackenzie was a member of the ICE for more than 50 years, and was elected as the President of the Cape Society of Civil Engineers (the forerunner of SAICE) in 1915. He died at Woodleigh Banket near Salisbury on 11 January 1941. At one point in his life, he suffered a personal setback when his...
wife suddenly died. He suffered from terrible shock, and its complications landed him in hospital for months while he slowly recovered to his full health. At his retirement, one colleague described him as “one of the hardest workers he had ever known, and as one of the most unassuming of men.” At his death, he was described as a “man of quiet disposition, kept well ahead of engineering practice elsewhere and was a perfectionist in his work”.

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James Merriman Greathead (1884–1965)

James Merriman Greathead was born on 15 July 1884 in Grahamstown, South Africa. He was educated at St Andrews College, Grahamstown, before continuing his schooling in England at Sherbourne School in Dorset and King’s College in London. He entered Christ College, Cambridge, in 1904 and qualified as an engineer in 1907, with honours in Mechanical Sciences. He worked in the Airdale Foundry (builders of steam locomotives) and at Leeds Corporation Waterworks for two years before returning permanently to South Africa in 1910.

Greathead started his long career with the SAR on 17 February 1910 as Assistant Engineer on the construction of the railway line between Lady Grey and Barkly East. He was promoted in 1911, and again in 1913. By the end of 1913 he was transferred to Head Office in Johannesburg to work on relaying and main line improvements. At the start of World War One he was Assistant to the Construction Engineer, and was sent to work on the urgent river crossing at Upington. In 1915 he was appointed as District Engineer at Upington, soon married Dorothy Charlotte Greathead (a cousin’s daughter), and left for England where he joined the Royal Engineers at Aldershot, building bridges with the 103rd Field Company in France. He took part in seven major actions between 1916 and 1918, earning a Military Cross in 1919, receiving the award personally from King George V. The couple sailed for South Africa in February 1919.

Back in the service of the SAR, numerous deployments followed. In 1920 Greathead served as District Engineer in Bloemfontein, moving to Cape Town in 1921 to work on a grain elevator. From 1922 to 1924 he was back in Head Office, in 1925 the Resident Engineer on the construction of the Addo–Kirkwood line, and in 1927 posted to Durban where he was promoted to System Engineer. In 1934 he was appointed as Inspecting Engineer in Johannesburg, promoted to Assistant Chief Civil Engineer in 1935, and on 1 July 1938 again to Chief Civil Engineer. During World War Two he assisted the Defence Department with the construction of heavy gun positions around Durban and Cape Town. In 1940 he was called up for fulltime service at Defence Headquarters, where he established and organised a number of engineering companies for road, railway, harbour and general construction, all of which saw service in Abyssinia (Ethiopia), North Africa, Palestine (Israel), and Italy. On 5 October 1940 he was recalled to Johannesburg to take up the position of Assistant General Manager (Technical), while continuing his defence work on a part-time basis. He retired from railway service in July 1945 to a farm in White River. He maintained an active interest in the Anglican Church and was engaged as Consulting Engineer to the Nyasaland (Malawi) Railways. He was a Director of Tavistock Colliery Witbank and Dorman Long Africa Limited until two years before his death at White River in June 1965.

James Merriman Greathead, described as a man of good humour and personal charm, was a descendant of a remarkable engineering family who arrived in South Africa as part of the 1820 Settlers. His uncle, James Henry Greathead, was an engineer famous for developing the Greathead Shield, a key component of the construction of the London tube system. Two of his brothers, Harold Merriman Greathead and Arthur Merriman Greathead, were also civil engineers educated in England, as was his son Philip James Greathead.

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HARD FACT #4 OF 6:

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Student to engineer - easing the transition by way of the final-year design project

OVERVIEW
In 2014 an innovative approach was followed with the final-year structural engineering design project at Stellenbosch University, in which students had the tough task of designing a glass-processing facility. The lessons learnt (both by the students and lecturers), challenges, successes and thoughts for the future are discussed in this article as we contemplate how to produce structural engineering graduates who are well equipped for the design office. Items such as site visits, oral presentations to practising engineers, YouTube videos, marshmallow and spaghetti models, and a lot of hard work helped create an interesting project (and hopefully better engineers for our society).

INTRODUCTION
Nobody should be surprised when two experienced structural engineers, who have just joined the staff of a university,
show a tendency to change the final-year structural design project in order to produce graduates who are better equipped to start a career in structural design. It should also not be surprising to learn that they found it difficult to define what exactly they wanted to achieve and how to go about the task. Our doubts grew when we reviewed what had previously been done and the results that were achieved – Stellenbosch graduates have built a name for being quite well prepared for following years. We reviewed what had previously been done and the results that were achieved – Stellenbosch graduates have built a name for being quite well prepared for following careers as engineers. Could we really improve on this?

A light went up when we read the article on teaching design skills by three lecturers of the University of KwaZulu-Natal in the September 2013 edition of Civil Engineering (Jaros et al. 2013). They had given a lot of thought to the matter of how to handle the final-year design project, including the question of meeting the ECSA Exit Level Outcomes. Their article, together with further correspondence and meetings with some of them, provided the basis on which we built our approach. Needless to say, we deviated in many ways from the details of the KZN methodology, and after a year’s experience, there is a lot to discuss with them.

PROBLEM DEFINITION

The fundamental questions we were faced with are: What should one strive to achieve through the final-year design project? What are the skills and insights students need to develop? Stated differently: What are the deficiencies we have to address? We believe that the following are important issues:

- At least some students have a problem with 3D perception. They did drawing subjects in earlier years, but it is rather different to visualise a gear or cone than to understand a structure so big that you can get inside it and that consists of many elements, especially if you are only looking at plan drawings.
- The visualisation problem extends to ‘seeing’ the flow of forces through the structure, down to the ground.
- And then there is the problem of visualising the behaviour of the structure – its deformations and deflections, and from that the moments and forces in the members. With this comes the need for a feel for the concepts of stiffness and flexibility.
- Students are new to the subject, so they are quite deficient in their structural vocabulary. Of course, the very existence of a vocabulary, of such words as ‘gusset’ and ‘cleat’, implies an existence of a vocabulary, of such words as ‘gusset’ and ‘cleat’, implies that there are standard things and standard ways of addressing structural problems that have been tried and tested and are used by design engineers worldwide. To try to be creative with these things would not differ much from trying to be creative with the spelling of the words for them.
- Maybe the biggest problem many of us can remember from our early days in a design office is that of a gap existing somewhere in the following chain: decide on concept > define geometry > determine loads > do analysis > design members > design connections/detail reinforcing. The gap tends to disappear fairly quickly in a design office, but it’s a devil in the beginning.

Then the students are unfamiliar with the outputs required from the design process. What constitutes proper calculations? What does a passable set of drawings and specifications look like? A bill of quantities is required for getting a grip on costs. Besides knowledge, there is a set of skills required to do these things well.

All of these issues are universal, but we

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**PROJECT STAGES**

- **Project start**
- **Phase 1 – Conceptual design**
  - Group work
- **Phase 1 – Oral presentation and review**
- **Phase 2 – Detailed design**
  - Individual work
- **Final submission of design project, drawings and calculations**

**INPUTS**

- A site layout and basic building requirements to be provided
- YouTube video resources on structural analysis
- Notes on preliminary design and an “Engineering Toolbox”
- Site visit to Consol
  - Insert coffee here for late night student work and last-minute project completion
- Review and questions by professional engineers
  - Insert student fear here during interviews
- Previous design course information and SA design codes
- YouTube video resources on analysis, rebar detailing and draughting for self-learning
- Physical models for explaining structural behaviour (to be used earlier in the course next year)
  - Insert coffee here for late night student work and last-minute project completion
  - Insert great joy here when finishing final year engineering

**INTENDED OUTCOMES**

- Understand how a structural engineer fits in an overall project in terms of layouts and requirements
- Conceptual design and understanding of overall structural behaviour (without needing to use software all the time)
- Team work and project coordination
- Communication and presentation of designs and structures – using calculations, visual aids and drawings
- Following a design from concept to completion in terms of how design, analysis, loading and requirements all fit together to produce a structure
- Detailed structural design calculations and understanding a structure down to connections
- Applying engineering judgement and using a variety of engineering resources to solve non-standard problems
- Don’t try convincing practising engineers that your mistake is actually correct and your structure will stand, even when it won’t – you will lose that debate
also asked the question: Are there any problems that are peculiar to young South African graduates? To consider this question one has to ask how conditions in this country differ from those in other countries. To us the key issue is that the engineering profession is only weakly regulated in South Africa. The authorities do not demand calculations or detailed drawings, and there is no formal system for checking designs. This leads to a general laxness towards keeping an eye on young engineers and getting them to conform to set standards, at least in many companies. In fact, some graduates will be employed by companies with weak administrative and procedural systems, where the boss is also largely self-trained. This implies that we have to do more than just teach principles – we have to instil in students an appreciation of proper systems and procedures for doing the various jobs that constitute a design project.

Another question that exercised our minds is whether our job included teaching students creativity in design. We came to the conclusion that the best we could do
was to allow some opportunity for learning ‘small creativity’ – the process of finding solutions to the many problems a designer is confronted with on ordinary projects. ‘Big creativity’ in the sense of dreaming up innovative solutions would require a redesign of the entire engineering curriculum and making it similar to the way architects are trained. Of course, one talks in class about Calatrava and Fazlur Khan, and even about industrial design to instil an appreciation for creative design, but the neatness and discipline of structures that come from an orderly mind and a deep understanding of structural function is, arguably, a more important value for students to acquire.

