PPS-SAICE NATIONAL 2020 PROJECT AWARDS – ALL THE WINNERS, COMMENDATIONS AND FINALISTS

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The year 2020 – a tale of two parts

INTRODUCTION

It was the best of times, it was the worst of times – the opening lines of Charles Dickens’ book, A Tale of Two Cities, are indeed relevant to this year, a year that has felt like the winter of despair to many and the spring of hope to others. It started like every other year – with new year’s resolutions and, for me as the new SAICE president, with plans intact for an exciting year in the making. Little did we know, however, that something of biblical proportions was about to impose itself on humanity around the world and put everything on hold without warning – the corona virus. The World Health Organisation declared it a pandemic on 11 March 2020.

Then came the announcement by President Ramaphosa regarding the hard lockdown which started on 27 March. Since then every plan had to be adjusted to comply with the lockdown regulations.

THE WINTER OF DESPAIR – THE SPRING OF HOPE

It was the season of darkness as our country reached some low points during the year in terms of high unemployment rates (42% and 30.8% based on an expanded definition and a narrow definition respectively, and 11.1 million people without jobs in Q3 as per an expanded definition), more than 800 000 people Covid-19 positive and more than 22 000 having lost their lives, the need for the economy to recover becoming even more urgent than ever before, and gender-based violence (GBV) in our nation becoming another pandemic. Regarding GBV – this scourge needs to be addressed by all of us without fail; the recent 16-day period of activism against GBV was a step towards the eradication of this disease, but far more must be done at a societal level.

It was the age of foolishness – the level of corruption which has been exposed at the Zondo Commission of Enquiry into State Capture should urge every citizen of this country to demand that this must stop with immediate effect and that the implicated should face the full might of the law, regardless of their position in society. For the sake of posterity we as citizens should all make ourselves available to assist in rebuilding our country based on sound ethical values. If we do not act now, the generations to come will hold us accountable for having watched as spectators without doing anything about the situation. We are reminded by Daron Acemoglu and James Robinson in their book, Why Nations Fail, that nations fail not because of their geography or their culture, but because of the legacy of extractive economic and political institutions that concentrate power and wealth in the hands of those controlling the state, opening the way for unrest, strife and instability. They further neglect investment in the most basic public services and infrastructure, something which should be avoided in our country. A collective effort is required from all of us to rebuild our country.

It was the spring of hope when, in the midst of the economic downturn and difficult environment, basic and higher education prevailed, and the academic year was saved. Despite the reported leaks of Maths and Science papers, much has been achieved this year in the academic space, and that should be commended.

RESET AND REWIRE – FOCUS ON THE LONG TERM

It was the age of wisdom – President Ramaphosa’s investment initiatives (now totalling R773.6 billion since the start of the SA Investment Conference in 2018) are encouraging steps to take the country forward. Countries develop when, in the opening lines of Charles Dickens’ book, A Tale of Two Cities, are indeed relevant to this year, a year that has felt like the winter of despair to many and the spring of hope to others. It started like every other year – with new year’s resolutions and, for me as the new SAICE president, with plans intact for an exciting year in the making. Little did we know, however, that something of biblical proportions was about to impose itself on humanity around the world and put everything on hold without warning – the corona virus. The World Health Organisation declared it a pandemic on 11 March 2020.

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ON THE COVER
This bridge on the road between Impendle and Himeville in KwaZulu-Natal provides an elevated roadway during flash flooding and completes the inland link between KZN and the Eastern Cape. The bridge showcases the expertise of Reinforced Earth® whose South African team has been supporting engineers across Africa for the past 45 years.

Reinforced Earth® has delivered reliable solutions for more than 40 000 000 m² of walls up to 40 m high in 80 countries throughout the world; here the company is at work in Ajaokuta-Warri, Nigeria.

FROM THE PRESIDENT’S DESK
The year 2020 – a tale of two parts

CEO’S CORNER
Adopting a transdisciplinary methodology to address complex infrastructure problems – Part 2

ON THE COVER
Walls anywhere, anytime!

PPS-SAICE 2020 NATIONAL AWARDS
Masquerading in style!
Projects: Technical Excellence Category
V&A Waterfront Swing Bridge
Raising of the Garden Route Dam
Emergency Reconstruction of Seaward Road Bridge over the Umhlutuzana River
Upgrade of the Stellenbosch Wastewater Treatment Works to MBR Technology
Coastal Park Materials Recovery Facility – Bulk Earthworks
Durban Point Promenade
Khwezela Life Extension (KLX) Dragline Relocation Project
HOP/Refab Manufacturing Facility
King Edward VII School Aquatic Centre
Midmar Water Treatment Plant Upgrade Phase 2
Northfield Business Park
REMINDER: Websites and email addresses on adverts are **LIVE**, and so is our contents page. **HAPPY CLICKING!**
Adopting a transdisciplinary methodology to address complex infrastructure problems – Part 2

Part 1 of this two-part article (see Civil Engineering, November 2020, page 5) served to introduce the notion that we live in a complex world with various schools of thought that need to be respected and incorporated into solutions. A single view such as, for example, that of a politician, an engineer, a regulator, a scientist, an environmentalist, a funder or financier, a social grouping or an implementing agency, no longer holds the relatively exclusive support that generally might have been the case in the past. Each grouping represents what could be called a discipline that has evolved over time and now holds its own in terms of the knowledge created, which should be deemed to have merit in its own right and thus deserves the respect and regard of the other. For far too long one discipline has arrogantly tried to outdo the other, to the detriment of society and the sustainability of the earth. Such competition motivated by ego, greed, and need for power and control has brought us to a tipping point – our behaviour needs to change to accommodate the multiple disciplines that are converging to achieve our geographic-specific objectives of poverty alleviation, economic inclusivity, and the lessening of inequality, to name a few. So how do we move forward?

In the previous article I made mention of one such approach referred to as transdisciplinary methodology, which is a methodology that accommodates a multi-lens approach to achieve the objectives mentioned, whilst incorporating the complexity of the needs and wants of multiple stakeholders. I would now like to explore this methodology further to give greater visibility and understanding, together with possible applications of such a model in changing how we look at infrastructure project development and implementation going forward in our Economic Reconstruction and Recovery Plan (ERRP), for example.

This example seeks to explore the weaving of the lessening inequality goal with infrastructure and quality education to bring about meaningful improvements whilst looking through the lenses of society, political ideologies, climate sciences, and technology. As this is an indicative approach, it does not profess to provide solutions as yet, as further development is required to enhance the contribution through research and peer review.

Table 1 on the facing page (targets, goals and disciplines) represents the aggregation of the Sustainable Development Goals (SDGs) that apply to Inequality (SDG 10), Quality Education (SDG 4) and Infrastructure, Industrialisation and Innovation (SDG 9), indicating the corresponding targets and corresponding aims to be addressed by a preliminary discipline. The preliminary disciplines are described as Social Dynamics, Techno-Economics, Earth Sciences, and Geopolitics. These can be referred to as the disciplines or lenses through which one could look at the aims and targets, and then address all aims as a collective.

The aggregation of each of the aims as they pertain to each discipline requires work to be done to solve the aims (problems) to find the solutions within the disciplines. Should it be decided that all disciplines are weighted with equal importance, there arises the possibility that social dynamics could be incorporated into infrastructure designs, earth sciences into education, economics into inequality, and social dynamics into education, to name a few. As we apply this thinking with greater granularity we have the opportunity to craft bespoke solutions at a community level that will achieve holistic solutions to education, infrastructure, and inequality as it applies to the three chosen SDGs. There are of course many disciplines and many goals that may be relevant, which will require that more thought be put into the problem matrix for further project definition. The development of a model is possible, to then allow for project testing and verification until the project KPIs are complete and holistic, thereby giving a greater sense of comfort that stated project objectives will be achieved in project execution.

In conclusion, this high-level overview shows that a multidisciplinary approach could be used to incorporate complexity into our mainstream project development and implementation schemes. The objective, as indicated in this case, shows we can ensure that education and infrastructure can co-exist to make meaningful contributions to inequality, which is fundamental to global sustainability and resilience in the 21st century. (Please see Table 1 on page 5.)

Vishaal Lutchman Pr Eng, PMP
vishaal@saice.org.za
<table>
<thead>
<tr>
<th>No</th>
<th>Target (SDG 10)</th>
<th>Description (Aims)</th>
<th>Disciplines</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Income growth</td>
<td>Prosperity</td>
<td>Techno-Economics</td>
</tr>
<tr>
<td>2</td>
<td>Social, economic and political</td>
<td>Inclusion of all people</td>
<td>Techno-Economics, Social dynamics, Geopolitics</td>
</tr>
<tr>
<td>3</td>
<td>Ensure equal opportunities</td>
<td>Social protection</td>
<td>Social dynamics</td>
</tr>
<tr>
<td>4</td>
<td>Adopt policies that converge income and social protection policies</td>
<td>Greater equality</td>
<td>Social dynamics</td>
</tr>
<tr>
<td>5</td>
<td>Regulation and monitoring of markets and institutions</td>
<td>Strengthen regulations to control fairness</td>
<td>Techno-Economics</td>
</tr>
<tr>
<td>6</td>
<td>Ensure a voice for developing countries</td>
<td>Access to credible global institutions</td>
<td>Geopolitics</td>
</tr>
<tr>
<td>7</td>
<td>Facilitating the safe migration of people</td>
<td>Well-planned migration policies</td>
<td>Social dynamics</td>
</tr>
<tr>
<td>8</td>
<td>Implementing a policy of special treatment of developing countries in terms of WTO agreements</td>
<td>Allowing for developing countries to progress economically</td>
<td>Geopolitics</td>
</tr>
<tr>
<td>9</td>
<td>Offer development assistance to developing countries</td>
<td>Allowing for development in countries that need it most</td>
<td>Techno-Economics, Geopolitics</td>
</tr>
<tr>
<td>10</td>
<td>Reduce the costs to migrate</td>
<td>Allowing for free movement of migrants between countries</td>
<td>Geopolitics, Techno-Economics</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>No</th>
<th>Target (SDG 4)</th>
<th>Description (Aims)</th>
<th>Disciplines</th>
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<tbody>
<tr>
<td>11</td>
<td>Equitable primary and secondary education</td>
<td>Free</td>
<td>Techno-Economics</td>
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<tr>
<td>12</td>
<td>Childhood education</td>
<td>Quality</td>
<td>Social dynamics</td>
</tr>
<tr>
<td>13</td>
<td>TVET and tertiary</td>
<td>Quality</td>
<td>Social dynamics</td>
</tr>
<tr>
<td>14</td>
<td>Technical and vocational</td>
<td>Skills</td>
<td>Techno-Economics, based on available employment</td>
</tr>
<tr>
<td>15</td>
<td>Education for vulnerable</td>
<td>Equal access</td>
<td>Techno-Economics, Social dynamics</td>
</tr>
<tr>
<td>16</td>
<td>Youth and adult literacy and numeracy</td>
<td>Make gains to ensure basic education</td>
<td>Techno-Economics, Social dynamics</td>
</tr>
<tr>
<td>17</td>
<td>Education facilities</td>
<td>Safe, good infrastructure, reduced bullying</td>
<td>Social dynamics, Techno-Economics</td>
</tr>
<tr>
<td>18</td>
<td>Scholarships</td>
<td>Awarding of growing scholarships</td>
<td>Techno-Economics</td>
</tr>
<tr>
<td>19</td>
<td>Teachers</td>
<td>Reduce the ratio of teachers/pupils</td>
<td>Techno-Economics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No</th>
<th>Target (SDG 9)</th>
<th>Description (Aims)</th>
<th>Disciplines</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>Reliable and resilient infrastructure</td>
<td>Affordable</td>
<td>Techno-Economics</td>
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<td>21</td>
<td>industrialisation</td>
<td>Inclusive</td>
<td>Social dynamics, Techno-Economics</td>
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<tr>
<td>22</td>
<td>Small-scale development</td>
<td>Increase</td>
<td>Techno-Economics</td>
</tr>
<tr>
<td>23</td>
<td>Upgrade and retrofit industry</td>
<td>Climate conscious</td>
<td>Earth systems</td>
</tr>
<tr>
<td>24</td>
<td>Innovation and technology in the industry</td>
<td>Research and development workers</td>
<td>Techno-Economics</td>
</tr>
<tr>
<td>25</td>
<td>Infrastructure development</td>
<td>Financial support in developing countries</td>
<td>Techno-Economics</td>
</tr>
<tr>
<td>26</td>
<td>Domestic technology development</td>
<td>Value-adding industrial development</td>
<td>Social dynamics, Techno-Economics</td>
</tr>
<tr>
<td>27</td>
<td>Access to information</td>
<td>Access to the internet</td>
<td>Techno-Economics</td>
</tr>
</tbody>
</table>
Walls anywhere, anytime!

ANNIVERSARY OF OUTSTANDING SERVICE
This year marks the 45th anniversary of the South African arm of Reinforced Earth®, and the local company is deservedly celebrating 45 years of trusted experience and expertise in mechanically stabilised earth solutions. For all these years the company has been supplying innovative, geotechnical engineering retaining structures to road and transport authorities, mining clients, design engineers and contractors, not only locally but all across Africa.

Reinforced Earth® structures combine engineered granular fill, tensile reinforcements and modular facing panels to create efficient load-bearing mass-gravity...
retaining walls to any practical height. The company’s specialists collaborate with engineering teams to find cost-effective solutions for their projects. Since pioneering the technology in 1963 (Henri Vidal, France), Reinforced Earth® has continued to develop new retaining applications through value engineering and targeted research and development, in the process delivering reliable solutions for more than 40 000 000 m² of walls up to 40 m high in 80 countries throughout the world.

Reinforced Earth® therefore broadly covers the following three service areas:

- **Engineering**, which entails detailed design and feasibility studies.
- **Custom materials supply**, which covers the supply of components and the enhancement of clients’ production capacity.
- **On-site technical support**, which includes the training of contractor personnel and the sharing of technical expertise.

**IMPENDLE TO HIMEVILLE**

The photos on the cover of this edition of *Civil Engineering* proudly show the result of part of a project that comprised the upgrade of approximately 50 km of rural gravel road, between Impendle and Himeville in KwaZulu-Natal, to a tarred surface road. This section of road D1357 completes the upgrade to the inland link between KwaZulu-Natal and the Eastern Cape. The project was commissioned by the Department of Transport for KwaZulu-Natal, and was led by DEC Consulting Civil and Structural Engineers, with Durant Civils as the main contractor.

Work on the culvert itself (pictured on the cover) commenced in December 2016 and was completed in March 2018. The new structures eliminate the previous hairpin bend at the upper end of the gorge and provide an elevated roadway during flash flooding. It was originally intended as a 155 m long bridge in box girder format on high columns spanning the gorge. The Reinforced Earth® design, instead, comprises 1 880 m² of TerraClass concrete facing panels, using 42 200 linear m of 45 × 5 HA steel reinforcing strips ranging from 4 m to 14 m. This design proved a far more economical solution, consisting of two 2-tiered walls back-to-back (benched into the in-situ rock and embankment) with a total combined height of 19 metres. The backfill comprised tillite and mudstone, which were locally crushed and sorted. Sufficient embedment and toe protection, as well as free-draining backfill material below the flood line, were key aspects of the long-term success of this project. Reinforced Earth® was responsible for the design and supply of materials, and, together with procurement and logistical planning, constructability workshops and continuous site support, the final deliverable ticked all the boxes.

**OTHER PROJECTS**

The other photos on these pages show a small selection of Reinforced Earth® projects that were completed in various locations across the continent.

**Info**

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GEBERIT PLUVIA
THE EFFECTIVE RAIN SOLUTION
SYPHONIC ROOF DRAINAGE WITH NEGATIVE PRESSURE

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BIM data and hydraulic calculation with Autodesk Revit

EFFICIENCY AND RELIABILITY, EVEN UNDER THE HEAVIEST RAINFALL
One system from the roof to the underground pipe connection: Perfectly matched components ensure that the overall system functions flawlessly. Sophisticated details and a consistently high level of material quality reliably ensure durability, safety and smooth operation. Now with a new rotating lock bar sealing for easy installation and maintenance.

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GEBERIT PLUVIA

FEWER PIPELINES
MORE PERFORMANCE

With Geberit Pluvia syphonic roof drainage, significantly less product material and space is required than conventional systems. The result: double the amount of rainwater discharge at half the pipe diameter, greater design freedom and higher cost-effectiveness during installation and operation. Geberit offers both professional planning software and a project-specific planning service for the configuration and dimensioning according to current standards. Geberit Pluvia - an optimum system solution.

15 GOOD REASONS TO CHOOSE GEBERIT PLUVIA
- Over 35 years of experience
- Wide range of applications
- Outlets for all roof types - factories, warehouses, shopping centres, airports, hotels, sport centres etc.
- Space-saving
- Small pipe diameter
- Less downpipes
- Cost-saving installation
- Less work on-site
- Low system weight
- Functions as a syphonic system
- Large areas can be drained through a single discharge stack
- Discharge of up to 25 litres of rainwater per second
- Less underground pipes, less manholes
- High reliability
- Outstanding durability

FEWER ROOF OUTLETS
Thanks to the high discharge rate of the syphonic system, fewer roof outlets are required. This results in savings in product material and amount of work needed, while also preserving the roof.

FEWER DISCHARGE STACKS
Because the pipes are filled completely, fewer drains are required. The result: greater flexibility in planning.

FEWER UNDERGROUND PIPE CONNECTIONS
Fewer discharge stacks and fewer connections mean lower installation and material costs.

SELF-CLEANING SYSTEM
The high flow velocity of more than 0.5 m/s when the pipeline is filled produces suction which contributes to the self-cleaning of the system. This ultimately means less time spent on maintenance.

NO SLOPE
Because Geberit Pluvia pipelines are laid horizontally, the drainage system does not result in any loss of space.

SUITE FOR PRACTICALLY ANY ROOF SHAPE
Geberit Pluvia ensures architectural freedom, as different roof shapes can be reliably drained with it. Syphonic roof drainage makes many things possible that would not be technically feasible with conventional systems.
On 12 November this year SAICE hosted its annual awards event mostly online, but also livestreamed from a small, elegant event in Johannesburg attended by the (masked) awards finalists and invited guests. The stylish evening of celebration showcased outstanding civil engineering projects spanning 2019/20. Considering the current trying economic climate, these examples of world-class South African engineering are truly inspiring. In this edition of our magazine we share these projects (finalists and winners) with our readers.

**AWARD CATEGORIES**
Projects were entered into the following categories:
- Technical Excellence Category (16 projects)
- Community-based Category (4 projects)
- International Category (3 projects)
- SAICE Institution Awards

**PROJECT ADJUDICATORS**
We would like to thank our team of adjudicators sincerely for giving so much of their time and expertise. They have to review each project according to the submission in front of them, and in this respect our adjudicators would like to share a word of advice. Projects of obviously winning standard are often presented from a public relations perspective only, omitting the essential in-depth civil engineering information on which the adjudicators’ evaluation has to be based. When preparing project submissions for adjudication, entrants should therefore always keep this requirement in mind.

**TECHNICAL EXCELLENCE CATEGORY**
The judging criteria in this category are the following:
- The project shows notable advancement in the application of new or existing methods of design, construction or project management.
- The project portrays the art and science of civil engineering.
- The project is functionally efficient.
- The project was well managed and completed on time.
- The project’s environmental and community impacts were well managed.

The joint winners in this category were the **V&A Waterfront Swing Bridge** (pp 12–14) and the **Raising of the Garden Route Dam** (pp 15–17).

The following projects in this category were highly commended:
- Emergency Reconstruction of Seaward Road Bridge over the Umhlatuzana River (pp 18–19)
COMMUNITY-BASED CATEGORY
Although almost all civil engineering projects happen in and for communities, the judges stressed that, to be considered for an award in this category, community cooperation should be seen as meaningful and empowering, and should be demonstrated throughout the project life cycle. The implementation should identify and close specific shortcomings and gaps within the community, while imparting useful and life-enhancing skills and technologies that will further sustain members of the community beyond the construction period. Lastly, its planning, design, choice of solutions and construction materials, as well as implementation should demonstrate innovative thinking in the application of civil engineering techniques for the benefit of mankind.

The judging criteria in this category can therefore be summarised as follows:

- Level of community cooperation and participation during the planning and execution of the project
- Sustainable benefit to the community after project completion
- Degree of skills development or technology transfer
- Demonstration of civil engineering’s contribution to the welfare of mankind
- Timely completion and well managed.

The winner in this category was the Mossel Bay UISP – Emergency Shared Basic Services (pp 36–37), while the following project was highly commended: Nkungumthi Irrigation Scheme (pp 38–39).

INTERNATIONAL CATEGORY
The judging criteria in this category are the same as for the Technical Excellence Category. The winner in this category was the Kashimbila Multipurpose Dam, Hydropower Station and Network Integration (pp 42–44). No commendation was awarded in this category.

INSTITUTION AWARDS
These are individual awards made by SAICE to recognise the exceptional contributions made by the Institution’s members, regional branches and technical divisions (pp 47–49).

SPONSORS
SAICE would like to take this opportunity to thank our sponsors sincerely again for making this wonderful event possible. They were PPS (naming-rights sponsor), SKI Civil & Structural Engineers, Reinforced Earth, Egis, and SIZABANTU.

We have gone to great lengths to ensure that the information of the key players in each project is reflected accurately as per each project entry form. We do, however, apologise should any key players have been overlooked inadvertently.
Bridges and moving bridges within the V&A Waterfront, Cape Town, have become a memorable part of any visitor’s experience. The recently completed new 4 m wide swing bridge at the Clock Tower in fact replaced a smaller much-loved 2 m wide swing bridge. The smaller swing bridge, built in 1997, was a beautiful, materially efficient structure which impressively opened and closed up to 60 times a day. However, with the further expansion of the Waterfront, the number of people crossing the cut was increasing yearly. By 2016, the previous 2 m wide walkway, which once seemed appropriate, was carrying 2.4 million people per year. To keep pace with the demand a new, wider bridge was commissioned.

DEVELOPING THE DESIGN

Well-designed objects do what they need to, and the design team first sought to find out exactly what the V&A wanted. They obviously needed a wider bridge with more capacity, but there were many ways of achieving that end. In the initial stages of the project the V&A’s commercial and operational staff were questioned about their expectations for the project. Through a quantitative process three key preference criteria stood out:

1. Functionality and reliability were important for the V&A. The new bridge had to be equally as efficient, effective and reliable as the existing bridge.
2. The cost was a fixed constraint and the bridge had to be built within a fixed budget (figure confidential but less than R30M).
3. Disruption to the visiting public, the V&A operations and the environment had to be limited.

Although the new bridge had to double the pedestrian capacity across the channel, the client required that it should match its predecessor’s speed of operation. This meant that it had to open in 90 seconds and close in 100 seconds. Furthermore, the bridge was required to be able to swing freely under ship impact rather than try to resist it.

The V&A Waterfront was rightly concerned about their visitors’ experience and the possible impact that the construction of the new bridge might have on their commercial operations. This was such a fundamental issue that it was a major factor in deciding on the location of the new bridge and on the construction method. The challenge became to find a moving bridge type that could deliver the required functionality within the set budget.

CHOOSING THE RIGHT BRIDGE TYPE

The decision on the most appropriate type of moving bridge was ultimately driven by cost. Both the capital cost and the predicted future routine and preventive maintenance costs were built up for a range of options. However, it quickly became apparent that the two viable options for the location were either a swing bridge or a bascule bridge. In the end a swing...
bridge was chosen as the more efficient option as it required less power to counter the design wind force.

SETTING THE LOCATION
To minimise disruption and the cost of any ferry service, it was critical that the existing bridge should remain operational for as long as possible during the construction of the new bridge. The time between demolishing the existing bridge and installing the new bridge therefore had to be limited.

It was decided that the new bridge should be positioned adjacent to the original bridge, allowing the new foundations to be constructed while the original bridge remained operational. However, the nose of the new bridge had to land at the same spot as the existing nose.

Moving the nose closer to the historical Clock Tower was not feasible as it would have restricted the available space for crowds waiting to cross the bridge. A plan was therefore devised to create a temporary abutment for the existing bridge while the new bridge abutment was being built. The existing bridge was rotated 10° short of its fully open position and docked into a temporary locking nose.

COMBINING STRUCTURE WITH MACHINERY
The new swing bridge uses a slewing bearing, supporting a self-anchored cable-stayed bridge. A slewing bearing option was preferred as it was considered to offer a more sustainable solution. Slewing bearings are tried and tested in both pedestrian bridge and industrial applications. Their large diameter allows them to resist overturning moment and hence a cable-stayed bridge with no backstays could be conceived. This was attractive in that it limited the works that had to be done on the quayside. It also allowed the bridge superstructure to be fabricated and assembled off-site and then barged and lifted into place, complete, on a single day.

FINAL DESIGN
In the final design it was decided by both the architect and the engineer to combine the pylon and spine beam into a single form tensioned by the stays. The desired effect of a continuous sweeping line was created by running a continuous capping element along the length of the pylon and spine.

The 40 m long deck superstructure is cable-stayed with a single plane of four locked coil cables, 28 mm in diameter, connecting to a central, upstand spine beam. The spine beam is 500 mm wide and has a total depth of 800 mm, but only 470 mm protrude above the top of the deck. An upstand beam was needed to ensure that the level of the deck surface matched the level of the quay as far as possible. The spine beam also removes bidirectional pedestrian conflicts, improving the flow of people crossing the bridge.

The superstructure sits on the slewing bearing, which is stressed down onto a doughnut-shaped pile cap by 34 vertical stress bars. The bridge is supported on eight piles, positioned in a ring.

The slewing bearing and hydraulic motors are in a plant room, created by the pile cap ring. By forming the pile cap in this innovative way it was possible to house the mechanical works within the depth of the foundations, thus reducing the required excavation depth and keeping the foundations above sea level, which was advantageous from a durability perspective.

DIGITAL MODELLING
An important part of the detailed design process was the development of a three-dimensional model in Revit of every detail of the bridge. This enabled the integration of electrical and mechanical works into the structure and provided the ability to check graphically the geometry and setting out of the bridge as it rotated.

CONSTRUCTION
On Tuesday 21 May 2019 the existing bridge was decommissioned, and disassembly began. On that Friday the preassembled new bridge deck was loaded onto a barge parked adjacent to a nearby jetty. Early the next morning the barge transported the bridge deck to site where it was then lifted and placed in position. For one month the public were ferried across the channel while the cables were being stressed, the deck level adjusted, the deck and handrail details completed, the pier head side abutment constructed, and the new barriers and gates installed.
MANAGEMENT, MEETING DEADLINES AND BUDGET COMPLIANCE
The project was delivered within very tight commercial and time constraints. It was in fact split into two stages to ensure that the construction works did not run into the V&A’s peak periods. The piling works were first built under one contract and then buried in sand and the area re-paved until the superstructure contract was activated in the following year.

SUSTAINABILITY, SAFETY AND ENVIRONMENT
Significant effort was invested into reviewing the energy, maintenance, and material and labour costs of building and running the new swing bridge. The final product is considered to be an energy-efficient and reliable solution, and the detailing and specifications of the steelwork, connections and paintwork are all aimed at extending the design life of the structure.

Care was taken to protect the existing built environment. The point cloud survey was used to record the pre-contract state of the historical quay wall and the adjacent buildings, and then to monitor the impact of the piling works on these structures.

CONCLUSION AND IMPACT
The success of the project is considered to lie in the integration of many disciplines to create a single moving form that sits seamlessly in its urban environment. Structure, architecture and lighting are integrated into a single well-designed object rather than being one layered onto another. The mechanical and electrical elements became the unseen internal workings that give the design value as a functional object. The bridge raises the standard of what can be achieved when design is integrated rather than subdivided.

There was also a happy ending for the original swing bridge which was shipped to Mauritius where it will continue its life at the Port Louis Waterfront.

The 4 m wide swing bridge can accommodate double the previous number of pedestrians.
SUMMARY

When engineering consultant Zutari (previously Aurecon) was tasked to raise the Garden Route Dam, it devised a novel solution due to unique technical constraints. The raising was needed in response to the recent drought, but also in accordance with the town’s long-term water supply planning. The existing storage capacity of the Garden Route Dam was increased by raising its full supply level by 2.5 m through the installation of a new spillway, thus enlarging the storage volume by 2.5 million m³.

The solution centred on a sophisticated hydraulic design in the form of a novel, state-of-the-art, non-linear spillway in the shape of a duckbill. Technical challenges included a bridge spanning the existing spillway opening, as well as the higher risk of overtopping to which the existing dam would be exposed.

NEED FOR RAISING THE DAM

The Garden Route Dam is one of the main water sources for the town of George. Long-term water resource assessments identified the raising of this dam as a highly beneficial and cost-effective option for development. The decision was taken to raise the full supply level of the dam by 2.5 m to gain an additional 2.46 million m³, thus increasing the total net storage volume to 12.1 million m³.

The original spillway, located on the right abutment, consisted of a linear, ogee-shaped, concrete overflow, 25 m long. A vehicle bridge crosses the spillway to provide access to the embankment. This bridge posed some challenges in terms of passing the design floods.

The relatively large and level approach channel directly upstream of the spillway was considered ideal for the construction of a non-linear weir.

The main goal of such a weir is to increase the overflow length such that the weir can pass more flow for a given overflow depth. This generally involves the construction of long spillways, typically three to five times longer than a linear spillway, in a limited area. The existing Garden Route Dam spillway was extended to 80 m by curving the spillway in the upstream direction in the shape of a “duckbill”.

DESIGN APPROACH

Although the task was to raise the dam in order to increase its capacity, the focus of the problem to be solved was on the installation of a new spillway at this higher elevation. A new overflow structure needed to have a higher discharge capacity to pass floods at a reduced freeboard. The project also had unique technical constraints, which prevented...
standard, linear or gated spillways from being used – the solution had to guide any large flows through a shallow and narrow opening presented by the existing spillway and its overhead bridge.

The design approach adopted by the project team can be summarised as in Figure 1.

The original design concept envisioned raising the dam’s water level by either lifting the existing overflow sill or installing some form of fuse gate system on the spillway. The various gate options were attractive from a capital cost perspective and would be able to pass the required floods without having to raise the crest of the embankment, all without having to make adjustments to the bridge across the spillway. Although this equated to simpler and less expensive construction, the reliability and long-term maintenance of the mechanical gate options remained a concern.

The detail design work encapsulated a comprehensive review of the design data. A re-evaluation of the dam’s flood hydrology showed flood peak values significantly higher than those that the original dam – and the gate options – were designed for. The originally envisaged raising of the spillway could not be achieved without having to raise the crest of the main dam wall as well, in order to mitigate the risk of overtopping.