An issue to be considered was that class sizes have increased significantly in recent years, and a more effective way had to be found to deliver a quality experience to some 40 students.

THE PROJECT

The design project given to the class was to plan and design a glass-recycling plant on a site on the outskirts of Stellenbosch. The advantage of an industrial project is that it has many potential solutions, and that the civil and structural engineer is well placed to be the ‘principal agent’ calling the shots for the whole job. The location was chosen because students could easily visit the nearby site, and also because its environmental and social sensitivity required these aspects to be addressed.

During the entire semester one morning a week was dedicated to lectures – explaining the project and the expectations and requirements, explaining aspects of design, answering questions, etc – and to interact with groups or individuals to address specific problems they
were experiencing, or to give design guidance. A large, open room with tables was obtained for this purpose, and we found this to be invaluable. We also arranged a site visit to a large glass-processing plant that incorporated many of the elements of the design project.

For phase 1, which lasted five weeks, the class was divided into groups of five. They had to plan the site, complete with aspects such as flow of materials, vehicle turning circles, sizes of bunkers, etc. with particular emphasis on the buildings, this being a structural design project. Qualitative (approximate) structural analysis was emphasised and they had to demonstrate how their chosen structures worked, how the forces flowed and how it would deform. They had to choose member sizes and slab thicknesses (the project involved both steel and concrete design) based on these qualitative analyses and rules of thumb. Sketches had to be done by hand.

At the end of Phase 1 each group had the opportunity to address the ‘clients’ (the lecturers and one or two practising consulting engineers, acting as external examiners) to describe their solutions, explain how the structures worked and why they were good, etc. Every group had to submit four A1-size posters. They had to show an ‘artist’s impression’ to demonstrate that the buildings and structures would not be too unattractive from the nearby road. At the end of a group’s presentation each member was handed a form on which to evaluate the contribution of each of the other group members.

All students reported that they worked extremely hard on the group projects, and that they gained a lot of insight into the behaviour of structures and how structures are put together. Both the posters and presentations testified, in general, to hard work and an acceptable level of understanding. This resulted in rather high marks and a narrow distribution of marks. No group failed.

At the end of the group assessment the various structures that constituted significant parts of each group’s project were divided among the individual members of the group, for detailed design. In essence the class was divided into steel and concrete structures, but a small group got structures consisting of both materials.

At the end of the individual phase, which lasted a further five weeks, each student had to hand in a maximum of three A1-drawings that fully defined the structure. In order to make sure that the drawings would be of an acceptable standard, a group of YouTube videos were made and posted, together with a template to assist with line thicknesses. Many students reported that they spent all the time needed to view these videos, and most of the drawings were of a higher quality than we expected. Lectures were dedicated to explaining what was expected with respect to drawings and calculations, how reinforcing had to be detailed, etc. We dedicated quite a lot of time to explaining structural behaviour, and a model consisting of spaghetti elements and marshmallow nodes came in handy in elucidating the bracing of a building.
The other deliverable was a ‘project file’ containing the following:
■ General project information.
■ Details on where information on the project can be obtained, including where electronic files are stored.
■ Calculations of loads and load combinations, assumptions, criteria to be met, and preparation of data for structural analysis.
■ Input and output of structural analyses.
■ Calculations for member and connection design. These had to be done to strict specifications – use standard calculation sheets, use pencil, make a sketch (to scale) in the top left corner, write where information comes from in the column on the right, etc.
■ A bill of quantities and a budget for the project; we provided the students with realistic rates.
■ A short report in which the student motivated why he/she should be regarded as having met the relevant ECSA Exit Level Outcomes.

The project file was intended to simulate the design documentation that an engineer should create for an actual, real-life project, acknowledging that any employer may have different requirements for how projects should be handled and documented, and how calculations and drawings should be done.

After the students had handed in their final designs, we marked these and then handed a representative sample to the same engineers who served as moderators. The results were then handed a representative sample to each student who had to develop a concept for their structure, an engineer should create for an actual, real-life project, acknowledging that any employer may have different requirements for how projects should be handled and documented, and how calculations and drawings should be done.

AASSESSMENT

The first question we need to answer is: How much have we lost of the approach that was followed before? In order to be able to answer that, we need a short description of how the course was taught the first time and how it was taught most recently.

We believe that for most students the gaps in the chain mentioned above, leading from conceptual design to details, have been filled, but not for all. On several instances we were shocked when right near the end of the semester a student would pose a question demonstrating a big gap in understanding. This proves that one semester is not enough to bring a final-year class with its typical spread of capabilities to a level where all the objectives are achieved with every student, no matter how hard they work or how well they handle the task.

We believe we were successful in teaching the class how to approach the process of structural design systematically and correctly, and how to document the design process adequately. Those who join firms with sound procedures will have an appreciation for the need for such systems; those who are employed by less organised organisations will hopefully remember something of what they had learned.

OFFERING THE COURSE THE WAY WE DID WAS QUITE AN ADVENTURE, AND WE LEARNED PERHAPS AS MUCH AS THE STUDENTS DID. WE CERTAINLY HAVE NOT DISCOVERED A SILVER BULLET, AND BELIEVE THAT IT DOES NOT EXIST FOR A SUBJECT AS COMPLEX AS STRUCTURAL DESIGN. OUR OPINION, HOWEVER, IS THAT THE FUTURE LIES ALONG THE FURTHER DEVELOPMENT OF THE METHODOLOGY WE EMPLOYED, RATHER THAN RETURNING TO THE PREVIOUS STYLE. IT WOULD BE FASCINATING TO GET FEEDBACK FROM THE CLASS AND FROM THEIR FUTURE EMPLOYERS AS TO WHETHER THEY ACTUALLY GAINED MORE FROM THE COURSE AS OFFERED.

WITH THANKS

The staff and students would like to thank Craig Findlay at Consol Glass for organising the very interesting site visit that the students undertook. Also thanks to AECOM’s structural engineers (Schalk Marais, Izak Groenewald and Karel Biesot) who attended the oral presentations and moderated the final project marks.

ONLINE RESOURCES

The resources provided in this course can be viewed online:
■ How to analyse and design a structure: http://youtu.be/Md08aiK98fu
■ How to do bending schedules in AutoCAD and Excel: http://youtu.be/bXwoulUX7w
■ An introduction to structural engineering draughting: http://youtu.be/CE5f-wnN0M (the first of six videos)

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Alternative Dispute Resolution - using the President’s List

SYNOPSIS
For many years the South African Institution of Civil Engineering (SAICE) has been maintaining a list of Mediators, Adjudicators and Arbitrators (the President’s List) comprising the names of members of the Institution who are willing and able to act as the foregoing in the case of disputes arising during construction contracts. This article gives pertinent statistics regarding the practical use of the list during the past years and presents some trends with respect to the nature of these disputes.

INTRODUCTION
The forms of contract used in construction projects in South Africa generally allow for one or more forms of alternative dispute resolution (ADR), should disputes between the contracting parties occur during the course of the contract. Specifically, the General Conditions of Contract for Construction Works (GCC, latest edition 2010, as well as earlier versions) provide for parties in dispute to request the President of SAICE to nominate a suitable person or persons to handle the dispute, should the parties not be able to agree amongst themselves regarding such person or persons. Since September 2009 the author has been involved in this nomination process on behalf of the President of SAICE, and has gathered the information as contained herein. It should be noted that the numbers given have no relation to the incidence of construction contract disputes, but are only representative of those cases referred to SAICE for nomination of a person to assist in resolving the dispute.

NUMBER OF CASES HANDLED
During the period September 2009 to March 2015 a total of 133 nominations were made by the SAICE President. This is roughly two cases per month over the 67-month period. Figure 1 gives a graph of the distribution of these cases for the full years 2010 to 2014, with 2010 being the highest with 28 cases, and 2012 the lowest with only 20.

WHO WERE THE COMPLAINANTS?
Figure 2 gives a graphical representation of the complainant entity. In 88% of the cases it was the (civil) contractor disputing the ruling of the engineer and/or the employer. In 7% of the cases the complainant was not a contractor, but another private entity.
such as the consulting engineer or a developer. The vast majority of disputes referred were civil infrastructure contracts, and payment issues were prevalent.

**WHO WERE THE RESPONDENTS?**
The distribution of respondent entities is given in Figure 3. In more than half the cases a local authority was involved, while in a further 19% of the cases the respondent was a (civil) contractor. Disputes between main contractors and sub-contractors frequently occurred, where payment issues were again prevalent. Where the respondent was a contractor and the complainant an employer, the disputes generally concerned adherence to the conditions of contract and/or quality of work.

**THE FORM OF ADR**
Whether mediation, adjudication or arbitration is called for in the case of a dispute is dependent on the particulars of the contract as contained in the contract data. Often a dispute may escalate from mediation to arbitration if one or more of the parties remain aggrieved after a first attempt at resolution. Naturally, in all cases the parties ultimately have recourse to the formal legal system of the courts. Figure 4 gives an impression of the form of ADR called for in the cases referred. Adjudication and arbitration were about equally represented, with somewhat less requests for the rather informal ADR mechanism through mediation.