Consequently, the design team had to develop a novel spillway concept that not only had a significantly higher discharge capacity than the previous alternatives but was also able to operate with as low a head as possible so as to minimise the height of the embankment raising. In addition to the spillway needing to have a high capacity, the extreme floods had to pass underneath the existing bridge across the spillway channel to avoid the high construction cost of raising or amending it.

A conventional labyrinth weir concept was examined, but this would have necessitated a significant raising of both the embankment and the bridge. This concept did, however, spark the unusual idea of having a single-cycle labyrinth similar to a trough or bathtub spillway. Refinement of this idea resulted in a tapered shape approximating that of a duckbill, hence its name.

Although duckbill or bathtub spillways are not unique, they are rare worldwide, possibly because they are difficult to predict. The Zutari team used its industry expertise to amend the hydraulic design to ensure that the weir would behave in a safe and predictable manner.

The main design criteria behind the operation of a duckbill weir is the ability of its downstream trough to remove flow, preventing backwater, or submergence effects on the main overflow crest. Although deep channels normally prevent such localised submergence, the local topography at the Garden Route Dam prevented installation of a deep channel. Since the submergence effects could not be negated, the design team instead developed the innovative idea to use the submergence to stabilise the flow and combat nappe instability. The high water level in the trough would purposefully drown out this undesirable behaviour.

The shape of the duckbill also helped to counter the restrictions posed by the shallow bridge opening. Flow bulking in its narrower upper end would force the flow to increase velocity rapidly towards the bridge. The resultant lower flow depths meant that the flow could safely pass underneath the bridge.

The final duckbill spillway design resulted in a total spillway length of 80 m, with a maximum discharge capacity of 570 m³/s at a freeboard of 4.1 m. The non-overspill crest of the embankment only needed to be raised by 1.56 m to allow for the passage of the Safety Evaluation Flood.
and the bridge across the spillway did not need to be raised or amended in any way.

CONSTRUCTION
The restrictive challenges of the site were countered by means of the following:
- A non-linear duckbill spillway with cantilever walls up to 4.9 m high
- A rock-anchored, concrete-lined floor to prevent erosion
- Partial removal of the existing concrete sill, with a drainage notch to prevent ponding
- Raising the main embankment by 1.56 m using new earthfill
- A limited implementation window to reduce the impact of flooding of the site during construction.

CRITICAL TIMING AND COMPLETION
The project was constructed on budget and on time within seven months, for just R20 million, with no claims for any extension of time or unforeseen costs. It showcased how relatively small, well-engineered and optimised adjustments to an existing water supply system can provide a more resilient system without compromising on dam safety. Furthermore, expansion of an existing water supply resource is preferable to the development of new sites as it limits the environmental impact on an already impacted site. Despite the novel nature of the engineered solution, this unique and innovative project had a low capital cost and will only have a small estimated maintenance cost.

The construction period ran from May to December 2019. This “dry weather” window was critical to minimise the risk of flooding in the dam. The coordination and sequencing of construction activities had to be carefully managed to allow completion within the available time. The dam has not yet filled up, meaning that the spillway has not yet been active.

The duckbill viewed from the downstream discharge channel; note the original spillway in the foreground.
INTRODUCTION
In April 2019 part of the 150 m long Seaward Road Bridge over the Umhlatuzana River in KwaZulu-Natal collapsed, cutting off an important regional transport link and hampering the local economy. It would have been relatively quick and easy to demolish and remove the whole structure, then rebuild it from scratch, especially under emergency provisions with a budget available. The alternative of taking apart and reconstituting the bridge involved many levels of uncertainty and risk, as the deck was specifically designed to be able to stay up only as an integrated structural arrangement and was never supposed to be tampered with once complete.

THE FLOOD AND THE FALL
The Seaward Road Bridge was constructed in 1979 as a five-span prestressed, post-tensioned concrete box girder. It supports the only direct access between the Umhlatuzana Industrial Park and major road, rail and sea connections to Durban.

The April 2019 floods in the southern regions of Durban claimed the lives of at least 85 people and caused an estimated R700 million loss in infrastructure damage, including damage to the Seaward Road Bridge.

The bridge crosses a complex curve in the river, which was originally intended to be canalised. The flooding first eroded the river’s east embankment immediately upstream of the bridge, redirecting the flow directly at the face of the eastern abutment, where the piles were exposed, and the abutment wingwall was dislodged. The saturated abutment fill pushed the precast piles out of position, then sheared them off. Without piles, the abutment collapsed. The remainder of the deck was not strong enough to perform without the support of the abutment, and the deck stresses were transmitted far beyond the end span, straining the prestress and reinforcing steel beyond serviceability, and cracking the concrete. The deck was twisted over sideways on its bearings and the end span had slumped down.

Access to the Industrial Park now required an additional detour of 5 km over a nearby hill along steep, narrow, winding suburban roads, where trucks had previously been completely forbidden. This was a hazard for both the large trucks carrying shipping containers and heavy machinery, and the local residents, including children walking to school. Congestion from trucks queuing to navigate difficult portions of road could introduce long delays in accessing the Industrial Park, holding up work and reducing productivity.

A rudimentary environmental impact assessment for the bridge reconstruction was quickly approved as part of a package of emergency flood repairs on the river. But with freedom to get the job done as simply as possible, the project team still felt a responsibility to look at both the human and environmental impacts of their plans. Trying and failing to salvage the remaining deck would waste time, but success would bring many benefits.

A careful inspection was carried out to map the extent of the strain damage, and the original as-built drawings were...
tracked down. The conclusion was that the excessive strain stopped just short of a point where a cluster of prestressing couplers connected the prestress cables from intermediate construction stages together. In principle, a new deck could be built to replace two of the five spans and the old couplers could be used to connect it with the salvaged deck and to share its loads.

**DESIGN CHALLENGES**

The original bridge was unusually unstable. The existing deck design was first completely remodelled and analysed using modern design codes and software. A number of complications were uncovered, particularly relating to torsional stiffness and global stability. The bridge is straight in its horizontal alignment so has no intrinsic stability. The piers cannot help as each has just one bearing, which cannot provide torsional restraint. The exclusive use of single-column piers gives a pleasingly sleek, minimalist visual impression. Stability is only introduced at the abutments, each of which has a pair of bearings. With the east abutment gone, the stability of the deck depended on that single additional bearing at the west abutment, 150 m away.

The collapsed portion of bridge deck needed to be removed without causing the remaining portion to collapse and become unsalvageable, while posing a major safety risk for the workers. Temporary stability was achieved with the urgent installation of ultra-heavy-duty 1000 kN props on either side of each pier. The props had to be monitored and adjusted during the demolition and construction stages to balance the torsional forces released as the collapsed spans were removed and then replaced.

The prestress analysis and design were made highly complicated by two unusual factors. Firstly, because half of the bridge is 40 years old, its concrete behaves very differently to new concrete when tensioned. Secondly, the bridge had to be lengthened by 4 m so that the piles for the new abutment would not clash with the original piles. The increased length also changed the loading and stiffness of the end span. Careful modelling of the various stages of the bridge’s construction, lifespan, demolition, reconstruction and future lifespan was done using Bentley Bridge RM software. In particular, the designers needed to be confident that, despite the variability in prestress losses, the residual force at the prestress coupler would remain balanced and the connection would not be overstressed, with extremely serious consequences.

The irregular bend and susceptibility to flooding of the Umhlatuzana River make it hard to predict its behaviour, and ongoing development upstream will produce stronger flows in the future. To safeguard Durban’s asset and public safety, an exceptionally robust new abutment and wingwall were designed. A mass abutment with encapsulated fill material provides the stability to withstand high loads and is protected by very long wingwalls. It sits atop a large, monolithic, three-tier pile cap, which required careful design, detailing and construction monitoring to ensure that no thermal or shrinkage cracks occurred in the complex arrangement. The 39 piles were installed with a specialised “overburden drilling eccentric” method to penetrate boulders, and permanent casings with a diameter of 508 mm were used to handle river scour effects.

**CONSTRUCTION CHALLENGES**

Once a reliable stabilising system was in place, the deck was sawn apart 2 m away from the 10 critical prestress couplers, which were then carefully exposed by hand. Rather than push the damaged deck off its support and demolish it on the ground, it was decided to break it up in situ using chemical explosives alongside the existing footprint and would reduce the time spent on demolition. With the deck wrapped in geofabric to prevent flying debris, a sequence of closely timed blasts created a safer, more predictable collapse. The blasts were specifically designed to prevent vibrations from destabilising the remaining portion of the deck or affecting nearby railway lines.

A major setback was discovered when the prestress couplers were exposed – the fittings from 1979 are not compatible with any of the prestress systems available today. In particular, the swage thickenings for new prestressing strands would not fit into the old coupler grooves. After extensive enquiries, the only option was to modify modern swages to fit. This required detailed empirical laboratory testing, with different modifications tested until failure, in order to confirm reliability.

**ENVIRONMENTAL EXCELLENCE**

The chosen solution was complex but left the existing footprint of the bridge in the watercourse unchanged, saved 850 m² of concrete in the existing bridge, and avoided a larger demolition that would have destroyed nearby trees with nesting birds. All 500 m³ of material from the demolished deck was recycled as layerworks, abutment fill material and gabion protection. Aesthetically, the project aimed to protect a beautiful natural ecosystem from being disturbed by maintaining the unusually limited substructure footprint and the minimalist arrangement of the existing bridge, despite the difficulties this posed for stability.
The tranquil Eerste River flows through the town of Stellenbosch in the Cape Winelands, bringing life to the surrounding agricultural and tourism communities. A key source of the Eerste River is the Stellenbosch Wastewater Treatment Works (WWTW).

In 2011, the Stellenbosch WWTW placed the livelihood of the Eerste River and the surrounding communities at risk. It was over capacity, dilapidated, struggling to meet effluent compliance, a hazard to the environment and a nuisance to the surrounding community. The rapid urban expansion of the town also placed additional pressure on the WWTW, hampering developments and economic growth within the town.

The Stellenbosch Municipality made the strategic and critical decision to upgrade the WWTW on a limited budget. Zutari undertook the planning and design of the treatment works in 2014, and construction began in 2015. The project is a testament to the technical skills in the South African water industry.

Prior to the upgrade, the main issues were odour nuisances from the plant and pollution of the Eerste River system. There was a critical need for the WWTW to be upgraded and its capacity extended to cater for future flows up until 2035. There were also financial constraints on the Municipality, and the upgrade was required to fit within a tight budget.

**DESIGN APPROACH**

The project comprised an upgrade of the plant to a full biological nutrient removal process with an average dry weather flow (ADWF) capacity of 35 Mℓ/day. The upgrade consisted of a new inlet works, a new 27 Mℓ/day membrane biological reactor (MBR) lane, the rejuvenation of the existing plant to an 8 Mℓ/day conventional activated sludge (CAS) plant, and new sludge treatment facilities. The plant’s design included other innovative features, namely a sophisticated control system, odour eradication and energy-efficient technologies. This innovative approach made the Stellenbosch WWTW the largest MBR WWTW in South Africa.
The upgrade comprises various process units and buildings.

The WWTW was designed to cater for a combination of domestic and industrial wastewater, as well for the seasonal changes in the influent loading due to the agricultural harvesting season. The design also maximised the integration of existing infrastructure into the new plant, thereby reducing the overall cost of the project.

The Municipality was an integral part of the planning and design stages, which allowed it to be involved in technology selection (process and equipment), operation and maintenance considerations and the aesthetic layout and appearance of the facility. Building Information Technology (BIM) was used to develop a 3D plant-wide model and immersed the Municipality in a 3D virtual reality tour of the plant prior to construction.

The MBR process is an advanced wastewater treatment process that uses ultrafiltration membranes for liquid–solid separation instead of conventional clarifiers. The use of MBR technology was beneficial in terms of the small footprint of the process, especially considering the spatial constraints of the site, and the production of high-quality effluent which surpasses the standards prescribed in the Water Use Licence issued by the Department of Water and Sanitation. A superior effluent quality presents immediate opportunities for the reuse of treated effluent. UV disinfection technology was adopted for the effluent of the CAS lane, which is a more environmentally friendly solution than the conventional chlorine disinfection method, and also disrupts and kills a wider spectrum of harmful micro-organisms.

Other Considerations

The building architecture and landscaping of the site were carefully designed to blend in with the natural and scenic surroundings. The landscaping made use of indigenous vegetation that would require low maintenance and low water demand.

In order to accommodate the Municipality’s budget and cash flow, the design had to allow the construction process to be phased, which also ensured that the existing works would remain operational during construction. The construction process was implemented in two phases, with all new infrastructure included under Phase 1, and Phase 2 comprising the upgrade of the existing CAS lane.

Capacity Building

Operation and maintenance of municipal infrastructure is a big challenge in South Africa. This project includes a three-year operation and maintenance period, where the WWTW operational and maintenance staff are trained by the contractor. The ability to operate and maintain this advanced facility is critical in ensuring the plant performs optimally to give the Municipality full value for its investment.

State-of-the-Art Facility

The Stellenbosch WWTW, which was fully commissioned in April 2020, is currently the largest MBR WWTW in South Africa. The incorporation of membrane technology has significantly improved the state of the Eerste River and the quality of water available for users. The MBR lane has been in operation for over a year, and the technology has proven reliable and robust. This state-of-the-art infrastructure facility puts the town of Stellenbosch at the forefront of wastewater treatment in Africa.

This project is a testament to the technical skills in the South African water industry, where consulting engineers, in partnership with municipal authorities and contractors, can provide solutions that are innovative, sustainable, operator-centric and community-focused, thereby also improving the livelihood of our rivers.
INTRODUCTION
The City of Cape Town understands the need to recycle everyday recyclable waste products, which will not only extend landfill life in the City, but also promote a culture of waste reduction and create an economy for the reuse of recyclable waste materials.

Recyclable waste in Cape Town can form between 20–30% of the waste stream by volume and, accounting for succesful diversion to a materials recovery facility (MRF), can result in a landfill airspace saving of close to the same percentage. Not only does this extend the landfill’s operating life, making waste disposal more economical, but it also promotes the sustainable reuse of recyclable waste products in the waste economy. An MRF is a specialised plant that receives co-mingled recyclable waste and, through a combination of mechanical sorting and hand picking by labour, separates and prepares recyclable materials into dedicated streams for marketing to end-user manufacturers who use recycled products as raw materials in their manufacturing or industrial processes.

The Coastal Park MRF will be Cape Town’s third MRF facility after two were previously completed in the 2010s, and it is the first to be sited on an existing operational landfill site where waste collection and disposal routes are already established.

SITING AND CONSTRUCTION CHALLENGES
The only land available for the MRF facility was an area of 65 000 m² area underlain by a 5 m thick municipal solid waste (MSW) deposit. In addition, a builder’s rubble deposit of 450 000 m³, 20 m high, was laid over a portion of the site, with no land available on the site for it to be moved to.

Approximately 60–70% of the site was covered by MSW deposit. During the geotechnical investigation, undercom posed newspapers confirmed the age of the waste as being from the late 1980s. Not only is MSW not a well-understood geotechnical material, the waste deposit is also highly variable by nature, with very different material properties possible over the entire development area. The threat of not only differential settlements, but also long-term mechanical breakdown of the organic content of the waste body
posed long-term settlement risks to any infrastructure built within or upon it. The generation of landfill gases such as methane can pose a fire and explosion risk throughout the infrastructure’s life cycle unless managed properly.

Excavating the waste and disposing of it on the operating landfill face, and importing competent material would not only have reduced landfill life by approximately 325 000 m³, it would also have come at a cost of R21 million. If the cost of importing competent new material at a cost of at least R55 million was added in, the project would not have been feasible unless an innovative and unique solution could be found by the team.

In addition, due to the sheer quantity of the material overlying approximately 40% of the site, it was not possible to measure the thickness of the MSW underneath the stockpile, and therefore to quantify the waste removal/shaping required to form the platform prior to tender, which posed a large risk of quantity variability and therefore financial variability to the contract.

INNOVATIVE SOLUTIONS
At an early stage JG Afrika recognised the importance of being innovative and engineering sustainable solutions to the many problems posed by the site. It was decided to support the building structure using single FRANKI piles, 600 mm in diameter, in each footing position as part of a piled foundation solution, but owing to the problem of supporting heavy vehicle traffic, ancillary structures and services, dynamic compaction was also required. The dynamically compacted waste is not relied upon alone, however, since the earthworks design includes a 500 mm engineered fill cap over the compacted waste, as well as a single layer of high-strength geogrid to help distribute loading across the platform and help mitigate any differential settlements experienced. This is then followed by the road or platform subbase and base course.

The best way to address the problem posed by the large rubble stockpiles was to beneficiate the builder’s waste into a product that could be used in construction. This was achieved by specifying that the builder’s rubble be crushed, screened and processed into an engineered fill product and used in the layerworks and bulk earthworks.

In order to ensure that landfill gas does not build up and pose a risk to the Coastal Park facility, an innovative gas vent system has been designed that incorporates drilling relief wells across the site, allowing a preferential path for gas release. The wells are linked by a collection pipe just beneath the surface of the dynamically compacted waste, which leads to a typical “whirly bird” extraction fan; this ensures a negative pressure to draw the gas to the surface and vent it to the atmosphere.

SOCIAL UPLIFTMENT
In a country battling with high unemployment and the Covid-19 pandemic, the MRF based on the current design has the potential to create up to 400 permanent jobs alone, with downstream jobs for delivery and pick-up of waste in addition to this. These jobs are all aimed at unskilled workers, including waste salvagers, sorters and delivery drivers, which allows the full labour market access to the positions. An informal waste sorting area has also been accommodated.

CONCLUSION
The City of Cape Town has identified the stimulation of the recycling and waste industries as a key part of a sustainable economy, and the construction of the Coastal Park MRF is an important statement of this intent. Any design for such a facility would need to reflect these principles, and JG Afrika were able to produce innovative and sustainable solutions to this unique and interesting engineering challenge.

Even with all these challenges, the contract was able to be completed in a reasonable time period, with the project outcomes having been met, as well as being under budget. The project commenced in June 2019 and was completed in July 2020.

This project serves to highlight the successful outcome when government and corporates work together to address capacity and implementing challenges in the public sector in order to achieve a sustainable benefit for the communities they serve.
OVERVIEW
The Durban Point promenade has been developed as part of the redevelopment of the entire Durban Point Precinct. This redevelopment intends to ensure free and unrestricted access to the beach in perpetuity for all members of the public.

To facilitate the high-rise beachfront development, the Promenade sits carefully between the erosion line and the building setback line. This land strip is approximately 30 m wide and is critically set above the projected high-water mark.

The Promenade is a two-level structure with circulation at the upper level and a variety of accommodation in the enclosed lower level, extending from the end of the existing promenade at uShaka Marine World to the end of the existing road at the edge of the harbour entrance, a total length of 680 m.

The 8 km stretch of the beach front, including the “Golden Mile”, stretches from the harbour mouth in the south to the Umgeni River in the north. Over the last two decades, various projects along the beachfront, particularly the 2010 upgrades to the beachfront promenade at uShaka Marine World to the end of the existing road at the edge of the harbour entrance, a total length of 680 m.

The 8 km stretch of the beach front, including the “Golden Mile”, stretches from the harbour mouth in the south to the Umgeni River in the north. Over the last two decades, various projects along the beachfront, particularly the 2010 upgrades to the beachfront promenade for the FIFA World Cup, have been instrumental in improving the quality of the beach front environment.

However, the section of the beach front between uShaka Marine World and the harbour mouth did not provide continuous access to the beach for the public. Only restricted access to the beach was provided through sites occupied by private watersports clubs. Furthermore, in 2009 the harbour entrance channel was widened, removing the King’s Battery as well as some historic harbour sheds, leading to further loss of amenity.

DESIGN APPROACH TO THE NEW TWO-LEVEL PROMENADE
The promenade is predominantly in cut to achieve the proposed platform level which is of G8 quality material, as is the fill material.

An important design consideration was the establishment of the level of the lower floor of the promenade infrastructure to deal with the anticipated wave run-up levels identified in the coastal processes study. The ground floor level of 3.8 m mean sea level (MSL) will be able to accommodate the 100-year return period storm event with the aid of a vegetated dune buffer on the seaward side of the promenade, except for the northern end where a run-up level of 4.35 MSL is anticipated. In this area, the northern ramp to the promenade will mitigate against the anticipated wave run-up levels. The erosion and scour design levels were also provided in the coastal processes study which dictated the design requirements for the sheet pile design; this will provide further shore protection throughout the lifespan of the structure.

The lower level slab was designed as a reinforced concrete suspended slab due to the low bearing capacity and cohesionless-type sands which are constantly affected by the fluctuating water table. Conventional permanent formwork has been replaced with a cement-stabilised in situ material alternative.

The upper level has been designed as a pre-stressed flat slab to accommodate the large spans. The curved profile of the slab edge presented a challenge for end blocks, therefore requiring recessed anchor blocks. The pre-stressing supplier undertook the design, supply and installation of their unique system, which is the DYWIDAG Bonded Post-Tensioning System. An independent design review was carried out by NAKO ILISO. This system provided for increased spans by reducing the number of columns, thereby providing a larger column-free area which allows for better manoeuvring of vehicles in the parking areas, as well as better utilisation of and unrestricted views within the private facilities. Drop panels were also designed on the internal spans of the Level 2 slab to account for punching shear.

CONCLUSION
The project was started in September 2019 and completed in August 2020. The management of environmental and OHS requirements, and the employment of local and classified labour were all well done, with all of the contractual targets met or exceeded. The standard of works met all specifications and the overall impression of the completed promenade is pleasingly attractive.
Durban Point Promenade
Stimulating economic growth in eThekwini

A key catalyst for the redevelopment and regeneration of the inner city providing housing, employment, commercial, retail, and recreational facilities for eThekwini residents.
OVERVIEW

As part of the Khwezela Life Ex Project, Anglo American Coal South Africa (AACS) relocated a dragline, colloquially known as the Pit Bull, from their Kromdraai reserves to their Navigation Pit reserves near eMalahleni, Mpumalanga. This project is strategically important to AACS in an overall programme to extend the life of the Khwezela Complex, bridging the production gap between the existing Kromdraai operation and the future resource potential identified in the Khwezela Resource Development Plan, which forecasts production up to 2035.

The dragline relocation study was undertaken by Zutari, starting in 2015. The detail design was done in 2018 for the walkway associated with the dragline relocation and included all civil and electrical designs associated with the dragline walk. Zutari was also appointed for supervision during construction in 2019.

The dragline, a Bucyrus 1570W model, is approximately 60 m high, 25 m wide, and weighs an incredible 3 600 metric tons. It is propelled by a combination of two walking shoes (or feet) that are 19 m long, and a tub, 18 m in diameter. The "walking" load is transferred through a series of steps from the tub to the feet, and vice versa. The machine is equipped with a boom that is 95 m long, which aids the balancing of the dragline when it walks.

For the dragline to be relocated, an 18.5 km walkway had to be built for this massive machine to walk over wetlands, railway lines, pipelines and the national route N4. It was a huge challenge as some of the biggest Eskom high-voltage lines going to Gauteng from Cahora Basa had to be bypassed, or boxed out, for the boom of the dragline not to cause damage.

A temporary dual 4-lane bypass also had to be constructed for the N4, to National Road standards. More than three years of planning, design and construction went into this capital-intensive project to ensure that the dragline could "crawl" safely to its home at a pace of 240 m per hour. Upon completion of the dragline relocation, the walkway had to be removed, and areas affected by the construction activities rehabilitated to their original state.

GEOTECHNICAL DETAILS

The geotechnical study included understanding and mapping ground risks, geotechnical investigations, modelling and design of the dragline walkway. Test pitting investigations were undertaken during the pre-feasibility study to gain an overall appreciation of the geotechnical conditions along the walkway alignment, and to identify ground risks that could impact the walkway alignment. These additional investigations were extended during the feasibility study to obtain additional information on one of the more challenging wetland crossings.

The presence of soft/compressible soils, as well as the presence of a deeply weathered diabase intrusion, necessitated further investigation to gain a better appreciation of the geotechnical conditions at depth. The dragline can accommodate approximately 300 mm of differential settlement before significant intervention is needed. The settlement design tolerance is driven by the dragline's ability to lift each foot to take the next step, as well as the ability to drag the tub. Excessive settlement could immobilise the dragline for considerable periods, which would require onerous and time-consuming remedial measures to allow the dragline to continue its walk. The design was therefore tailored to limit delays that could result in the dragline becoming immobilised.

Owing to schedule constraints encountered during construction of the walkway, it was necessary to accelerate construction activities in some of the areas along the dragline walkway. This acceleration was largely necessitated by a defined timeframe, during which the dragline was obligated to traverse an existing Transnet freight rail crossing.

A SAFE WALK

The protection layer and fill traversing the N4 freeway enabled the dragline to cross the freeway without causing deflection in the road structure. The walk over the railway line and the rehabilitation were completed successfully in only 56 hours. The combination of the geofabric as a separation layer and engineered rockfill proved effective, and the line was reinstated without significant deflections or failure of the rail layerworks.
INTRODUCTION
The purpose of the East London Industrial Industrial Development Zone (ELIDZ) is economic development and job creation. ELIDZ required the design of HOP/Refab, a 33 000 m² manufacturing facility in Zone 1A of the ELIDZ – a fast-tracked project of noticeable proportions.

The facility consists of an industrial factory and office buildings. The factory, a cladded structural steel frame with steel columns and lattice trusses, and a floor area of approximately 27 540 m² space, includes adjacent double-storey offices of 369 m². These administration blocks consist of a reinforced concrete frame with a reinforced concrete first floor. The height of the factory eaves is approximately 9.5 m.

Some of the factory requirements by the tenant included that the floor panel should be 200 mm thick seamless reinforced concrete and that the column grid position in the factory should be 18 × 18 m. The seamless nature of the reinforced concrete floor was to facilitate the installation and smooth movement of the equipment to be utilised by the tenant.

STRUCTURAL DESIGN APPLICATION
The factory floor was designed taking into account the loading and bending moments on the factory floor, geotechnical conditions, construction duration and constructability.

The geotechnical report on the site, which has a slope of 7.0 m, indicated that the soils on site consisted of collapsible potential heave and shallow bedrock. Seasonal perched groundwater conditions were also indicated.

The safe bearing resistance of the founding material ranged from 50–450 kPa. The factory and adjacent building foundations needed to accommodate the variable founding conditions from shallow rock to the deep 4.5 m fill. The expected seasonal perched groundwater conditions were addressed through the use of shallow Megaflow drains under the factory floor, draining to the external stormwater system.

A 200 mm reinforced concrete floor slab continues into the south-eastern media room roof, which spans 12 × 6 m. The required factory live load of 33 kN/m² had to be resisted. To reduce deflections and cracking at the interface between the two slabs of the factory floor slab and media room roof, the media roof’s slab thickness was increased to 400 mm and the short span extended by 6.0 m beyond the supporting wall. This provided continuity and increased slab stiffness against deflection.

The south-western media concrete reinforced media room roof of 35.5 × 14.6 × 0.400 m was supported by reinforced concrete columns around the perimeter and at internal wall positions, spaced at 10.1m–9.3m–8.7m–7.4m. The 10.1 m end span over the oil drum store had a steel column at mid-span to reduce deflections. It was indicated by the tenant during construction that this column would be an obstruction to forklifts. The column was then replaced by fixing two 457 × 191 × 67 steel I-beams at critical positions to the underside of the slab to act as composite beams with the reinforced concrete slab. This ensured that the deflection of the slab remained within allowable limits.

owe spaced at 6 000 mm centres and were designed to resist the loads and bending moments transferred from the steel columns.

Small cracks were expected in the reinforced concrete resulting from thermal movement and concrete creep shrinkage. The reinforcing design aimed to limit crack width to <0.2 mm. There is indeed aggregate interlock at the cracked positions as was expected, but this system of continuously reinforced concrete reduces the cost of joint maintenance in the long term, such as would be required in a jointed floor.

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The King Edward VII School Aquatic Centre, Houghton, Johannesburg, is a redevelopment of the previous uncovered ageing school swimming pool into a world-class aquatic centre to be used for the swimming and water polo learners of both the high school and junior school.

The architectural design maximised the existing swimming pool site to encompass a 2 750 m² covered, but naturally ventilated, aquatic centre to include two large new pools for swimming and water polo, plus a learn-to-swim facility. Within the covered area, a new double-storey adjoining structure houses the changing rooms, upper viewing platform and plant rooms, while keeping and upgrading the original entrance to the pool area on the northern side – a structure with significant heritage value. A focal point of the development is the intricately featured roof with clear spans over the pools and an intriguing stepped apex, creating an unusual form and space.

Several structural solutions to complement the architectural intent were formulated and discussed regarding the feature roof. Options ranging from a traditional trussed roof to a space frame were considered. In the end a combined off-shutter reinforced concrete (RC) support frame and slender plate girder, long-span portal roof solution was chosen to accentuate the space and form while providing a slick minimalistic roofing structure.

In further developing the structural design it became evident that the nine uniquely shaped 720 x 300 x 137 kg/m fabricated plate girder rafters at 6.0 m centres, spanning 32.25 m, would be supported on large 400 x 1 200 mm by 8.0 m high RC columns to the west, and the single bay RC portal, 9.3 x 8.0 m high, with a 5.2 m cantilever support arm to the east. This eastern portal would create the frame between which the changing area at ground level and the viewing platform and upper plant room would be built.

To keep the exposed roof structure as sleek as possible, and detail the connections as cleanly as possible, the consultant, WCSE, proposed the use of cast-in high-strength anchors to create the capacity required for the two critical steel-to-RC moment connections. The western connection called for a moment capacity of 845 kNm at the column, while the eastern beam connection required 540 kNm capacity, all within a width of 400 mm, and as neat as possible to give the “springing” sensation the roof design required. On both ends RC corbels and seats were designed to take all shear load in order to use the cast-in anchors for pure tension.

Peikko (Pty) Ltd was engaged to review the connection anchor requirements and together with the team the Peikko COPRA Anchor system was chosen – 8/M39 anchors to the western connection and 6/M39 anchors to the eastern connection. This is the first time in Africa that these anchors have been used for such a purpose.

Due to the stepping apex point in plan of the roof, there was a constantly changing roof surface slope in two directions. Global Roofing Solutions confirmed that their Zip-Tek 420 sheeting profile would work. Thereafter, WCSE designed the fanning CRLC purlin system to support the sheeting and over-purlin Lambdaboard thermal and acoustic insulation. In addition, the two horizontal cross-bracing bays were confirmed, plus the associated RC end portals to provide stability in the north-south direction, while the eastern RC portal frames provided east-west stability. Once the feature roof design was confirmed, the remainder of the centre’s structural design was carried out.