**GEOGRAPHICAL DISTRIBUTION OF DISPUTES**
During the period under review, disputes in all of the nine provinces were referred to the President. The current President’s List (as those of the previous number of years) contains no names of members residing in either Limpopo or Mpumalanga. In almost all of the cases where one of the disputing parties was from either of these provinces, the other party and/or the consulting engineer resided in Gauteng, and these are thus included here. Figure 5 depicts the geographical distribution of disputes referred. Gauteng at 40% of the total and the Western Cape at 20% top the list, while a somewhat disproportionate 17% of the disputes originated in the Eastern Cape, again with local authorities being the majority of the respondents.

**INVOLVEMENT OF OTHER PARTIES**
In 85% of the cases referred, consulting engineers were involved with the
project, albeit not necessarily as a party to the dispute. Disagreement with the engineer’s decision often resulted in a dispute referred. In 44% of the cases the complainant also involved another external entity, such as an attorney or a claims consultant.

**THE PRESIDENT’S LIST**

**Geographical distribution of persons**
The current list of Mediators, Adjudicators and Arbitrators contains particulars of some 76 members, with a geographical distribution as given in Figure 6. Only a few members are in North West, Free State and the Northern Cape while, as mentioned before, no members on the list reside in Limpopo or Mpumalanga.

**Utilisation of the list**
In the final instance, Figure 7 gives an indication of the utilisation of persons on the list during the past 67 months. It is quite conceivable that 100% utilisation will not be achieved since, apart from location, the particular expertise required in a particular dispute will dictate who may be nominated. Nevertheless, in the 133 nominations made during the period under review, more than two thirds of the persons on the list have been used. In a few cases the President was requested to nominate a replacement after the withdrawal of the first person, while in only one case the parties requested that an arbitrator nominated be removed and replaced with another person.

While persons nominated through this process are encouraged to relate the outcome of the dispute resolution process to SAICE, these have generally not been forthcoming, with the result that reliable statistics regarding the success rate or other aspects of the process are not available at this time.

It should be noted that ICE-SA maintains a separate list of Adjudicators only, performing duties in the case of disputes arising under the NEC documentation. All of the names on the ICE-SA list also appear on the President’s List, either as Adjudicators and/or Mediators and/or Arbitrators.

**Attributes of the current list**
Certain aspects of the current list require urgent attention. While not being fully representative over all provinces, it is still very much white male dominated and extremely rapidly ageing. New participants are thus required, and SAICE should take steps to ensure that the list is improved regarding the current deficiencies. To this end the Project Management and Construction Division of SAICE is giving attention to the admission criteria and application procedures applicable to the various categories of ADR. A number of courses on ADR are also being presented during the year by various bodies in the engineering industry, and it is hoped that members interested in ADR will come forward and apply for inclusion on the President’s List.

**CONCLUSION**
The list of Mediators, Adjudicators and Arbitrators, as maintained by SAICE, serves a valuable function in facilitating dispute resolution in the South African construction industry. Continued expansion of this list to make it more representative of SAICE members and to give it a new lease on life, is essential. Participants should again be urged to share the outcome of their dispute resolution experience with the SAICE Head Office.
Delo® Testimonial: Fraser Alexander Mining

Achieves 21,000+ hours in articulated dump truck operation using Caltex Delo® family of products.

Founded in 1912, Fraser Alexander has grown from humble beginnings to become a key player in the South African mining industry and in selected global locations including sub-Saharan Africa, Australia and South America.

“We run a fleet of approximately 412 pieces of equipment, which includes such things as ADTs, front-end loaders and excavators. The very high exhaust gas temperatures and the long haul, have a harsh effect on the engine. We run Delo® across the board in all the engines,” said Theo Wilcox, Technical Manager at Fraser Alexander.

After 21,000+ severe service hours using Delo® XLD Multigrade SAE 10W-40, Caltex and Fraser Alexander personnel agreed to inspect one of their Mercedes-Benz OM 906 LA engines from a Bell 20-ton articulated dump truck (ADT) used in coal hauling operations.

“We see excellent deposit control provided by Caltex Delo® XLD Multigrade SAE 10W-40 - free movement of the rings, for good sealing. Clean underside, for good heat transfer; and the crown lands, the second land, and the third land are clean, as are the ring grooves. I’ve inspected all the contact surfaces of the valve train components, and wear is also well under control,” said John Green – Chevron Technical Specialist.

Additionally, the team inspected the major cooling components of the Mercedes-Benz OM 906 LA engine that used Caltex Delo® XLC Coolant. Despite the harsh operating environment and hard water found in the operating area, the water pump impeller and pump housing showed no signs of cavitation or corrosion after 21,000+ hours of operation. The thermostat was clean and free of any visible silicate film or corrosion.

“We haven’t found any signs of pitting of cylinder liners or buildup of scale or anything like that on the water pump or any of the other cooling components using the Caltex Extended Life Coolant,” stated Wilcox.

“Having inspected the engine parts of the OM 906 LA diesel engine, we are confident to say it’s the combination of the engine design and manufacturer, the maintenance practices of Fraser Alexander, and the performance of Delo® XLD Multigrade SAE 10W-40 and Caltex Delo® XLC coolant that have enabled the customer to achieve maximum engine durability,” said Green.

“We operate in a developing country with many challenges to the successful operation of a fleet of equipment, and I’m very pleased to say Delo® is not one of the things I have to worry about. I’m confident that Delo® helps our fleet of equipment go further,” said Wilcox.

To learn how Delo’s family of products can help you go further, visit CaltexDelo.com.
CONSTRUCTION OF 544 LITRES PER SECOND GRAVITY LINE UNDER WAY

After experiencing severe water shortages, the Makhado Local Municipality and the Department of Water Affairs (DWA) established the Makhado West Bulk Water Supply Scheme Project in Limpopo to provide communities in the region with sufficient potable water. The Valdezia to Mowkop gravity line, comprising 800 mm and 750 mm diameter steel pipes, is currently being constructed by the DWA.

The gravity line comprises two main sections. The first section starts at the 16 Mℓ concrete reinforced Valdezia reservoir. It has a 544 ℓ per second design capacity, and has a DN 800 steel pipeline that spans 2 329 m to its end point at Node T1, where the second section begins.

Section two has a design capacity of 412 ℓ per second, and has a DN 750 steel pipeline that spans 14 653 m to its end point at the booster pump station. The project is currently being executed on a fast-track basis to enable early water delivery to the surrounding communities.

Leading fluid conveyance and pumping solutions expert Incledon has been tasked with supplying more than 16 km of the 750 mm and 800 mm diameter steel pipes in 18.2 m and 19.2 m lengths. The ends are also prepared for site butt welding with epoxy lining and fusion-rigid polyurethane coating.

Due to the urgent nature of the project, the contract period for the manufacture and supply of the steel pipes, fittings and valves is just 36 weeks from the date of order.

“Quality will not be compromised, as a third-party inspector will inspect all the products to make sure they comply with the specifications laid down by the DWA,” says Incledon Polokwane sales representative At White.

All the respective manufacturers are also required to draw up quality control plans (QCPs), which have to be approved before they can commence with manufacturing. To date, most of the respective QCPs have been approved by the third party inspector, and the manufacturers have been given the go-ahead to start with production.

In total, Incledon will supply steel pipes, fittings and valves worth more than R97 million to the project. In mid-February the first pipes were delivered onsite, and the valves and fittings will be delivered according to a priority list that was issued by DWA Construction.

The contract went out on tender in September 2013, and was awarded in June 2014 to engineering contractor Meetse Civils, who tendered with Incledon on this project. The contract was signed and the order issued in July 2014.

“Although this is a challenging project, progress has been smooth to date, thanks to the excellent working relationship between all parties involved. I am confident, therefore, that the project will be completed within specified deadlines and budgets,” concludes White.
AT 50 GEDORE IS JUST GETTING WARMED UP

When most start winding down at 50, Gedore South Africa continues to produce quality hand tools with a lifetime guarantee.

The Gedore Group was founded in 1919 by three brothers who started manufacturing hand tools from their family home in Remscheid, Germany. From the small homestead the company grew into a multinational organisation which, in addition to South Africa, has manufacturing operations in Germany, Austria, the United Kingdom and Brazil. The company remains family-owned, and is represented and sold on every continent.

Over 40 years after the company’s inception Gedore arrived in Africa to take advantage of its industrialisation and the onset of vehicle assembly plants. Gedore Tools South Africa was established in New Germany, KwaZulu-Natal, in 1965 by Omnitool GmbH (representing Gedore Germany) and local shareholder HW Schmidt Industrials (Pty) Ltd. The company has since become a 100% subsidiary of Omni-Tool GmbH.

The introduction of hot-forged, German-engineered hand tools into the South African market would prove to revolutionise the industry, from small business practice to large enterprises. In the early days of production all the forgings were imported from Germany and then machined and plated locally. However, the introduction of drop-forging hammers enabled Gedore South Africa to increase production, and its range, with the use of locally procured steel. Today Gedore is the leading supplier of hand tools to the South African industrial sector, while also distributing to markets in Africa, Europe, Australia and Brazil.