The nine sets of RC off-shutter supports were cast between October 2019 and January 2020, completed as the plate girder rafters were delivered to site for installation in late January 2020.

In conjunction with the feature roof construction, the two large watertight RC pool shells were cast. The shells incorporated the various box-outs required by the pool specialists for the filtration and cleaning system, as well as the sports equipment anchors. In addition, the precast hollow-core planks were lifted into place in February 2020 to create the suspended floor to the new eastern block.
The Midmar Water Treatment Plant (WTP), which is located in Howick, KwaZulu-Natal, is owned and operated by Umgeni Water and treats raw water from the Midmar Dam located on the upper Umgeni River system. The WTP supplies water to a large number of areas, including Howick and most of the south-western and southern suburbs of Pietermaritzburg, Richmond and the Umlaas Road node, and eThekwini Metropolitan Municipality’s Outer West area. The supply area has recently been extended via eThekwini Metropolitan Municipality’s Western Aqueduct.

The WTP required upgrading from a design operating capacity of 250 Mℓ/d on a raw water intake basis to 395 Mℓ/d, corresponding to a treated water production capacity of 375 Mℓ/d. The plant utilises chemical dosing, super pulsators and rapid gravity sand filters, with disinfection using chlorine gas for the production of potable water. Sludge and wash water effluents are treated in a sludge plant from which treated effluent is discharged to the Umgeni River, and dewatered sludge is disposed of on nearby land.

In order to supply the new quantum of raw water to the plant, the rising main needed to be duplicated, three of the existing pumps had to be replaced, and a fourth pump and motor with associated pipework had to be installed. The upgrade of the rising main pump station was carried out under a separate contract by Bosch Projects, while the duplication of the rising main was carried out by others, although the hydraulics and systems integration design was carried out by Hatch.

Phase 2 of the project required the addition of several key modules to an active water treatment plant. On the surface, it may appear that adding modules of an existing proven design should be fairly straightforward, and for those particular elements (super-pulsator, filters, clariflocculators and thickeners) the module sizing was predetermined from known process performance parameters. However, for this particular project there were multiple multi-disciplinary elements that had to be integrated into the existing plant. All of this work had to be carried out with minimal disruption to the production of water, and brought online without affecting the environmental compliance of the plant’s discharge to the Umgeni River.

One of the project highlights was the re-engineering of the design for the backwash plant outlet to the river which was constructed from excavated rocks and boulders to ensure an aesthetic, yet functional, structure that blends into the surroundings as it is visible to the public from the other side of the river.

Numerous safety principles were included in the design of the upgrade, such as the addition of chlorine ventilation equipment to the filter gallery, as well as structural modifications around the filter syphon valves to improve working conditions for operational staff.

One of the highlights of this project included a new chlorine tanker facility, complete with an emergency chlorine scrubber (ECS) that serves the dual purpose of providing continuous ventilation to both the existing chlorine drum room and the new chlorine tanker room via a network of ducts and electrically actuated dampers.

The number of contractors and subcontractors involved exceeded ten, while the number of individuals who had some form of input easily exceeded 500. Managing these diverse inputs and requirements was one of the most significant challenges faced by the consulting team.

Construction commenced in May 2015 and was completed by June 2019. Potable water is now available to a bigger service area, thus reaching communities that previously did not have access to a reliable supply.
OVERVIEW

The Northfield Business Park is Durban’s newest Premier Business & Logistics Park, strategically located north of Durban close to major routes leading to King Shaka International Airport, the Port of Durban and the N3 freeway to Johannesburg. The development will eventually comprise 13 upmarket warehouses with a total gross leasable area of 170 000 m². The project is aimed at meeting the growing demand for warehousing and industrial space in the greater Durban area.

The feasibility of developing this 30-hectare portion of land seemed impossible due to the adverse terrain (steep slopes falling towards an internal watercourse), unfavourable in-situ material quality, and geotechnical issues. However, with innovative and committed engineering the seemingly impossible has been achieved.

The project consisted of approximately 1.7 km of asphalted roadway, 2.7 km of piped stormwater reticulation, 2.5 km of sewer reticulation, 2.3 km of water reticulation and 8 km of electrical and telecommunication ducting. With the varying internal top structure requirements, provision of access and service connections required extensive coordination. eThekwini Metropolitan Municipality are currently designing a major upgrade on Old North Coast Road and the site accesses had to suit existing and future road levels at the tie-ins.

BULK EARTHWORKS

Given the large size of the site and the number of platforms required, the immediate challenge was producing a balanced cut-to-fill earthworks design while still maximising platform extent and maintaining project feasibility. This was further exacerbated by the various types of material found on the site, namely shales, siltstone, dolerite, sandstone, Berea red sands and residual clays. Approximately 2 million m³ of earthworks were required to be moved to achieve the platformed sites over three phases.

Just over one third of the material was unsuitable for conventional fill. Therefore, to avoid offsite spoiling, various alternatives (sandwiching, blending and encapsulation) were applied. End-user requirements and material utilisation resulted in the platform levels and sizes being in a continuous state of flux. This meant that platforms, roadways and service designs needed to be flexible while still tying into the respective boundary constraints. The platform designs resulted in some fills reaching depths of about 40 m above the existing ground level.

STORMWATER ATTENUATION

The extents of the platform finishes and yard areas resulted in a substantial increase of hardened surface area and associated runoff. SMEC designed the stormwater system and attenuation pond with outlet-control measures. The design utilised the existing wetland area basin for storage and infiltration. The system would eventually discharge and connect into the existing municipal stormwater system that is located on Old North Coast Road.

A 1 800 mm diameter pipe culvert was designed to convey and discharge attenuated outflows from the development to the existing downstream culvert. This culvert was 310 m in length and its alignment traversed one of the design platforms, resulting in it being buried 25 m below the finished platform level. The culvert would therefore be subjected to excessive loading because of the weight of the material above it. To alleviate the loading on the buried pipes SMEC incorporated a compressible layer above the pipe. This approach was used to transfer the load away from the pipe and through the adjacent fill material.

ENVIRONMENTAL ISSUES

Dust-suppression and monitoring measures were implemented, while the visual impacts on adjacent residential areas were alleviated by planting trees to create a screen around the warehouses. The protection of the very rare and endangered frog species, the Spotted Shovel-Nosed Frog, was handled with the assistance of the Endangered Wildlife Trust.

CONCLUSION

The third and final phase was completed in September 2020. The Northfield Business Park project provided numerous challenges that were successfully overcome by all role players, resulting in the development of a premium logistic business park that has created invaluable employment opportunities and is set to bolster Durban’s economy.
Rehabilitation of the M4 Embankment – Durban

SUMMARY
The Department of Transport, together with the eThekwini Metropolitan Municipality, faced a major challenge as periodic heavy rainfall, coupled with a burst underground concrete pipe, resulted in major erosion of the eastern and western embankments and partial collapse of the M4 Freeway in Umhlanga. A solution that would be functional, cost-effective and environmentally friendly was very urgently required. The M4 is a north-south metropolitan route in Durban, lined by indigenous coastal forest and the ocean. It is a significant regional artery connecting the central Durban CBD to the KwaZulu-Natal North Coast and is used by thousands of commuters on a daily basis.

The solution was a collaborative team design, including the installation of a new high-density polyethylene (HDPE) underground stormwater pipe, with the upper and lower slopes of the embankment reinforced with a Green Terramesh® system, and repairs to the collapsed road layer works.

DESIGN OF REINFORCED SOIL STRUCTURE
The design of the soil reinforced structure using Paragrid (Geogrid group) and the Green Terramesh facing was conducted in accordance with SANS 207:2006. A limit state design philosophy was used, which involves increasing the soil weight and external loading by appropriate partial load factors, and reducing the soil properties and geogrid strength by appropriate partial material factors.

The internal stability depends on the ability of the reinforcement to resist loads imposed on the slope. The slices method for circular slip analysis was used to calculate the internal stability of the slope.

The effects of dead loads and external loads were considered during the external stability check on the slope. Stability was checked against bearing and tilt failure, forward sliding and slip circle failure in accordance with SANS 207.

For each layer that required reinforcement, two layers of geogrid were positioned in both the longitudinal and transverse directions. Longer lengths of lighter strengths of geogrid were required to prevent pull-out.

The reinstatement of the western embankment comprised mechanical stabilisation of the embankment positioned over the fill soils that formed the grade for the HDPE pipe. To increase the stability of the embankment to an acceptable factor of safety, soil nails were used that would penetrate through the Green Terramesh, the backfill material and the loose fill soils, and that would terminate within the medium-dense to dense aeolian soils within the slope. Due to the ground conditions encountered on site, the Self Drilling Anchor (SDA) system was adopted. Corrosion protection in the form of zinc coating was provided on all soil nail bars.

AESTHETIC APPEAL
Prior to failure, the slopes were covered with vegetation which contributed to their stability. As new vegetation would take a significant time to establish, face (erosion) protection consisting of the environmentally friendly Green Terramesh was used. The washaway had led to a mudslide which affected the Umhlanga Lagoon Nature Reserve that is a sanctuary for small wildlife and a number of wetland and coastal forest species. Green Terramesh allows for a 45° batter and adds an environmental feature since the system allows for greening to provide a visually pleasing landscape. Plants to match those existing there were reinstated on the upper and lower slopes.

CONCLUSIONS
After six months, including a stop in construction due to the current Covid-19 pandemic, this strategic arterial route was successfully opened to the public. The sensitive nature of the emergency project required excellent and efficient engineering and project management work by the entire project team.
BACKGROUND
The development of the Menlyn Node, along Atterbury Road in Pretoria, included the upgrading of the Atterbury Interchange.

Maccaferri was involved with the specialist design, supply and site supervision of the retaining walls, using mechanically stabilised earth wall solutions. Using high-tenacity polyester straps, the soil was reinforced to stand vertically, while for the face several options were available depending on the client’s requirements and tolerances – a gabion face, a vegetated face or a concrete panel face.

The interchange consists of five major soil-reinforced walls with a maximum height of 13 m covering a total area of 4 300 m². The designs were performed in accordance with the latest design code, SANS 8006:2012, using ad hoc, specialised design software, limit equilibrium, and finite element analysis for the assessment of deformation such as settlements and horizontal movements both in the short and long term.

FIRST OF ITS KIND
The project is a first of its kind to have made use of three different types of retaining structures combined to meet the project requirements: concrete panels for the BRT ramp, while a gabion face was used in the proximity of the attenuation pond to merge with the adjacent gabion hydraulic structures. For the first time the two systems (gabion and concrete panels) were also used in the same section to blend the two systems and create a smooth transition, achieved by replacing the last 1.5 m high drop with concrete panels, sitting on top of the gabions with an offset to demarcate the transition.

The concrete panel system, MacRes®, consists of a combination of geotext soil reinforcement connected to large concrete facing panels. The polymer geotext linear reinforcement is placed between compacted layers of structural backfill and is intimately connected to the precast concrete panels. The panels, 140 mm thick with an average size of 2 m², were cast in a dedicated area and delivered to site ready to be installed in progressive layers as the height of the reinforced compacted backfill rose behind.

The gabion face wall, the Terramesh® System, is a modular system used to form rock-faced reinforced soil walls. It was used at the base of the attenuation pond to cater for wet/dry scenarios up to 4 m high. The gabion face has a long-standing history of being one of the best-performing erosion-control measures in hydraulic structures. Placed on top, reaching the final road level up to 12 m high, the MacRes with concrete panels blended with the general requirement of a concrete panel facing which delivers excellent aesthetics, low maintenance and a high-reliability finish to the walls.

The attenuation pond was designed as a collection point for two major culvert outlets coming from Garsfontein Road and Dallas Avenue, as well as surface run-off. The pond was designed for a 1:100 year return period reaching a flow of 86 m³/s. To protect the toe of the wall from possible scour, Reno Mattresses® were included along the entire wall in the pond. A silt trap was also constructed.

Another challenge was the request to include a staircase to assist pedestrians to access the bus station on top of the bridge and for ease of mobility. Two walls were constructed 2 m apart, creating the base of the staircase, a front and a back wall. The front wall’s panels were stepping up, while the rear wall’s panels were stepping down. Also, during excavation of the foundation, although a geotechnical investigation had been performed, several soft layers were encountered and a “dump rock” stone blanket was constructed along the length of the MacRes wall and affected areas to reduce differential settlements.

A FLAGSHIP PROJECT
The uniqueness of this project lies in the use of different retaining systems, as well as in the complex geometry catering for high drops. Construction started during September 2015 and was completed in November 2019.
Sappi Saiccor Woodyard Upgrade

OVERVIEW
Sappi Saiccor’s Mill, situated 50 km south of Durban, is one of the production facilities for Sappi Saiccor Dissolving Pulp. In 2018, the Mill embarked on increasing its capacity to raise production volumes from 783 000 to 890 000 air-dry tons per annum, mostly for the export market, through various expansion project investments throughout the Mill. For this purpose, the company needed to upgrade the woodyard and its equipment, the chemical and recovery areas, the fibre line and the uptake machine.

To make space for the project to commence, the entire woodyard at the Sappi Saiccor Mill needed to be rearranged. This involved the decommissioning of two of the existing chipping lines and the stockpile area, as well as the installation of a new chipper (300 tons per hour) to replace the decommissioned capacity. A new, completely automated woodchip stockpile system needed to be erected in the area previously used as a timber stockpile area. The rail system required a complete redesign to enable the offloading of timber directly to the new chipper and existing Chipper No 6. The Woodyard Upgrade Project commenced in August 2017 and was completed in April 2019.

As the chipper is one of the largest in Africa, innovative structural design for movement and vibrational effects was required, which included the use of reinforced concrete frame structures and piled foundations for the chipper foundation, chipper building, log receiving table and chipping line. The use of precast structures expedited construction.

INGENIETY
One of the technical complexities and most innovative solutions was the design of the new chip piles reclaim tunnels where, due to poor ground conditions, large ground settlements were expected under the weight of the new chip piles. Piling would have been highly expensive and impractical considering the volumes and depths of piling that would have been required (piling up to over 30 m deep, hundreds of piles). A geotextile, mechanically stabilised earth raft was designed to reduce the effects of differential settlement under the tunnels.

The reinforced concrete tunnels were then built in “keyed tunnel segments”, pre-cambered (built higher on a curve) to allow for calculated anticipated settlements along their lengths, all to ensure that the mechanical equipment on rails would not be disrupted by differential settlements (including the reclaimers which cantilever off the tunnels).

Precast construction was used for the chip pile walls, which saved time. The project included precast buttresses and precast wall panels. The buttresses supported the A-frame above, for the conveyor gantries. The buttresses had to be piled for relative movement.

To facilitate the best solution for the Sappi Saiccor plant, the new screen building was positioned above the existing sulphur store. The final design, comprising multi-level steel frame structures, was supported on a new, large, reinforced concrete table frame structure over, and interfacing with, the existing sulphur storage area. This further assisted in reducing the vibrational effects of the chip screens.

The project also involved the replacement of the entire railway line and the railyard, inside an existing and operating infrastructure.

CONCLUSION
Despite the extremely congested operation and project interface, the SiVEST management team was able to complete the project to a high standard of accuracy and with very little disruption to Sappi’s operations. Local procurement was a key focus area, with 80% of the project spend awarded to local entities. At peak there were 15 contractors on site employing more than 620 people, which equated to 1 206 861 man-hours.

Sappi Saiccor’s Mill, situated 50 km south of Durban
INTRODUCTION
The Signature is a four-storey concrete-framed building in Rosebank, Johannesburg, containing 37 new residential units. The building is the maiden project of a new developer and UBACON was approached not only to design the concrete frame, but to also assist with constructing it.

UNIQUE FEATURES
The ground conditions were not favourable for the construction of the building without modification to the ground, or piling. The costs and advantages of ground improvements versus piling were considered – the cost saving on ground improvements and the opportunity for employing labour-intensive methods made ground improvement the method of choice. Excavations for the base were done and the bases were over-excavated and backfilled using dump rock and good soil to improve the bearing capacity of the ground. The improvement in the soil meant that concrete bases could be used to found the building at a reduced footprint.

Once the design of the base improvements had been done, an as-built survey to check the alignment and setting out was conducted. It was then unfortunately discovered that there was an error in the initial setting out by the surveyor and a solution needed to be found.

The solution was to consolidate all the pads and create a uniform raft of 2 000 m² requiring 500 m³ of concrete. The raft had to accommodate all services and have falls to accommodate drainage. Due to the level differences on the site, the raft also had to incorporate a retaining wall. After 84 trucks of concrete, the task was completed.

ARCHITECTURAL CHALLENGES
The architect’s vision was that every apartment and every room would have natural light, including the bedrooms on the south side with no access to light due to being in the middle of the building. The solution was to bring in light from the roof as a light tunnel. The positioning of the light wells, however, was not ideal – they were located in crucial support lines or along expansion joints. A method of supporting the slabs, having the lightwells and not compromising on the design was developed. This involved some cantilevering and some hanging elements ("structural gymnastics").

Having floating walkways, designed as balanced cantilevers, created unique special elements in the building and created a feeling of lightness.

The site had a big crossfall across its length. This was optimised to accommodate basement parking. The challenge with the levels was that all the existing services were shallow and connection into them needed to allow for adequate gravity drainage. To solve this involved having the roof drainage suspended to the first-floor slab, which mitigated any falls needed at the ground floor. A stormwater attenuation facility was also introduced on the site and all this water was used as grey water within the building. All the lower-level apartments have gardens on the suspended slabs and the grey water assists with garden maintenance.

The architectural elements included a large amount of concrete features. For this reason steel hanging details were used that supported brickwork. The brickwork was then plastered and painted, giving concrete lookalike beams, without compromising the effect in any way.

Due to the length of the building, two expansion joints were needed. The challenge was to conceal the joints while not compromising the façade of the building. The solution involved tucking the slab behind a feature wall that had the ability to expand and contract. The expansion joints worked out beautifully with movement, as anticipated and designed.

CONCLUSION
Buildings mould us – they change the way we think about spaces, they excite our minds and they create opportunities. A project at inception is a possibility – a possibility of what could be. The time spent at The Signature not only grew the team technologically, but also advanced the way they now think about structures.
INTRODUCTION
The uMshwathi Local Municipality in KwaZulu-Natal is supplied bulk water from Umgeni Water’s DV Harris Water Treatment Plant (WTP). In 2007, Umgeni Water investigated the provision of bulk water services to Efaye, Ozwathini and Southern iLembe, which revealed that the Wartburg System was reaching its ultimate capacity and therefore would need to be augmented. Thus the uMshwathi Regional Bulk Water Supply Scheme was implemented in a number of phases. Hatch were appointed by Umgeni Water to undertake the detailed design and construction monitoring of Phase 2 of the scheme.

Phase 1 consists of an 850 mm diameter steel pipeline from the existing Claridge Reservoir to a new 8 Mℓ reservoir at Wartburg, while Phase 2 consists of a 700 mm diameter steel pipeline from Wartburg to a new 10 Mℓ reservoir at Dalton and two pump stations. Two booster pump stations were designed and constructed, one on the Phase 1 pipeline (constructed under a separate contract) and the second on the Phase 2 pipeline.

The Phase 2 pipeline consists of 15.1 km of 700 mm diameter steel pipe with a 6 mm wall thickness and 3LPE coating, with 57 chambers incorporating air, scour and isolating valves.

The 10 Mℓ Dalton Reservoir is a 40 m diameter prestressed concrete structure with a flat concrete roof slab and a height of 9.4 m. The reservoir was constructed on an existing reservoir site with future planning of a second identical reservoir. Concurrent construction of the Phase 3 infrastructure on the same site under a separate contract required close coordination and liaison between the respective consultants and contractors.

The interface between the Phase 1 pipeline and the Phase 2 pipeline is the new 8 Mℓ Wartburg Reservoir which was constructed under a separate contract adjacent to two 1.5 Mℓ reservoirs. The integration of the three reservoirs was added to the scope of the Phase 2 project during the contract and required the construction of new chambers, pipework and control systems on the Wartburg site.

INNOVATION IN DESIGN AND CONSTRUCTION
The scheme has a 40-year design horizon, so the civil structure and pipework were designed and constructed for the ultimate flows, while the pumps and electrical switch gear as installed cater for the first two duty points over 20 years. Through the use of variable speed drives, the speed of the pumps, and hence the volume of water supplied, can be adjusted as required.

The integration of the existing Wartburg Reservoir system into the overall uMshwathi Scheme was complex, as there were multiple permutations of flow scenarios. This required the development of complex PLC programming that took the various criteria into account, but at the same time allowed the flexibility for the parameters to be adjusted in the future.

The risk to personnel working on pipelines as a result of stray AC currents is becoming more important and the client, in considering these risks, embraces a strategy of no harm, adopting a conservative approach. During construction, a decision was made to retrofit AC protection measures on all chambers on the Phase 2 pipeline, and following this success they were extended to key chambers on the Phase 1 pipeline.

CONCLUSION
Phases 1, 2 and 3 of the scheme were constructed with overlapping time frames and the key to the success of commissioning the scheme and delivering water was effective coordination with the various role-players; this is highlighted as a critical key success factor in this project. A high-quality end product was produced with minimal impact on the environment. At the same time, the project ensured the development and empowerment of communities, emerging contractors and consultants, in line with national development goals.
SUMMARY
More than 6,000 households, living in over 28 identified informal settlement areas within the Mossel Bay municipal area, benefited from a project to install Emergency Shared Basic Services. The initiative has made a marked difference to the quality of life of the communities living in these settlements.

The supply of these interim basic services was the first step in the incremental upgrading of all the area’s informal settlements under the Upgrading of Informal Settlements Programme (UISP) process. The process to formalise and develop permanently serviced sites (Stage 3 of the UISP) is by nature lengthy, and interim action to improve the living conditions of the residents’ households had become a high priority.

The Mossel Bay Municipality appointed Zutari (previously Aurecon) as its implementing agent, responsible for coordinating and managing the overall deliverables of the UISP process.

Commencing in May 2019, construction of the project to install interim basic services was completed by June 2020. It was implemented during Stage 1-2 of the UISP, in parallel with the formal in situ township establishment processes and the development of permanent enhanced serviced sites with secure tenure.

The success of the challenging interim project was to a large extent due to innovative engineering design development on site, informed by close and meaningful community collaboration. A sense of proud ownership in the outcome was generated by involving the community in the design, and employing local labour in the construction processes.

PROJECT ASSESSMENT WITH COMMUNITY ENGAGEMENT
The first step of the project was to conduct an assessment of all existing services in each informal settlement to identify what had to be rehabilitated to render them functional. A community survey was also conducted to establish the number of households living in each area and to determine the demand for additional interim shared basic services infrastructure to meet the identified shortfalls.

Following the demand assessment, engineering designs for new infrastructure were completed and cost estimates prepared. The placement of new infrastructure was often challenging due to the nature of informal settlements, which were sometimes very densely populated, combined with a topography that featured steep slopes. In-depth engagement with the communities was undertaken to inform the final placement of infrastructure.

Zutari monitored the construction activities during the 12-month contract. Ongoing engagement with the communities was required in each area to minimise community conflict and to encourage the residents to take ownership of the new facilities and prevent vandalism, as well as to exercise continued care and maintenance of the infrastructure.

CHALLENGING DEMANDS
The project was very much a team effort with various specialists from different disciplines and backgrounds collaborating and finding solutions to complex problems. Experienced and careful community engagement was key to the whole process.
Zutari’s human-centred approach focused on finding the strengths and talents of the beneficiaries, and identifying the people who already had the basic skills to work on the project. In total, 90 people were then trained to have job-specific portable skills and to be employed on a contractual basis. The beneficiaries bought into the process of empowerment from grassroots levels up and drove the project themselves. This successful approach left portable skills in the community and provided a source of income for the duration of the project.

Interest in the project was high, and a sense of pride and dignity was created among the beneficiaries. The project was done by the people for the people and the general feeling was “we did it ourselves”.

SCOPE OF WORKS
The interim services contract included:
- Construction of sewer pipelines with associated manholes and connections
- The supply, assembly and connection of on-site fabricated toilet structures
- Construction of standpipes for water supply with associated connections
- The rehabilitation of existing toilet structures.

The scope of works included the rehabilitation of 372 existing toilets and 76 water points, together with the installation of 326 new toilets and 112 water points across the informal settlements, including the link infrastructure to connect the toilets to the municipal infrastructure network.

Instead of the usual method of supplying externally manufactured whole precast concrete toilet structures, an innovative Envirosan toilet design was used, involving the production of kits of concrete panels at a temporary on-site facility. This innovation enabled the maximum use of additional local labour to be trained in the casting of concrete panels and assembling the toilet structures for the project.

ENVIRONMENTAL IMPACT AND COMMUNITY INVOLVEMENT
The informal settlements were generally densely populated and it needed careful engagement with the communities to inform them about what was planned, and to incorporate any community requirements into the designs. The designs also had to be responsive to changes, such as adding extra toilets for new settlements not in the original plan, or making provision for wheelchair users in certain instances, or having to move infrastructure due to access considerations. Achieving community buy-in was essential to ensure that the new infrastructure would be protected by the communities using those facilities and to limit vandalism and neglect.

A janitorial capacity building programme was also initiated in which people from the community were trained and registered under the Community Development Workers Programme for the cleaning and maintenance of the toilet facilities. The programme is a long-term initiative that is creating employment opportunities and community ownership of the facilities.

SOCIAL ENGAGEMENT AND BENEFITS
The interim basic services initiative made a marked difference in improving the quality of life for the residents living in informal settlements. Previously, the people had limited access to infrastructure such as taps and toilets. There were a number of existing toilets and water points in selected areas, but that infrastructure was badly damaged and mostly disfunctional. The initiative rehabilitated most of the existing infrastructure and added extra infrastructure in the areas where the need was the greatest.

CONCLUSION
The project commenced in November 2018 when the funding application and investigations were completed. Construction started in May 2019 and was completed within time and within budget in June 2020.

The whole first phase intervention project was successfully completed. Due to shortfalls in infrastructure as well as the continued growth of the informal settlements in the municipal area, additional emergency shared services are again required in most areas. Second-phase intervention funding application has been submitted to the Western Cape Department of Human Settlements and once funding is approved, additional infrastructure can again be added. This will enhance the Mossel Bay Municipality’s commitment to improving municipal service delivery to the vulnerable communities living in the surrounding informal settlements.
INTRODUCTION

Food security and enterprise development are two goals for any rural development effort, no less so for the Department of Agriculture, Land Reform and Rural Development (DALRRD). The Nkungumathe community within rural northern KwaZulu-Natal was identified by the DALRRD as fitting participants of such an endeavour; this was facilitated through the development of agricultural land under irrigation.

Following a tender process, JG Afrika (Pty) Ltd were appointed for the feasibility, design and construction monitoring of the development of an 18 ha greenfields development for vegetable production, namely the Nkungumathe Irrigation Scheme in the Nkandla Local Municipality of the King Cetshwayo District Municipality.

KEY CHALLENGES

The development of an irrigation scheme incorporates a wide variety of requirements, including environmental requirements and constraints, water supply, crop selection and associated agricultural potential, community interactions and skills development, as well as structural and water engineering.

Several key challenges were encountered during the development of an irrigation scheme for this site. Firstly, there was a need to accommodate water demand flexibility during irrigation, considering the varied requirements across 11 plots to be managed by 11 local cooperatives. Then, there was a large difference in elevation (up to 100 m) between the water source and the land parcels identified for development, which would conventionally result in extremely high energy costs.

Consequently, there was a need to ensure that the subsequent operational costs for the irrigation development would remain within the grasp of small-scale farmers.

There had to be simplicity and consistency of design to provide for the steep learning curve that would be experienced by the local community who would now become “irrigation farmers,” and thereby improve the chances of sustained utilisation and management of the infrastructure.

The end users, i.e. members of the local cooperatives, needed to understand and buy in to the project in order to facilitate the promotion of skills development and technology transfer as required for on-going utilisation of such a system.

PROJECT SCOPE

Irrigation infrastructure developed for the Nkungumathe Irrigation Scheme included:

- A reinforced concrete pump station building and abstraction works on the Mhlaluze River, containing two 30 kW centrifugal pump sets, and a 250 mm diameter steel rising main with associated pipes and fittings
- Two steel panel reservoirs (200 kℓ and 150 kℓ respectively) and a high-lift pump station housing a 17 kW centrifugal pump set with associated pipework and fittings, as well as solar panels and associated equipment to power the pumps during irrigation
- Two steel agricultural storage sheds to serve as a produce storage facility and for the safe storage of agricultural machinery and implements
- Gabion works for erosion control and the restraint of historic soil erosion that would have extended into the irrigation area if left unresolved.

The specific issues highlighted above were addressed by the following:

- Water demand flexibility: Two bulk water reservoirs provide storage capacity for water after both abstraction and an initial lift, but before distribution in-field. From these reservoirs, part of the irrigation area may be irrigated directly by gravity, whereas the water requirements for the remainder of the irrigation area may be serviced through direct delivery in-field from the high-lift pump station that is situated adjacent to the reservoirs. This accommodates the fluctuating water demand in-field, which is dictated by the operational demands of individual
cooperative members, without adversely affecting operation or the efficiency of the water abstraction and supply.

- **High elevation difference and subsequent high energy requirement:** The irrigation infrastructure is entirely solar-powered. This eliminates both the direct energy usage costs and fixed time-based costs that would be expected for utilisation of electrical infrastructure (such as is conventionally supplied by Eskom). The estimated energy cost saving is R22 000 per month if operated at peak demand.

- **Simplicity and consistency of design:** The irrigation system selected is a dragline sprinkler irrigation system, which is the simplest system to manage compared with other system options and was utilised by a nearby irrigation development, so there is already some familiarity with this type of irrigation system. Furthermore, the in-field sprinkler layout, sprinkler selection and scheduling are consistent across the entire scheme, allowing neighbouring farmers and cooperatives to assist one another due to the similarity of irrigation scheduling between plots.

**EMPOWERING SUSTAINABILITY**

Community understanding and contribution is a critical component of such a development. DALRRD was consulted regarding the identification and selection of available sites prior to the feasibility assessment and on the choice between drip and dragline sprinkler irrigation. The findings and recommendations of the feasibility assessment were presented by JG Afrika to the DALRRD and cooperative representatives before the design was finalised; the community selected dragline irrigation.

The high energy requirements due to the greatly differing elevations across plots created a need for a sustainable, energy-efficient solution independent of the current national grid. This led to the innovative utilisation of solar panels to supply power to the pump stations. The agricultural produce farmed from the lands will be used, firstly, to provide food security to the community and, secondly, to provide a means of income through the sale of excess produce. Solar energy allows the cooperatives to be independent of the grid, thereby ensuring there are no steep monthly electrical operation costs that would be detrimental to the affordability of the scheme for the local farmers and reduce their profit margins significantly. The solar panels are an excellent example of renewable energy providing long-term sustainability for communities, while at the same time allowing the optimisation of an engineering design.