For 50 years Gedore Tools South Africa has been forging and manufacturing quality hand tools which come with a lifetime guarantee. Maintaining these exceptional standards has given the company a sustainable competitive advantage, which has allowed it to become South Africa’s leading supplier of quality tools. Its association with the holding company in Germany has allowed Gedore Tools SA to benchmark its quality, products and processes with international standards.

PUTTING A DAMPENER ON FIRE DAMAGE

Property damage and physical injuries related to fire are more prevalent during the extinguishing phase than actual contact with the flames. To overcome this challenge, I-CAT Environmental Solutions stocks Telesto’s EXTINGUISHmist – a handheld water mist fire extinguisher able to suppress all common causes of fire without collateral damage to property, humans, animals and the environment.

I-CAT non-executive director Professor Jan du Plessis notes: “This has the potential for enormous cost savings. Using conventional equipment, only five percent of water directed at the fire actually applies to extinguishing it. The remaining 95 percent floods the surroundings. With the EXTINGUISHmist a superfine, ‘dry to the touch’ mist is emitted that quickly vaporises in the fire zone.”

Comprising simply demineralised water, the mist is also 100 percent human, animal and environmentally friendly. Prof du Plessis explains: “Other fire suppressants, such as foam, dry chemical powder and CO₂, are toxic, causing harm to humans and animals, destruction to property, and pollution. The EXTINGUISHmist, on the other hand, is ideally neutral and is so safe that it can be sprayed directly onto victims threatened by fire, allowing responders to swiftly and effectively execute rescues.”

Response time is the main factor determining the extent of a fire’s damage to life and property. Prof du Plessis points out that EXTINGUISHmist’s universal application across all common fire classes not only accelerates fire incident response, but also reduces the need to carry multiple types of equipment. “Equipped with the EXTINGUISHmist, responders can attack a fire immediately without having to worry about whether the agent is appropriate for the type of fire.”

The small amount of water sprayed from the EXTINGUISHmist – just six litres per minute – also guarantees a ten times longer lasting firefighting capacity than traditional hoses. It also has a high degree of dispersion and forms a large screening surface or ‘halo’. This is just one percent of the volume of water used by fire hoses and the mist ‘halo’ generated is in fact far more effective.
"People shielded by this mist barrier can survive even in close proximity to a powerful fire. It protects firefighters and victims alike from thermal radiation and smoke. Because the mist contains air, it allows them to breathe freely, preventing asphyxiation and buys time in rescue operations. Rescuing victims is problematic with other suppressants, as the agents are harmful," adds Prof du Plessis.

The EXTINGUISHmist portable fire extinguisher consists of a proprietary nozzle and phase regulator that can be incorporated with any manufacturer’s cylinder and valve – either stored pressure or cartridge-type. The technology is also available in a hose and reel device that can be mounted onto fire trucks, vehicles and trailers. "No other fire suppression technology can claim the same application breadth and people, animal, property, and environment friendliness as EXTINGUISHmist can," concludes Prof du Plessis.

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REMACON PRODUCTS’ FLEXIBLE MODULAR WALL SYSTEM PROVES A WINNER

YFEL, an innovative modular precast concrete wall unit developed by retaining blocks producer ReMaCon Products and launched into the market 18 months ago, has been well received in a number of industries which require easy-to-assemble, and moveable walls for containing and separating different types of products.

YFEL - so called because of its inverted Y-shape and its resemblance to the Eiffel Tower in Paris - was devised by ReMaCon for its flexibility of application in many different industries that are not the obvious target for precast concrete products.

“Our first three sales already confirm this diverse demand,” commented Silvio Ferraris, the company’s Managing Member.

“One sale was to shipping company Grindrod Intermodal who purchased mostly 4 m high YFELs - the largest in our range - to contain and separate a variety of locally mined high-value minerals, such as chrome and ferromanganese in granular and powder form, which it holds in storage at its Bluff Road (Durban) and Denver (Johannesburg) premises prior to export.”

The order from Grindrod Intermodal was placed in September last year for a total of 367 YFELs comprising 164 x 4 m units for Bluff Road, and 179 x 4 m units and 24 x 3 m units for the Denver facility. The 4 m units supplied to both storage sites included special corner units that were designed to intersect a YFEL wall at right angles to provide a series of separate adjoining enclosures.

ReMaCon completed delivery of the Bluff Road units in February this year and the Denver units in March.

Purchasers of the units are provided with instructions for installing the walling – either a crane or forklift truck is used to lift and place them, and the YFELs are designed to hold support pins for this purpose.

Another sale was made to Remade Recycling, a Germiston-based company that recycles various waste materials, mainly paper.

It ordered over 60 x 1.8 m high units that have since been distributed among its Kya Sands, Pretoria and Kempton Park sites. In all but one instance they have been installed in external areas to...
optimise the use of space for storage of waste paper, plastic and other recyclable materials.

The single different application is at the Kya Sands facility west of Johannesburg where some of the YFELs have replaced the bottom sections of the sheet-metal-clad sides of a waste paper storage shed as protection from forklift trucks which previously damaged the walls while operating inside the shed.

The third purchaser of YFEL wall units was a chemical company in the North West Province. ReMaCon supplied over 100 x 4 m YFELs along with a number of corner units for the establishment of a series of separate enclosures to store various materials involved in the company’s production processes.

The YFEL is particularly well suited for storage of dry bulk materials. “Its great advantage over conventional storage methods, which invariably comprise fixed built-in structures, is that it can be easily and quickly installed and reshaped in accordance with the changing requirements for dividing and storing products of many different kinds,” Silvio explained.

The units are manufactured in heights ranging from 1.2 m to 4 m.

NEW RESEARCH FUNDING FOR CoMSIRU
The Concrete Materials and Structural Integrity Research Unit (CoMSIRU) at the University of Cape Town has been successful in securing new funding for its research. In the past the Unit was mainly funded by the Cement and Concrete Institute (C&CI), which channelled funding from the cement industry to tertiary institutions. However, due to dynamic changes in the industry, the C&CI closed down in 2013. Efforts were then made to replace the C&CI, and The Concrete Institute came into being with the same mandate around education and training, but with a significantly reduced staff and budget.
In an attempt to keep CoMSIRU adequately funded, Professor Mark Alexander, CoMSIRU Director who will be retiring at the end of 2015, together with his co-directors Prof Pilate Moyo (who will be the Unit’s new Director from 2016) and Associate Professor Hans Beushausen, therefore decided to approach construction companies for further sustaining funding. This has been successful as they have secured funding from Haw & Inglis, and Aveng Grinaker-LTA, with another two companies in the pipeline.

As a company Haw & Inglis’s core focus is on major national and provincial arterial roads and urban highways, and its expertise extends to urban infrastructure and select industrial, commercial, residential and sports building projects. The group furthermore has strong vertical integration with in-house crushing and concrete work operations to support its roadwork activities. Its MD, Enzo Menegaldo, is also a civil engineering graduate from the University of Cape Town.

For Aveng Grinaker-LTA, and its MD Chris Botha, their focus is on finding ways of retaining young graduates in the company. As such, they have decided to give these graduates the opportunity to register for the MEng degree at CoMSIRU, which will take three to five years to complete. Aveng Grinaker-LTA will thus give funding to their research work, and as such the research from the projects on which the students will work will also feed into the company.

CoMSIRU, at any one time, has 30 to 40 full-time Masters and Doctoral students, with a number of part-time MEng students. Over the years the Unit has also received strong financial and other support from major agencies and companies, such as the National Research Foundation, Sika SA (Pty) Ltd, PPC Ltd, AfriSam, The Tertiary Education Support Programme (TESP) of ESKOM, the Water Research Commission, The Concrete Institute (previously the C&C1), as well as the University of Cape Town.

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**CMA ANNOUNCES 2016 AWARDS FOR EXCELLENCE**

The Concrete Manufacturers Association (CMA) has announced that its Awards for Excellence competition will be run during 2015/16. PPC, the leading supplier of cement in southern Africa, is the anchor sponsor of the competition.

According to Echo Group managing director Monique Eggebeen, who chairs the CMA’s awards committee, the purpose of the awards is to recognise excellence in the use of precast concrete and to honour those professionally associated with its diverse applications.

“This is the pinnacle event in the precast concrete construction calendar, and it presents an outstanding opportunity for CMA members, both large and small, to showcase their products and
to establish themselves as trendsetters in the use of precast concrete," says Monique.

The competition is open to all providing that a CMA member enters the precast products for the competition. Entries must be submitted by no later than 16 October 2015.

There are six award categories in this year’s competition:

- Aesthetics – commercial
- Aesthetics – residential (private single dwellings)
- Community upliftment
- Technical excellence
- Innovation
- Precast for life

Projects may be entered into more than one category, and entries will be judged on the contribution precast concrete elements make in a particular category.

Floating trophies will be presented to the manufacturers of the precast concrete elements in each of the six categories. In addition, commendation awards will also be made to three runners-up per category, provided that these entries meet the standards of the judges.

The trophies and commendation awards will be presented at a gala dinner ceremony at Summer Place in Johannesburg on 23 April 2016.

Entry forms, and entry leaflets which cover the rules of the competition, can be downloaded from www.cma.org.za. Any queries regarding the competition can be directed to the competition organiser, John Cairns.

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**HYDROSTATIC CONCRETE DUMPERS IDEAL FOR TOUGH OPERATING CONDITIONS**

Hydrostatic drive unit concrete dumpers are ideally suited to the arduous operating conditions found on South African construction and building sites. This is according to Devin van Zyl, CEO of Lambson’s Hire, which has stocked its countrywide fleet with Wacker Neuson 1.6 ton and 3 ton dumpers to meet customer demand for reliable, hardworking equipment.