The Project Steering Committee met regularly to address construction and community-related issues. This committee included representatives from the Nkungumathe cooperatives who were actively part of the consultation process required to reach resolution on these issues. The contractor used local labour for activities such as pipe trenching and pipe laying. This provided a short-term income stream for local community members, as well as skills development, which will be of significant value to participants during the operation and maintenance of the scheme. Hands-on training was done on site with 25 community members. Participant selection was done by the community.

Further support after completion of construction is anticipated through the Department of Agriculture’s extension service to farmers during cultivation, including seed and fertilizer required.

**HUGE BENEFITS TO THE LOCAL COMMUNITY**

The significant contribution to civil society is highlighted by the effect on the ability of local community members, within the rural context of the Nkungumathe community, to provide food security and enable potential enterprise development through sales of subsequent produce.

The irrigation scheme provides the potential for 36 permanent jobs during production. The scheme impacts 11 local cooperatives, and not only supports these cooperatives, but also gives hope to other aspiring cooperatives seeking support. This provides a tangible demonstration to local scholars as to how the contribution of civil and agricultural engineering can have a positive impact on livelihoods and facilitate the opportunity to change lives.

**CONCLUSION**

The project commenced in January 2019 and was completed in March 2020. The local community are now in possession of an irrigation infrastructure that will promote their own food security and will encourage enterprise development within their community at a significantly reduced operational cost.
The eThekwini Zibambele Poverty Alleviation Programme, initiated in 2003, demonstrates significant benefits in terms of sustained alleviation of poverty by providing participants with the opportunity to re-establish a sense of identity and social reintegration that comes from being gainfully employed.

The Programme attempts to provide meaningful employment for mostly woman-headed households in the rural and peri-urban areas of the eThekwini Municipality. It provides cost-effective, labour-intensive methods for the routine low-intensity maintenance of the Municipality’s rural road network.

In addition, Zibambele provides training for civil engineering students who are able to use the Programme to obtain the necessary skills for their experiential training. The Programme demonstrates the critical role of civil engineering in bettering society by facilitating job creation, skills development, capacity building and the alleviation of poverty.

The Programme is aligned with the government’s mandate to create short-to medium-term employment opportunities aimed at reducing unemployment. Households, rather than individuals, are engaged to carry out the maintenance activities. Each contractor is assigned a length of road, varying from 0.3 km to 0.5 km, depending on the difficulty of the terrain. The Programme currently employs 7 000 participants, equating to an estimated 3 000 km of the Municipality’s road network being maintained.

The Programme provides contractors with employment for two days per week to perform their road maintenance tasks. Daily tasks typically include maintenance of the road drainage system, ensuring good roadside visibility, maintaining the road surface in good condition, clearing the road verges of litter and noxious weeds, and other labour-intensive activities as determined from time to time.

The EZM Joint Venture team of 24 passionate staff play an active role in the daily management and operations of the Programme.

Through the Programme, eThekwini Municipality’s Roads and Stormwater Maintenance Department is fulfilling a core function, namely the maintenance of its road network and other assets. This is demonstrated through:

- Reduced maintenance costs, through the targeting of people living within walking distance from their places of work.

What differentiates the Zibambele Programme from other poverty alleviation programmes is that it creates meaningful work, while also offering longevity and sustainability through its household employment model.

With the Programme being a significant employer of members of the community, community support plays a vital role as it facilitates inclusive and extensive stakeholder engagement. eThekwini Ward Councillors, together with local communities, are responsible for determining which participants are employed through the Programme. This creates a true sense of ownership on the Programme and of partnership with the Municipality.

The selection process is a consultative one which engages the community where the neediest of households are identified; this is verified through a Means Test. Participants from households are employed on a one-year fixed-term contract and, upon expiry, the community either opts to renew or replace the participant.

The Programme relies on Zibambele Coordinators to support and monitor the participants daily. They are individuals studying towards a Diploma in Civil Engineering, and therefore the Programme assists with providing experiential training. On a bi-annual or annual basis, the Programme is currently able to provide 16 students with experiential training.

The health and safety of the participants and operational staff is of critical importance. For example, after the lifting of the stringent Covid-19 lockdown restrictions, the operational tasks on the Programme did not resume until masks and hand sanitisers had been procured for every Coordinator and participant on site. The Coordinators follow the Covid-19 screening procedures every morning to ensure that no participant is vulnerable to the virus.
Environmental sustainability is also an important value of the Programme. The Programme aims to enable environmental control by paying careful attention to erosion and pollution. The participants are trained to manage grass verges in such a way as to prevent erosion. Refuse collected on site is no longer burned but is collected and transported to central depots where it can be separated and, where possible, recycled.

Other than the objectives relating to poverty alleviation, job creation and maintenance of infrastructure, the eThekwini Zibambele Poverty Alleviation Programme provides an ideal opportunity for the forging of links between the Municipality and local communities, with community involvement ensuring that there is buy-in and sustainability.

The involvement of civil engineering students in the project provides skills transfer that is crucial in ensuring the advancement of civil engineering. The Programme demonstrates the socio-economic benefits of having a healthy partnership between civil engineering, government and community participation, while also addressing the government’s fundamental objectives.

The Mjweni Pedestrian Bridge over the Thongazi River in KZN links the settlements of Ncukeni and Makatini on the south coast of KwaZulu-Natal. Previously it was a great challenge for residents of the two villages to cross the river, especially during the rainy season when there was also a particular safety concern for young children going to school.

The Mjweni Pedestrian Bridge over the Thongazi River

The Mjweni Pedestrian Bridge over the Thongazi River in KZN links the settlements of Ncukeni and Makatini

In 2017, the MMK Group was appointed to undertake the design and construction of a pedestrian bridge that would link the two villages.

The bridge consists of three spans simply supported on continuous steel trusses and platforms fixed to reinforced concrete columns. This type of bridge was chosen for the ease with which the steel members could be fabricated and taken to site in transportable lengths.

The budget for the approximately 70 m long bridge structure (including the walkway) was approximately R2 500 000. More than 20 direct jobs were created during construction, with 15 of the workers being local residents from both villages.
Kashimbila Multipurpose Dam, Hydropower Station and Network Integration

**INTRODUCTION**

The preliminary design of the Kashimbila Multipurpose Dam on the Katsina-Ala River in the Taraba State, Federal Republic of Nigeria, was initially focused solely on the dam’s functioning as a buffer in case the natural embankment of Lake Nyos in nearby Cameroon failed. As the design process progressed through a more multi-purpose approach, the capacity of the dam was increased to provide irrigation and potable water to the surrounding towns and villages, as well as for the generation of hydropower.

The Government of Nigeria appointed SCC (Nigeria) Ltd (SCC) to design and construct the flood protection dam, subsequently changed to provide a multi-purpose use. SCC then first appointed Zutari to review the concept design of the spillway proposed by the Federal Ministry of Water Resources and then to undertake the detailed design, including an increase in the capacity of the proposed 6 MW hydropower generation to 40 MW, as well as better routing of the transmission line to improve the electricity network and distribution in eastern Nigeria. Some key project components designed by Zutari were:

- A 36 m high composite dam
- A 40 MW hydropower station and associated substation capable of releasing 260 m³/s
- The Kashimbila substation equipped with 2 × 30 MVA triple winding transformers for the local rural electricity supply
- A 132 m long bridge to connect the two riverbanks
- The necessary outlet works for the irrigation supply, the potable water supply, and the river releases
- 210 km long double-circuit 132 kV transmission lines and 45 km long double-circuit 33 kV transmission lines, both with OPGW with lattice towers
- 45 km of 33 kV reticulation network supplying electricity to numerous small towns and villages
Two new 2 x 60 MVA 132/33 kV substations and two new 2 x 15 MVA 33/11 kV substations, as well as the upgrading of the 132/33 kV Yandev substation. The project took many years to complete – from November 2007 to March 2020. It has had a huge positive impact for Nigeria and is one of their showcase Presidential Projects. Its benefits to the local community include job creation, potable water supply, electrification, and an improved transmission network to this region of the country.

A COMPLEX AND CHALLENGING PROJECT
Several challenges made the project complex and difficult to undertake.
Nigeria does not have a significant manufacturing or heavy engineering manufacturing sector. The country had very limited galvanising facility, so all galvanised steel had to be imported. A construction camp had to be designed for approximately 800 semi- and unskilled workers and 21 expats. Also there were no facilities, and communication around the site was poor. At the beginning of the project, the team relied purely on satellite communication.

As is often the case, a lack of hydrological data on the river made water resource studies difficult to conduct. Several flow measurements were carried out on site to rate the gauge plate installed by the contractor, with the highest flow measured by Zutari being ~ 1 470 m³/s using the Sontek M9 acoustic doppler and the contractor’s jet ski.

The Government of Nigeria used the opportunity of the interconnector between Kashimbila and the grid (Yandev substation) to expand the transmission network in the deprived region, resulting in the lines being lengthened from approximately 105 km to 210 km. However, it caused significant complexity in terms of voltage regulation along the line, as well as overall network stability issues.

Tribal issues raised security concerns around the dam area and along the transmission line route, and sometimes the site had to be locked down when violence erupted.

A dolerite dyke encountered under the power station required an adjustment in the arrangement. Additional grouting was also required at the contact between the dolerite and the gneiss rock formations. Extensive weathering through a lineament and weakness in the river channel required substantial foundation treatment, consolidation, and preparation before the clay for the core of the embankment could be placed.

On two occasions the project had to be suspended due to a lack of funding. In 2014, an Ebola outbreak during the peak of the construction made travelling challenging. In addition, malaria was fairly common. The hot and humid climate played a significant role in the design of the HVAC and equipment.

UNIQUE AND UNUSUAL FEATURES
The project has a number of unusual features, the first one being the diversion of the river through culverts left in the dam. Typically, in dam engineering, a diversion tunnel or a separate cut-and-cover conduit would be used to divert the river. In the case of Kashimbila, the project had to be designed for the high flow variations annually and a high tailwater level. The gradient of the riverbed is flat, with the riverbed at 168.5 masl and the river still having to travel 900 km before reaching the sea. The site did not allow for a diversion tunnel, and hence the concept was to construct a gravity spillway off channel while letting the river continue to flow in its natural channel as long as possible, and to leave 10 ‘culverts’ through the mass gravity structure for the next phase of the river diversion.

The design allowed for a partial closure of the river diversion by closing the first eight culverts. This required the construction of a separator wall upstream and downstream to be able to place an embankment coffer dam to isolate the first eight culverts. The last two culverts were then closed by dropping the sacrificial gates upstream of the culverts, to start impoundment.

The forming of the ogee crest was innovative. As the ogee has a specific shape, containing three radiuses, the contractor suggested prefabricating some elements, which would be placed 2.5 m apart the better to guide the required formwork. The prefabricated elements had holes to allow for lacing bars and, through good control, also used a low-shrink concrete mix to bind the precast element and the in-situ concrete.

NOTABLE ADVANCES IN ENGINEERING
Zutari’s innovative, out-of-the-box thinking led to several changes in the initial concept of the project.

The spillway, hydropower releases, and the approach and return channels were modelled at Stellenbosh University. The modelling resulted in optimisation of the design.
Choice of turbines played a key role in the success of the project. Vertical Compact Axial Turbine (CAT) units were selected, commonly referred to as the ‘Saxo’ type, alluding to its shape. This arrangement, offered by only a few suppliers in the world, was based on the ability to pre-assemble as much of the turbines as possible in the factory, to transport the turbines to site, and then to assemble and embed them as easily as possible.

From the inception of the detailed design in 2012, Zutari used 3D design to improve the quality of design and presentation to the construction team and, more importantly, to integrate the various elements of the project and ensure a zero-clash approach, which facilitated the construction and minimised disruption. The electro-mechanical elements (provided by the supplier as solid 3D files) were brought into the Revit 3D models in order to minimise the interfaces. Models were exchanged between Zutari and the turbine supplier to ensure that components, such as the cable trenches, cables, cable ducts, secondary concrete, hydraulic pipes, cooling water supply and compressed air pipes systems, were a perfect match. Through proper planning, collaboration and interface management, this collaboration between all the parties was a resounding success.

Using 3D models, finite element models for analysis were also developed for various components of the project for optimisation purposes. The development resulted in significant cost savings to the project, not only on the dam and hydropower structure itself, but also on the transmission towers. The transmission line lattice towers were designed from scratch following the requirements of the contract for a new Wind Zone (wind zone as defined by the TCN specifications, where the project was located in Wind Zone C effectively receiving winds of up to 120 km/h). Once designed, the different types of tower were individually type-tested in a specialist facility in Eastern Europe.

In view of the importance of the hydraulic profile on the upstream side of the turbine and its directly coupled generator, Zutari conducted a computational fluid dynamics (numerical) model analysis of the full waterway. At the time, such a model was state-of-the-art. Working hand in hand with SCC and the turbine supplier, Zutari was able to design the structure economically without any inherent risk to the electro-mechanical equipment. Being a low head scheme (~ 18.5 m head at rated output), each 10 cm of head loss had a significant value, estimated to be around USD$ 2.7 million over a 30-year period.

Taking into consideration the lack of fabrication capability in Nigeria, the location of the site, the costs of shipping and land transport, and other logistics challenges, Zutari specified to Profection, the specialist subconsultant, that the design of the gates was to be largely modular and able to fit into standard containers as far as possible. The various modules were then assembled on site and lifted into position.

SUCCESSFUL HANDLING OF IMPACTS ON THE ENVIRONMENT
Offering significant sustainability features, the project’s initial design for a flood-control structure was changed to a multi-purpose dam, and included increased energy production, improved reliability of water supply, and consideration for significant commercial farming downstream.

The project was in full compliance with the environmental mitigation plan. The dam also offers a navigable way between the villages located on the left and right banks. In addition, the dam improved the fishing prospects for the locals, and a pilot aquaculture project is currently under way.

The annual energy generation of the project, estimated to be ~ 236 GWh/annum on average, gives power to close to a million people. (In 2011, the average energy consumption per capita was calculated to be 150 kWh per capita per annum.) This is a reduction of approximately 99 120 t/CO₂ per annum for Nigeria.

EXCELLENCE IN ENGINEERING
The technical design parameters derived from the project specifications developed by the Federal Government of Nigeria were relatively generic. However, the international standards and industry best practice used were contributors towards this successful flagship project.
The Road Development Authority of Mauritius (RDA) has for some time been planning a bridge across the Grand River North West (GRNW) valley to link the areas of Chebel and Sorèze on the eastern and western sides of the valley in order to ease the growing vehicular traffic congestion and provide a dedicated pedestrian walkway between the two areas. Finally, on 11 April 2018, the government of Mauritius and the RDA launched the construction of the A1M1 link as part of the country’s larger road decongestion programme. The piling works commenced in September 2019 and were completed in February 2020.

**UNUSUAL FEATURES**

The new bridge is based on a classic extradosed design and is the brainchild of Systra International Bridge Technologies. Boasting a bridge deck length of 330 m and supported by two piers towering more than 80 m above the river level, the bridge is set to become a national landmark. The piers are supported on 80 piles of 1 080 mm diameter.