Devin explains that many dumpers experience gearbox failure resulting in unwanted downtime and frustration for customers. “However, by opting for hydrostatic drive units this problem will be eliminated. Feedback from customers, combined with extensive research and testing, forms the basis of all our equipment choices. We need to know that the machines we send to site will perform according to specs and remain operational for as long as possible. While adequate maintenance plays a large role in the uptime of our equipment, it is even more important to make the right selection upfront.”

---

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The heavy-duty, mid-size dumper range provides greater utility for building processes and logistics. The swivel-tipping skip, available on both the 1.6 and 3 tonner, comes with a 180° tilt, facilitating precision dumping of material, and is perfect for applications where exact placement of concrete is a prerequisite.

The range features hydrostatic permanent two-wheel drive on the 1.6 ton, and twin-lock four-wheel drive on the 3 ton as standard. This makes on site travel, at continuously variable speeds of up to 16 km/h on the 1.6 ton version, and 25 km/h on the 3 ton version, effortless even on the roughest and most uneven surfaces.

Operator-friendly hydrostatic controls are provided by the hydrostatic drive system, eliminating the need for gear changes whilst driving. The operator is thus able to concentrate on negotiating around and over any site obstacles, making these dumpers extremely easy and safe to use. The dumpers have a clearly laid out instrument panel and have wide, robust leg protection, further adding to ease of use for the operator.

The absence of a clutch and gears also means that maintenance is reduced to a minimum, resulting in maximised operational time on site and minimised overall operating costs.

The dumpers are ideal for surface construction, civil engineering, road building, quarrying, industry, demolition and rubble handling, waste disposal, forestry, farming and landscaping work, and public works.

“The success of our fleet is based on understanding exactly which equipment works in specific environments. Our team is able to consult with customers and provide them with the right plant item for their particular application, taking the tedium out of plant selection for them,” Devin points out.

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R200 MILLION HALLMARK HOUSE TO ENHANCE EXPANDING REGENERATION OF MABONENG PRECINCT IN JOBURG CBD EAST

Hallmark House on Siemert Road in the Maboneng Precinct of Johannesburg East is being transformed into an attractive glass-panelled tower featuring expansive residential apartments, an all-suite luxury hotel, and health, entertainment and leisure facilities. The multimillion-rand development, positioned to become the most enviable address on the African continent, is scheduled for completion in May 2016.

Residential sales have now opened and its curated lifestyle experience merging art, design, culture and architecture appeals to a variety of lifestyle needs. Central to its African aesthetics is the overall minimalist feel, with interiors reflecting the lines and silhouettes of the surrounding urban metropolis.
furbishment of an inner-city building to the east of the CBD that would become Arts On Main, home to world-renowned artist William Kentridge’s studio. This preceded a series of retail, commercial, industrial and residential refurbishments in what is today Johannesburg’s Maboneng Precinct. By 2013, Propertuity’s Maboneng Precinct portfolio comprised 40 buildings.

“The rate at which Maboneng Precinct has developed since 2008 is solid proof that there’s a thirst for more world-class regeneration of residential, retail and commercial space in Johannesburg’s CBD. Hallmark House will be meeting that need, and more,” adds Jonathan.

David says that Johannesburg’s eastern CBD regeneration is perfectly in line with what is happening around the world, and points at Hackney in London’s East End and New York’s Meatpacking District as examples. “It’s incredibly exciting to be working with Jonathan to regenerate Johannesburg’s CBD,” he says. “The transformation of Hallmark House is an opportunity to apply fresh thinking to urban communities and to create a new typology that reflects changing lifestyles and a more fluid approach to the way we inhabit cities.”

British conceptual artist Mat Chivers, who for the last four months has worked in residency at Nirox’s Sculpture Park in the Cradle of Humankind, will be installing a solo exhibition called ‘Altered States’ at Hallmark House. The exhibition will explore the evolution of modern consciousness, creating a bridge between human evolution and the current technological age. The exhibition will consist of a five-ton carved boulder from the Cradle of Humankind, an installation work, performances and 25 print works.

Ken Reynolds – regional executive of Nedbank Corporate Property Finance which is funding the Hallmark House project –

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COEGA UNDERTAKES R126 MILLION SANITATION UPGRADE AT EASTERN CAPE SCHOOLS

A R126 million sanitation infrastructure upgrade project is underway at rural schools in the Eastern Cape thanks to the Coega Development Corporation (CDC), on behalf of the Eastern Cape Department of Education – almost 1 000 toilets are being built as part of the wider initiative to improve infrastructure at Eastern Cape Schools.

Millions of people do not have access to proper sanitation across South Africa, and at some schools the situation is especially dire. The Eastern Cape, along with the Limpopo and KwaZulu-Natal Provinces are the worst affected in terms of infrastructure backlogs.

Sanitation facilities at rural schools are generally bad, with toilet blockages, and broken and dirty facilities, meaning that if there are bathrooms available, they are often unusable. Some schools have no sanitation facilities at all, so scholars are forced to use the outside areas as a toilet.

“Poor sanitation infrastructure is problematic. It affects the personal hygiene and safety of the children, impacting negatively on their learning. The South African Human Rights Commission (SAHRC) and other recent research projects into child development have found that a lack of decent infrastructure infringes on a human's right to education,” says Thembeka Poswa, CDC Programme Manager.

“The Department is striving to ensure that the schools have sufficient toilets and hand-washing facilities. Every effort should be made to improve safety and privacy. School sanitation programmes not only impact on children's education and development, they are essential to enable individuals to live and learn with dignity,” added Thembeka.

Currently 947 toilets are being renovated at 108 schools in the Transkei.

The CDC said it had appointed 11 contractors in February to upgrade sanitation facilities and toilets by the second half of the year.

Dr Ayanda Vilakazi, CDC Head of Marketing and Communications said urgent intervention was needed in schools in the Eastern Cape.

“No access to toilets infringes on a child’s right to human dignity. As a socio-economic development agency, Coega strives to effect positive change to communities in South Africa by undertaking infrastructure development or upgrade programmes on behalf of various government departments.”

Earlier this year Coega also delivered 17 schools out of 25 Infrastructure Upliftment Programmes across the Eastern Cape, after taking on construction of 25 schools for the government-led Accelerated Schools Infrastructure Delivery Initiative (ASIDI).

“This year learners across the Eastern Cape started their school year in newly-built schools thanks to the DoE-EC’s commitment to improving the learning and teaching environments for pupils,” says Dr Vilakazi.

During the 2013/14 financial year CDC, through its Eastern Cape School Building Programme, delivered a total of 73 projects valued at R638 million on behalf of the DoE-EC. This portfolio included emergency schools, early childhood centres, technical workshops and the eradication of mud structures.

In total, 27 schooling facilities were completed and handed over to clients and communities.

INFO

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These toilets at Daliwonga Senior Secondary School in Cofimvaba, Chris Hani District, are amongst those in dire need of upgrading
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On page 9 of the January/February 2015 edition of our magazine, we depicted former SAICE Executive Director, Dawie Botha, as President-Elect for 2015. Voting for SAICE 2015 Office Bearers took place at the SAICE April 2014 Council meeting. Towards the end of the year, however, Dawie was elected as Ward Councillor during a by-election in the Municipality of Overstrand, and he therefore decided to relinquish the position of President-Elect in favour of pursuing a more politically-orientated career. His extensive knowledge and experience of municipal affairs and municipal engineering will stand him in good stead as Ward Councillor, and we wish him all the best in this new and encouraging endeavour. Dawie will still be serving SAICE as Council and Executive Board member, which, with his institutional knowledge and industry network, is a most fortunate arrangement for the Institution. Dr Chris Herold, well known in the water engineering environment, has taken over as President-Elect for 2015. The resultant vice-president vacancy that was created, due to these movements within the presidential team, will now be filled by André Frieslaar, who is a familiar face in SAICE transportation engineering circles. Both Chris and André were elected to their respective positions at the SAICE Council meeting held on 14 April 2015.

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### The SAICE 2015 Presidential Team

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Vice-President  
Managing Director  
Bosch Stemele  
magugumelad@boschstemele.co.za

**André Frieslaar**  
Vice-President  
Director  
HHO Africa  
andre@hho.co.za
Clause 3.1.1 of the By-Laws reads as follows:

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

Nominees accepting nomination are required to sign opposite their names in the last column of the nomination form. Nomination for election to Council must be accompanied by a Curriculum Vitæ of the nominee not exceeding 75 words. The CV will accompany the ballot form, and the format of the CV is described in Sections A and B. According to a 2004 Council resolution, candidates are requested to also submit a focus statement. Please see Section C in this regard.

Section A: Information concerning the nominee’s contribution to the Institution.
Section B: Information concerning nominee’s career, with special reference to civil engineering positions held, etc.
Section C: A brief statement of what the nominee intends to promote / achieve / stand for / introduce / contribute, or preferred area of interest.

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

Closing date: 31 July 2015. Acceptable transmission formats – email, fax and ordinary mail. All nominations are treated with due respect of confidentiality.

If more than 10 nominees from Corporate Members are received, a ballot will have to be held. If a ballot is to be held, the closing date for the ballot will be 31 August 2015. Notice of the ballot will be sent out using two formats, i.e.
1. By e-mail to those Corporate Members whose electronic address appears on the SAICE database, and
2. By normal surface mail to those members who have not informed SAICE of an e-mail address.

In accordance with Clause 3.3 of the Constitution, the Council has elected Office Bearers for the Institution for 2016 as follows:

President Dr C Herold
President-Elect Mr S Naicker
Vice-President Mr E Kerst
Vice-President Mrs D Magugumela
Vice-President Mr A Frieslaar
Vice-President Mr E Chinnappen

In terms of Clause 3.3.4 of the Constitution, the following are ipso facto members of the Council for the year 2016:
The immediate Past-President Mr M Pautz
The two most recent Past-Presidents Mr S Mkhacane
Mr P Kleynhans

M Pillay Pr Eng
Chief Executive Officer
April 2015
# NOMINATION FORM 2016

## 10 Corporate Members

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<thead>
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## Under 36 Members

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Please fax, e-mail or post this form, plus the CV of the nominee, to SAICE National Office, for attention Memory Scheepers, by 31 July 2015

Fax: 011 805 5971  |  e-Mail: memory@saice.org.za  |  Postal address: Private Bag X200, Halfway House, 1685
Three of South Africa’s leading engineering associations have become the first Associate Members of The Concrete Institute and will serve on its Board:
- Consulting Engineers South Africa (CESA)
- The South African Forum of Civil Engineering Contractors (SAFCEC)
- The South African Institution of Civil Engineering (SAICE).

The three cement producers (Lafarge, Sephaku and AfriSam) who founded The Concrete Institute in 2013, are the main Board members who will now work in close liaison with the new Associate Members.

The addition of the three new Associate Members to The Concrete Institute Board marks the start of the implementation of the Institute’s mission, stated in 2013 at its establishment following the closure of the Cement & Concrete Institute, to not only concentrate its technical and educational services on the cement and concrete industries, but to broaden its operations to also include complementary organisations in the South African building and construction sectors.

Bryan Perrie, Managing Director of The Concrete Institute, says the Institute is delighted to have the three respected and influential engineering bodies as Associate Members. “Civil engineering practitioners play a vital role in the building and construction industry. They are responsible for planning, designing and building infrastructure such as dams, bridges, water distribution networks, railways and runways, roads, sanitation systems, even cellphone towers – everything that adds quality to South Africans’ lives. Having the civil industry on board, is a major step towards The Concrete Institute and its members being able to speak with one voice to assist government in the implementation of the National Development Plan to the benefit of employment and the general economy.”

SAFCEC, the forerunner of which was founded in 1939, has played a major role in developing South Africa’s infrastructure, which has been the foundation of the country’s economic prosperity.

CESA is the voice of consulting engineering in South Africa. The body actively promotes members’ joint interests and provides quality assurance for clients. More than 500 firms, employing well over 23 300 staff, are members of CESA.

SAICE is a learned society seeking to advance professional knowledge and improve the practice of civil engineering. SAICE has a proud history spanning more than a century, and, with over 11 000 members, is the largest body of its kind in South Africa.

According to Perrie, The Concrete Institute is hoping to co-opt other building and construction bodies with similar missions on its Board this year.

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Civillain by Jonah Ptak

For more engineering humour, please visit “Unreal Bridges” on Facebook and “@TheUnrealBridge” on Twitter.
I would like to congratulate Johannes Haarhoff on his excellent first (of a series of three) articles on the construction, 100 years ago, of the Prieska to Upington railway line. His article emphasises the fact that rail has been used by government in this country for a century or more as a political instrument.

In what is termed “transport diplomacy” by Dr Loubser, General Manager of the SAR&H between 1970 and 1983, rail was used to establish “harmonious” working arrangements and to influence, through political leverage, relationships with many ostensibly hostile African states with vastly different political ideologies during the Apartheid period of our country.

An earlier example of the political role of rail was the use of rail for ferrying men and arms to far-flung reaches of our country by British colonial forces during the “Boer” war (sometimes called “die Engelse oorlog”) at the turn of the 20th century. This war has been termed a railway war.

A further example in more recent times has been the construction of uneconomic branch lines to “keep the people on the land”, as well as the promotion of agricultural and mining interests through charging uneconomic tariffs. Much more recently was the use of commuter rail, once again at uneconomic tariffs to promote the “separate development” of far-flung areas during the 1970s to 1990s.

Having spent the first five years of my engineering career on the route location and construction of new railway lines, including tunnels, using “in-house” resources for all the work, J Johannes Haarhoff’s article brings home the camaraderie experienced in such engineering endeavours, even though my experience was 40 years later than that of the railway construction described in the article.

Malcolm Mitchell Pr Eng
mally2@vodamail.co.za
A strong foundation for infrastructure success

Concrete Pipes

ROCLA
OUR DIFFERENCE IS CONCRETE

ROCLA’s Rubber Ring Joint Pressure Pipe is a watertight pipe for use in low pressure (2 to 8 Bar) applications.

The Spigot and Socket type joint is formed with a widening of the wall of the pipe on the one end, with the joint sealed with a rubber ring.

ROCLA is Southern Africa’s leading manufacturer of pre-cast concrete products for infrastructure, including pipes, culverts, manholes, roadside furniture, retaining walls, stock troughs, poles and other related products.

Tel: 011 670 7600 | www.rocla.co.za

A strong foundation for infrastructure success

many international investigations that I have undertaken in recent years:
- I have appeared before the 15 judges of the International Court of Justice in The Hague in connection with an international boundary dispute.
- In another case I was one of 30 international experts in water resource development who were invited to Japan to assist with the establishment of a national water resources research centre. This is now functional.

It is clear that the one issue that still does not seem well comprehended by critics is the synchronous (not causal) linkage between variations in solar activity (including sunspots) and the hydro-meteorological processes.

A second issue that seems to confound critics is that there are two fundamentally different approaches to the solution of problems relating to the water environment. The first is the approach typically used by academics. In essence it involves the development of unprovable mathematical relationships. Climate change is a good example. The second approach is used by practitioners who rely on time series analyses, which is the analysis of sequences of recorded data. Joseph’s biblical prophecy is an example.

The collection, analysis and publication of hydro-meteorological data were my personal responsibilities for a number of years in the Department of Water Affairs when I was chief of three hydrological divisions – surface water hydrology, groundwater hydrology and water quality. I occupied the most senior scientific post in the civil service.

The following list of my contributions to society speaks for itself:
- Publications related to water resources research, development and management (82)
- Commissioned research reports (7)
- Commissioned reports used for litigation (8)
- South African and international appointments (7)
- Awards for extraordinary services (7)
- Short courses of three to five days each designed for practitioners, from 1978 to 2001 (16) (attendees included several from neighbouring countries; the courses continued for 21 years, which make them the longest series of training courses in the civil engineering profession).

As a matter of interest, I still have a huge volume of material, much of which is of archival value dating back for more than 100 years.

I have had a wonderful and fruitful career serving my country and its people in several capacities, but things have changed. It is terribly sad having to witness the slow degeneration of our society. Hardly a day passes when we don’t see photographic reports in the media of pain, suffering and death. I have not seen any examples of action by my profession to overcome them. This is despite my many submissions, protests and publications. Increasing water shortages have already started to develop as a result of the ignorance of those whose responsibility it is to participate in the healthy growth of our nation. I once reported that people were living in Alexandra Township in conditions that no human beings on our planet should have to endure. Twenty years later nothing has changed.

The question remains then, what was the motivation for Geoff Pegram’s letter when I have done far more for this country and its people in the water field than anybody else in our profession?

Will Alexander Pr Eng (Emeritus Professor)
alexwjr@iafrica.com
In late 2014 SAICE sadly learned about the passing of Roy Donovan, the South African Institute of Civil Engineering Technicians and Technologists’ (SAICET) 1981–1982 President, and later Honorary Fellow. (SAICET, formed in 1974, merged with SAICE in the early nineties.)

In the years leading up to his tenure as President, the role and status of technicians, and the quality and type of their academic and practical training had generally been ill-defined. However, it was during the first year of his presidency, thanks to the work by the Institute’s members, that engineering courses at Technikons (formerly Colleges for Advanced Technical Education) began to be restructured effectively, thereby making up the first academic year’s syllabus towards the Higher National Certificate.

Born in the south of England on 17 May 1936 he immigrated to South Africa around 1970. Here he became involved in SAICET’s activities, after finding employment with the City of Cape Town’s Department of Water. It was here that Iain Macfarlane (SAICET President from 1985–1986) met Roy. Iain kindly recounted for us some of his memories of Roy and his involvement and contributions to the industry.

REMEmBERING ROY

“Roy had an enquiring and inventive mind. He was always very keen on computers, even before the sophisticated days of netbooks and laptops, and was the proud owner of a BBC Microcomputer. It was on this machine that he developed, on behalf of the City of Cape Town, a programme and database to record and correlate all information regarding the installation and reading of water meters, as well as the consumption data and future predictions, all in order to assist in the function of the department.

“Also at this time, Roy set up a database of all waterworks-related equipment that was required in the installation of water reticulation projects and other works, recoding each item so that there was conformity in the industries. This database was made available throughout South Africa, and assisted greatly in the tendering and contracting field.

“His report writing and budget presentations were also always clear and to the point, and he had the ability to easily compile a final long-hand speech often under pressure and in difficult circumstances, always in his neat handwriting.

“Roy was a passionate model railways hobbyist. He had a permanent track in his home and always remained up-to-date regarding the latest international developments in model railways. On the many trips from Cape Town to Johannesburg to attend SAICET/SAICE council meetings, Roy would often slip away to buy another gem to add to his collection.

“Old cars was another of Roy’s interests, and on one occasion he rebuilt an old BMC Wolseley. When it was almost complete, he took it for a test drive. Invariably he was stopped by the traffic authorities for having no number plates, insurance cover or road licence, amongst some other infringements, but with his obvious enthusiasm he managed to extricate himself from this fix.

“He was a dedicated family man, and an accomplished organist and pianist, too, and he would regularly play the organ at his local church.”

We at SAICE extend our condolences to Roy’s family, and wish them comfort and strength during this time.

Compiled by Rebekka Wellmanns with assistance from Iain MacFarlane
SAICET President 1985–1986
iain@mac.co.za
INTRODUCTION
The Engineering Council of South Africa (ECSA) has reiterated its call to all engineering practitioners to register with the Council.

“The nature of engineering and related fields is such that regulations and guidelines have been put in place to govern the industry,” says the president of ECSA, Cyril Gamede Pr Eng. “It is a process that has seen the South African engineering profession being recognised locally and abroad, and that assures stakeholders of verified credentials and a commitment to continuing professional development.

“ECSA, in partnership with government and academic institutions, seeks to promote a high level of education and training of engineering practitioners to facilitate full recognition of professionalism in engineering, both locally and abroad.”

REGULATORY BODY
ECSA is the only recognised engineering regulatory body in South Africa, and in this capacity it is also accountable to the public for fair and transparent administration of its operations. The recognition by other professions, locally and abroad, gives a wide spectrum of stakeholders a measure of protection and peace of mind. Hence registration with ECSA is paramount, with individual and business benefits including the following:

Peer recognition of qualification and experience
Professional registration is based on peer recognition by members of the appropriate ECSA committee, where committee members assess whether the minimum requirements necessary for registration are met (the various ECSA committees cover all the recognised engineering professions, such as civil, mechanical, electrical, chemical, etc).

Public confidence in professional competence
Professional registration assures the public that an engineer’s competence has been assessed by other professionals, who are knowledgeable in their fields of expertise.

Membership of professional societies
Professional registration is a prerequisite for membership of the various voluntary associations (VAs) recognised by ECSA (of which SAICE is one), thereby offering access to international best practice in the various engineering fields, as well as certain financial benefits, such as a reduced annual ECSA fee if membership of a VA can be demonstrated.

International recognition
ECSA is a signatory to the Washington, Sydney and Dublin Accords (respectively for the education of engineers, engineering technologists and engineering technicians). These agreements provide for mutual recognition of graduates by the registering bodies in the signatory countries, for example Australia, New Zealand, the United Kingdom and Ireland.

“With South Africa’s increasing globalisation, it is critical for our country to be competitive at an international level. Registration contributes substantially to the preservation of professional standards, and ECSA’s continued international recognition is crucial for the maintenance of high standards,” adds Gamede.

Employability
More and more employers require registration with ECSA as a prerequisite for appointment to certain engineering positions. From an employer’s perspective, confidence in the professionalism of staff is crucial. Since not all employers have

Cyril Gamede Pr Eng (ECSA President)
Cyril, who is the CEO of Umgeni Water, was appointed as president of ECSA in July 2012. He holds a degree in Mechanical Engineering, a Master’s in Mechanical/Industrial Engineering, and an MBA from the University of Cape Town. He made history when, in the mid-1990s, he became the first president of the National Society of Black Engineers.

Adrian Peters Pr Eng (ECSA Vice-President)
Adrian has been vice-president of ECSA since July 2012. He is a civil engineer with 22 years’ experience in municipal engineering, and is currently Head of Engineering at the eThekwini Municipality. He led the process of establishing the first Transport Authority at a municipal level in South Africa prior to taking up his current position.
been educated and trained in engineering, registration is widely regarded as an additional and objective indication of an engineer’s competence. Hence registration with ECSA works in favour of an engineer who is seeking employment.

Statutory empowerment
Legislation holds employers responsible for the safety of their employees, so appointing ECSA-registered engineers assists employers to comply with this legislation, and serves as an additional safeguard against unsafe practices, thereby also ensuring the public’s safety. This is the engineering profession’s contribution towards promoting public health and safety – the environment which distinguishes ECSA’s sole existence and activity in the engineering domain.

The ECSA president emphasises that, “The interests of the country and the public can only be served properly if a profession is healthy and thriving, which is why registering with ECSA is central to maintaining a strong engineering profession.”

Legislation holds employers responsible for the safety of their employees, so appointing ECSA-registered engineers assists employers to comply with this legislation.

MORE INFORMATION
Website
Non-registered engineering practitioners are encouraged to visit the ECSA website for more information: www.ecsa.co.za

Contact ECSA
T: +27 11 607 9500
E: engineer@ecsa.co.za
P: Private Bag X691, Bruma, 2026
1st Floor Waterview Corner,
Bruma Office Park,
Ernest Oppenheimer Avenue,
Bruma, Johannesburg

Engineering the Future
To address the insufficient numbers of engineering professionals available to deal with the sustained demands of our country, ECSA and its recognised engineering voluntary associations (VAs) and other stakeholders have committed themselves to an initiative called Engenius. Engenius was established primarily to grow and transform the engineering profession through the following key objectives:

- To promote national collaboration, coordination and support amongst organisations involved in advancing the engineering profession, e.g. statutory bodies, government departments, SETAs, higher education institutions, schools, FET colleges, the public and private enterprises.
- To promote the engineering profession to primary and high school learners in order to attract sufficient numbers of suitably educated learners representative of the demographics of South Africa.
- To manage a range of support activities, such as marketing and fund-raising.

Since its founding, Engenius has reached many learners throughout the country, even in some of the remotest areas. Recently Engenius was involved in the UNESCO Africa Engineering Week, the National Engineering Week, and the Eskom Expo for Young Scientists at the University of KwaZulu-Natal.

Engenius is continually living up to its aim of providing learners with an understanding of the role of the engineering profession in their lives, and it is hoped that the Engenius message – “Engineering makes it happen!” – will keep on inspiring learners to make engineering a career of choice.

Engenius is dependent on assistance from professionals in the VAs and the industry, engineering students and career guidance facilitators, all of whom take the time to interact with learners about engineering. In addition, students and young professionals are actively involved in assisting high school learners with Mathematics and Science in various schools and study centres. The Engenius website (www.engenius.org.za) is also used to drive its methodology, encouraging learners to:

- Try engineering by referring learners and educators to stakeholder activities, such as competitions, exhibitions and school projects.
- Consider engineering by providing information on where to study, subject choices, bursaries, etc.
- Identify engineering challenges by encouraging learners to log an engineering challenge in their communities which may be solved by engineering students as part of their community-based projects.
- Find help by referring learners to supplementary education programmes in Mathematics, Science, Technology and English.

Through its Engenius initiative ECSA is reaching learners all over South Africa
After fostering continued networking, collaboration and learning, locally and across borders, for the last 30 years, the UJ Civil Student Society (UJ-Civils for short) of the University of Johannesburg became an official SAICE Student Chapter in 2014, and was nominated as one of the top student chapters of the year.

The past three decades have seen UJ-Civils pursuing its mission of engaged interaction with industry, thereby providing civil engineering students with opportunities to meet with, and learn from, industry partners. During this time UJ-Civils has grown from strength to strength, with 2014 arguably being the most successful year in its illustrious history, as proved by the following list of high-quality events:

- In May, the third annual UJ-Civils Golf Day was attended by more than 20 engineering firms. The event served as a powerful lesson in project management, and provided significant opportunities for networking.

- In September, UJ-Civils took a group of 30 civil engineering students on an educational excursion to Moscow, Russia, where the students were taken on personalised tours of various construction projects and plants, including a state-of-the-art stadium redevelopment, skyscraper (and other building) construction and a brand-new cement manufacturing plant. During their time in Moscow, the students also visited and interacted with fellow engineering students at two of Russia’s most prestigious universities.

- In October, UJ-Civils organised and hosted the annual Engineering Ball. Sponsored by AVENG, the event allowed various industry representatives to interact with students in an informal manner. The theme of the Ball was From Russia with Love and included video uplinks from friends and colleagues met in Moscow.
In addition to the above, regular networking functions were held throughout the year, where students got to meet representatives from such companies as Knight Piésold, BASF, Lafarge, Penetron and many others.

The year 2015 promises to be even greater still! This year, UJ-Civils has partnered with the Confucius Institute, who has committed its assistance in organising an educational excursion in September to Nanjing and Shanghai, China. This excursion continues the chapter’s current theme, *Civil engineering and socio-economic development within BRICS*. Within this theme, students are given exposure to the tremendous strides in social and economic upliftment that civil engineering, through the provision of high-quality infrastructure, brings to developing countries. Successful excursions to Brazil, Russia, and now China, mean that our students are able to frame their technical knowledge in the context of the global need for improved infrastructure.

Alongside arrangements for the China tour, UJ-Civils is already busy organising its annual Engineering Ball (which promises to be even better this year), as well as continued regular interaction with engineering companies throughout the year, and of course its annual Golf Day (which happened very successfully on 15 May at the Glen Vista Country Club in Johannesburg).

**GET INVOLVED!**

UJ-Civils needs the continued support of industry partners. If you, or your company, would like to get involved with the activities of the UJ Student Chapter – by attending the annual Ball, hosting a function, or sponsoring the educational excursion or the next golf day – please contact us at:

- ujcivil@uj.ac.za
- dkruger@uj.ac.za (Deon Kruger)
- +27 11 559 2589/3144

*On site at a high-end hotel construction project in Moscow, Russia*

*Site visit to the 2016 Olympic Athletes’ Village in Rio de Janeiro, Brazil*

*One of the regular industry functions hosted by UJ-Civils*

*UJ-Civils at the Bauman Moscow State Technical University*
SAICE YMBI???
The YMBI is short for Young Members’ Branch Initiative. Towards the end of 2014 the SAICE YMP (Young Members’ Panel) felt that it was difficult to have a proactive approach with Panel members spread across the country. The YMBI was then introduced in an effort to regionalise the YMP. Each region has a YMBI that consists of young SAICE members who serve on the committee of that particular region’s SAICE Branch. The YMBIs implement the initiatives of the YMP in their respective regions. On the Western Cape YMBI team we have Andani Nesane, Brandon Fredericks, Caro-Joy Barendse (Western Cape representative on the YMP), Jody Klaasen and Liandie Otto.

The YMBI aims to address issues experienced by civil engineering practitioners who are bridging the gap between tertiary institutions and their working careers. We provide a platform for young SAICE members to voice these issues, and, coupled with this, we are interested in addressing issues related to young professionals outside their 8–5 job. We will, furthermore, be providing support to the student chapters as needed.

OFF WE GO...
The group started hiking at 07h00 on Saturday, 11 April 2015, in the thick mist that gave the perception of walking in a storm. Once an altitude above the clouds was reached there was nothing but clear skies. Brian Holdridge, who is also on the committee of the SAICE Western Cape Branch, comfortably led the hike while explaining what we could expect to see on top of the mountain. The path is well maintained and has a few huts owned by various organisations along the way for those interested in overnighting. The first dam that we passed was the De Villiers...
Dam, which was constructed by the Wynberg Municipality. This dam, which captures water of a tributary of the Disa River, is so beautiful that on its own it already made the hike worthwhile. Two more dams, the Alexander and Victoria Dams, which are dependent on the same source, were dried up at the time of our hike.

We eventually reached the majestic Woodhead Dam, and took a break. The dam was named after the mayor at the time, Sir Thomas Woodhead in 1897. The dam was used to retain the water of the perennial Disa River after a drought in 1880 (http://www.hiketablemountain.co.za/table-mountain-walks-reservoirs/). We marveled at the accuracy of construction, considering the technology that was available during the 1800s. A peek through the window of the museum gave us some insight into what tools were available for the building of these dams. As we contemplated an alternative path back down the mountain, we enjoyed the view of the shimmering water surface. After reenergising, we packed up and were on our way again.

THANK YOU!

We thank Brian for being keen on leading the hike and for sharing his knowledge with us, and Liandie Otto for organising the event. We appreciate the support the event received and look forward to even more involvement from young SAICE members at our upcoming events. Watch this space!

NOTE

The Woodhead Dam on Table Mountain was awarded International Landmark Status in 2008 by the American Society of Civil Engineers. The October 2008 edition of Civil Engineering featured the event, as well as a number of supporting articles covering the history and construction of the ‘dam on a mountain top’. To read these interesting articles, please visit SAICE’s website (http://www.saice.org.za) and scroll to the October 2008 edition under the Services button.
# SAICE Training Calendar 2015

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<td>Bloemfontein</td>
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<td>Greg Parrott</td>
<td><a href="mailto:cheryl-lee@saice.org.za">cheryl-lee@saice.org.za</a></td>
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<td>Business Finances for Built Environment Professionals Handling Projects in a Consulting Engineer's Practice</td>
<td>28–29 May 2015</td>
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<td>SAICEfin15/01617/18</td>
<td>Wolf Weidemann</td>
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<td>Leadership and Management Principles and Practice in Engineering</td>
<td>9–10 September 2015</td>
<td>Durban</td>
<td>SAIMechE-0543-02/15</td>
<td>David Ramsay</td>
<td><a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<td>Water Law of South Africa</td>
<td>10–11 June 2015</td>
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<td>SAICEwat13/01308/16</td>
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<td>Earthmoving Equipment, Technology and Management for Civil Engineering and Infrastructure Projects</td>
<td>22–24 July 2015</td>
<td>Midrand</td>
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<td>Prof Zvi Borowitsh</td>
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In-house courses are available. To arrange, please contact: Cheryl-Lee Williams (cheryl-lee@saice.org.za) or Dawn Hermanus (dawn@saice.org.za) on 011 805 5947

Every two or three months a group of semi-retired padmakers gather at the Milkplum Café in Pretoria’s Botanical Gardens. This always happens on a Tuesday, as pensioners are granted free access to this magnificent facility on that day of the week. In addition, the lunches are remarkably affordable.

Alan Parrock, who supplied the photo and who, at 65, is by far the youngest in the group, marvels at the hundreds of years of collective high-end wisdom gathered around the table in such delightful surroundings. They are nearly all still actively involved in work, with no thought of putting their feet up. Philip Savage, for example, who is in his nineties, still enjoys discussing his latest research, while Adrian Bergh, also in the nineties, continues to put in a day’s work at his office on the CSIR campus.

The padmakers in the photo (taken on 27 January this year) are from left: George Dehlen (who, due to his extraordinary mental arithmetic ability, conducts the financial duties at the end of lunch by informing all how much each must pay), Daan Visser, Nicol van der Walt, Paul Taylor, Phillip Savage, Frank Netterberg, Jop du Plessis, Eduard Kleyn and, unfortunately, only the back of Tony Williams’ head.

Others who form part of this grouping are Eddie Otte, HB Pretorius, Theuns Botha, Gary Jones, Ciaran MacCarron, Jimmy Fitzsimons, Bingle Kruger, Pieter Strauss, Otto Schnitter, Ewen Duncan, Harold Bofinger, Alex Visser, Ronald Cromarty, Peter Copley, Malcolm Mitchell, Tom van Riekevorsel, Stefaans Poolman, Billy Thompson, Danie van Vuuren, Bill Cameron and Paul Taylor.

Contact:
Frank Netterberg (fnetterberg@absamail.co.za)
# Candidate Academy Course Schedule 2015

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Course Date</th>
<th>Location</th>
<th>CPD Accreditation Number</th>
<th>Course Presenter</th>
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<tr>
<td>Road to Registration for Candidates</td>
<td>30 July 2015</td>
<td>Durban</td>
<td>CESA-357-04/2016</td>
<td>Allyson Lawless</td>
<td><a href="mailto:margie@ally.co.za">margie@ally.co.za</a></td>
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<td></td>
<td>2 September 2015</td>
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<td>Road to Registration for Mature Candidates</td>
<td>6 July 2015</td>
<td>Durban</td>
<td>CESA-484-01/2017</td>
<td>Peter Coetzee</td>
<td><a href="mailto:margie@ally.co.za">margie@ally.co.za</a></td>
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<td></td>
<td>5 October 2015</td>
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<td>Road to Registration for Mature Candidates</td>
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<td>CESA-484-01/2017</td>
<td>Rob du Preez</td>
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<td>Basic Contract Administration and Quality Control</td>
<td>22-24 July 2015</td>
<td>Cape Town</td>
<td>CESA-359-04/2016</td>
<td>Theuns Eloff</td>
<td><a href="mailto:margie@ally.co.za">margie@ally.co.za</a></td>
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<td>14-16 October 2015</td>
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<td>Getting Acquainted with Road Construction and Maintenance</td>
<td>22-24 June 2015</td>
<td>Johannesburg</td>
<td>CESA-379-05/2016</td>
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<td><a href="mailto:margie@ally.co.za">margie@ally.co.za</a></td>
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<td>19-21 August 2015</td>
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<td>Getting Acquainted with Basic Pressure Pipeline Design</td>
<td>10-11 June 2015</td>
<td>Johannesburg</td>
<td>CESA-376-05/2016</td>
<td>Dup van Renen</td>
<td><a href="mailto:margie@ally.co.za">margie@ally.co.za</a></td>
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<td>6-7 August 2015</td>
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<td>CESA-377-05/2016</td>
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<td>Getting Acquainted with Sewer Design</td>
<td>7-8 September 2015</td>
<td>Durban</td>
<td>CESA-378-05/2016</td>
<td>Peter Coetzee</td>
<td><a href="mailto:margie@ally.co.za">margie@ally.co.za</a></td>
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<td>Getting Acquainted with the Fundamentals of Tendering and Procurement</td>
<td>9-10 July 2015</td>
<td>Cape Town</td>
<td>CESA-395-06/2016</td>
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<td>Getting Acquainted with Geosynthetics in Soil Reinforcement</td>
<td>7-9 October 2015</td>
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<td>SAICEgeo14/01627/17</td>
<td>Edoardo Zannoni</td>
<td><a href="mailto:margie@ally.co.za">margie@ally.co.za</a></td>
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