The underlying soil profile at each pier position revealed a combination of silty gravels, colluvium, clay, rock layers and boulders, which are common in riverbeds and pose significant challenges for the piling works. To overcome the complex soil profile, a combination of rock augers, coring buckets and a chisel were used. Where thick rock layers were encountered, a cluster drill was used to penetrate these layers. The cluster drill incorporates numerous small down-the-hole (DTH) hammers and is specifically designed to penetrate hard rock. Having both methods available on site enabled the team to reach the required founding depth with relative ease, regardless of the ground conditions.

In addition, a first for Mauritius, two O-cell tests were carried out to verify the design and construction of the foundation piles. O-cell tests require no kentledge or reaction piles and proved to be cost-effective for tests with very high test loads. These tests were carried out by Fugro Loadtest.

**CONCLUSION**

As the bridge is located within a valley, access could only be provided through a single narrow access road. The combination of restricted access and working platforms, and the requirement for many items of equipment and tools meant that careful planning and implementation of the piling works was needed to meet the tight timeline of the project.
OVERVIEW
Located approximately 30 km from the capital city of Accra, Tema is home to around 70% of Ghana’s major container and port-handling traffic. The container terminal has been operated by Meridian Port Services (MPS) since 2007. In June 2015, an agreement between the Ghana Ports and Harbours Authority and MPS was signed for the development of a new harbour and container terminal, an expansion of the Port of Tema.

The new port project is located adjacent to the old port and has been designed to provide enough draught and modern container-handling equipment to accept and service the largest container vessels operating on global trade routes. The new port can accommodate vessels with a capacity of 22 000 TEUs, increasing from 5 000 at the old port. The new terminal will significantly increase Ghana’s container-handling capacity to around 3.7 million TEUs per year from 800 000.

The main construction works entailed:
- rubble mound breakwater of 3.55 km
- 1 400 km quay wall
- capital dredging for the inner basin, turning circle and approach channel
- 127 ha of reclamation and ground improvement
- 90 ha of heavy-duty pavement and underground services
- infrastructure for electrified rubber-tyred gantry cranes
- 12 MW back-up power station, substations and other electrical works
- port and terminal gates
- four major buildings and numerous smaller buildings
- upgrade of the access to the port involving a new roundabout and approaches.

The marine works commenced in late 2016 and the land works in early 2018. The first parts of the quay and rear crane rail were completed in December 2018, allowing the commission of the ship-to-shore cranes.

The first milestone achieved was the handover of the project works (the first commercial operations for two container berths –700 m) to the operator in June 2019. The second milestone (commercial operations for three container berths –1 000 m) was achieved in April 2020. The marine works for the fourth berth were completed significantly ahead of schedule during June 2020.

HEALTH, SAFETY AND ENVIRONMENT
The track records for health, safety, environment and social performance were excellent. A construction project of this magnitude has significant scope for the degradation of the environment and the local communities, mainly fishermen. It was therefore vital to carry out all construction works, and subsequent operations, in a manner that minimised any negative impact on the community, and the onshore and offshore environment. Throughout the project life cycle, much consideration was given to the environmental and social impacts.

Some specific interventions included the construction of an offset turtle nesting and hatching beach, and the interception, collection and treatment of drainage water from the city of Tema which formerly discharged directly to the sea.

CHALLENGES OVERCOME
As Ghana is a seismically active zone, the design of the marine and land infrastructure needed to address liquefaction of marine sediments and the reclamation materials, and the structural stability of the breakwater, quay wall and buildings. Solutions included the removal of liquefaction-prone materials, consolidation of marginal foundation materials and detailed analysis and structural design of major elements.

For several months, Ghana experiences unsuitable sea conditions for marine construction. Therefore, to place the caissons safely, and carry out the hard rock dredging, the construction of the breakwater was advanced, thereby providing enough sheltered water for year-round marine operations.

SOCIAL BENEFITS
Over 4 000 staff worked on this project, more than 90% of whom were Ghanaians. Having been exposed to international construction standards, and health, safety and environmental systems, this project will leave a legacy. The staff returning to the Ghanaian labour market have gained skills and training to further develop themselves and contribute to the growth of the economy.
SAICE Individual Awards

In the SAICE Individual Awards sub-category a number of awards were made by the Institution under the headings listed alongside, and presented to the winners by SAICE President Fana Marutla.

Division of the Year: Project Management and Construction Division
Benti Czanik received the award from SAICE President Fana Marutla on behalf of the Division

Branch of the Year: Johannesburg Branch
Chairperson Refilwe Lesufi received the award on behalf of the Branch
Nikeshnee Padiachey, chair of the Chapter, was thrilled with their award.

Project Manager of the Year (award sponsored by Egis Operation South Africa): Amjad Hendricks Pr CPM

Amjad has exceptional skills as a construction project manager at Zutari, and is the ‘go-to-guy’ in construction-related matters in his region.

Graduate Technologist of the Year: Parellin Naidoo

Parellin works at Bosch Projects, leading the construction monitoring of the eThekwini Municipality’s Northern Aqueduct Augmentation Phase 5 Bulk Pipeline Project.

Graduate Engineer of the Year: Naadira Ballim

Naadira, who works in the water section at JG Afrika as a civil engineer, is the vice-chair of the SAICE Pietermaritzburg Branch where she also advances the profile of women engineers.

Young Technologist of the Year: Letshego Sehume Pr Tech Eng

Letshego, who is the immediate past chairman of the SAICE Bloemfontein Branch, works for the Municipal Infrastructure Support Agency, providing technical support to various municipalities in the Free State.

Technologist of the Year Highly Commended: Marisa Ackhurst Pr Tech Eng

Marisa, who is an Associate (Marine Structures) at Zutari is the first South African to publish an ICE design guide in the marine and coastal engineering field.

Most Supportive Advertiser of the Year: Reinforced Earth, represented by Bom Maqude (the runner-up was AfriSam who unfortunately could not attend the event).

These awards are made annually by the SAICE magazine to recognise the continued and loyal support of SAICE’s magazine advertisers.

Student Chapter of the Year: University of Johannesburg Auckland Park Kingsway Campus

Nikeshnee Padiachey, chair of the Chapter, was thrilled with their award.
Technologist of the Year: Kamashan Reddy Pr Tech Eng
Kamashan, who works for Transnet Group Capital as a Senior Manager overseeing the Transnet Freight Rail civil, permanent way and geotechnical design departments in Gauteng, is also the chairman of the SAICE Railway and Harbour Division.

Young Engineer of the Year (Joint Winner) (award sponsored by PPS): Byron Mawer Pr Eng
Byron, who works for JG Afrika, is a highly skilled young engineer with an MSc in Geotechnical Engineering; he is also the current chairman of the SAICE Western Cape Branch.

Young Engineer of the Year (Joint Winner) (award sponsored by PPS): Radeshni Moodley Pr Eng
Radeshni, who is Section Manager for the Urban Development Function Group in SMEC South Africa’s KZN Region, is a natural leader and a role model for other women engineers.

Engineer of the Year (sponsored by Reinforced Earth): Monro Jansen Pr Eng
Monro serves on SAICE’s Finance and Administration Committee, mentors SAICE graduate members, coaches maths and science at high schools, and partially sponsors the UJ Student Chapter, all in addition to running his own civil engineering company, Infraconsult Engineering.
SIZABANTU Piping Systems
2020 Photo Competition
The Winning Photos

We thank the panel of judges for making time in their busy schedules to sift through and choose the winning photos in our popular annual photo competition. The judging criteria include:

- the creative portrayal of civil engineering activities or projects
- originality
- photographic expertise
- visual impact
- balance and artistic composition
Second: Construction Unit Swartberg Pass
Photographer: Adam Moolagee

Third: In Time
Photographer: Victor Bicamumpaka
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<td>Getting Acquainted with Ethics</td>
<td>19 May 2021 Midrand</td>
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<td>TBC ECSA</td>
<td>Stewart Gibson</td>
<td><a href="mailto:lizelle@saicepdp.org">lizelle@saicepdp.org</a> <a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<td>Getting Acquainted with General Conditions of Contract 3rd Edition (GCC2015)</td>
<td>1–2 February 2021 Midrand</td>
<td></td>
<td>CESA-1575-04/2022 Credits: 2 ECSA</td>
<td>Theuns Eloff</td>
<td><a href="mailto:lizelle@saicepdp.org">lizelle@saicepdp.org</a> <a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<td>Getting Acquainted with Geosynthetics in Soil Reinforcement</td>
<td>10–11 May 2021 Midrand</td>
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<td>SAICEgeo20/02758/23 Credits: 2 ECSA</td>
<td>Edoardo Zannoni</td>
<td><a href="mailto:lizelle@saicepdp.org">lizelle@saicepdp.org</a> <a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<td>28–29 June 2021 Midrand</td>
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<td>Theuns Eloff</td>
<td><a href="mailto:lizelle@saicepdp.org">lizelle@saicepdp.org</a> <a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<td>Getting Acquainted with Road Construction and Maintenance</td>
<td>17–18 March 2021 Midrand</td>
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<td><a href="mailto:lizelle@saicepdp.org">lizelle@saicepdp.org</a> <a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<td>Getting Acquainted with Sewer Design</td>
<td>19–20 April 2021 Online</td>
<td></td>
<td>CESA-1577-04/2022 Credits: 2 ECSA</td>
<td>Andrew Brodie</td>
<td><a href="mailto:lizelle@saicepdp.org">lizelle@saicepdp.org</a> <a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<tr>
<td>Getting Acquainted with Stormwater Design</td>
<td>3–4 May 2021 Midrand</td>
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<td>Andrew Brodie</td>
<td><a href="mailto:lizelle@saicepdp.org">lizelle@saicepdp.org</a> <a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<tr>
<td>Getting Acquainted with Water Resource Management</td>
<td>8–9 April 2021 Midrand</td>
<td></td>
<td>SAICEwat18/02328/21 Credits: 2 ECSA</td>
<td>Stephen Mallory</td>
<td><a href="mailto:lizelle@saicepdp.org">lizelle@saicepdp.org</a> <a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<tr>
<td>Pressure Pipeline and Pump Station Design and Specification</td>
<td>22–23 February 2021 Port Elizabeth</td>
<td></td>
<td>CESA-1578-04/2022 Credits: 2 ECSA</td>
<td>Dup van Renen</td>
<td><a href="mailto:lizelle@saicepdp.org">lizelle@saicepdp.org</a> <a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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Register online: www.saice.org.za
### SAICE / Candidate Academy 2021

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<tr>
<th>Course Name</th>
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<td>Road to Registration for Candidate Engineers, Technologists and Technicians</td>
<td>8 February 2021</td>
<td>Johannesburg</td>
<td>CESA-1579-04/2022 Credits: 1 ECSA</td>
<td>Allyson Lawless Stewart Gibson Phathi Masimirembwa</td>
<td><a href="mailto:lizelle@saicepdp.org">lizelle@saicepdp.org</a> <a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<td>Road to Registration for Construction Project Managers and Construction Managers</td>
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<td>Midrand</td>
<td>TBC SACPMP</td>
<td>Ken Bromfield</td>
<td><a href="mailto:lizelle@saicepdp.org">lizelle@saicepdp.org</a> <a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<td>3 June 2021</td>
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<td>16 March 2021</td>
<td>Midrand</td>
<td>CESA-1641-10/2022 Credits: 1 ECSA</td>
<td>Stewart Gibson Phathi Masimirembwa</td>
<td><a href="mailto:lizelle@saicepdp.org">lizelle@saicepdp.org</a> <a href="mailto:dawn@saice.org.za">dawn@saice.org.za</a></td>
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<td>Road to Registration for Mentors, Supervisors and HR Practitioners</td>
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<td>CESA-1580-04/2022 Credit: 1 ECSA</td>
<td>Allyson Lawless</td>
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### SAICE / South African Road Federation (SARF) 2021

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<tr>
<th>Course Name</th>
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<td>TBC</td>
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<td>SAICEtr19/02471/22</td>
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<td>J Onraet</td>
<td><a href="mailto:sybul@sarf.org.za">sybul@sarf.org.za</a> <a href="mailto:tshidi@sarf.org.za">tshidi@sarf.org.za</a></td>
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<td>Assessment and Analysis of Test Data</td>
<td>TBC</td>
<td>TBC</td>
<td>SAICEtr20/02606/23</td>
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<td>R Berkers</td>
<td><a href="mailto:sybul@sarf.org.za">sybul@sarf.org.za</a> <a href="mailto:tshidi@sarf.org.za">tshidi@sarf.org.za</a></td>
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<td>Concrete Road Design and Construction</td>
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<td>B Perrie Dr P Strauss</td>
<td><a href="mailto:sybul@sarf.org.za">sybul@sarf.org.za</a> <a href="mailto:tshidi@sarf.org.za">tshidi@sarf.org.za</a></td>
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<td>Successful G1 Crushed Stone Construction</td>
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<td>D Rossmann</td>
<td><a href="mailto:sybul@sarf.org.za">sybul@sarf.org.za</a> <a href="mailto:tshidi@sarf.org.za">tshidi@sarf.org.za</a></td>
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<td>Stormwater Drainage</td>
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<td>SAICEtr20/02608/23</td>
<td>4.5 ECSA</td>
<td>C Brooker Dinggaar Mahlangu Alaster Goyins</td>
<td><a href="mailto:sybul@sarf.org.za">sybul@sarf.org.za</a> <a href="mailto:tshidi@sarf.org.za">tshidi@sarf.org.za</a></td>
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<td>Traffic Signals Design and Intersection Optimisation</td>
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<td>Dr John Sampson</td>
<td><a href="mailto:sybul@sarf.org.za">sybul@sarf.org.za</a> <a href="mailto:tshidi@sarf.org.za">tshidi@sarf.org.za</a></td>
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<tr>
<td>Non-Motorised Transport Practitioner’s Course</td>
<td>TBC</td>
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<td>Dr Hubrecht Ribbens Andrew Wheeldon</td>
<td><a href="mailto:sybul@sarf.org.za">sybul@sarf.org.za</a> <a href="mailto:tshidi@sarf.org.za">tshidi@sarf.org.za</a></td>
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<td>Traffic Impact Studies: A Complete Step by Step Training Course on how to prepare Traffic Impact Studies</td>
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<td>Ravash Dookhi</td>
<td><a href="mailto:sybul@sarf.org.za">sybul@sarf.org.za</a> <a href="mailto:tshidi@sarf.org.za">tshidi@sarf.org.za</a></td>
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<td>HDM4 (The Highway Development and Management)</td>
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<td>Prof Alex Visser</td>
<td><a href="mailto:sybul@sarf.org.za">sybul@sarf.org.za</a> <a href="mailto:tshidi@sarf.org.za">tshidi@sarf.org.za</a></td>
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<td>Perspective on Traffic Impact Assessment</td>
<td>TBC</td>
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<td>SARF17/TIA01/20</td>
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<td>Steven Sutcliffe Prof Mark Zuidgeest</td>
<td><a href="mailto:sybul@sarf.org.za">sybul@sarf.org.za</a> <a href="mailto:tshidi@sarf.org.za">tshidi@sarf.org.za</a></td>
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<td>Understanding and Investigation of Road Traffic Accidents</td>
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<td>Craig Proctor-Parker</td>
<td><a href="mailto:sybul@sarf.org.za">sybul@sarf.org.za</a> <a href="mailto:tshidi@sarf.org.za">tshidi@sarf.org.za</a></td>
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</table>

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. For SAICE-hosted Candidate Academy in-house courses, please contact: Dawn Hermanus (dawn@saice.org.za) on 011 805 5947 or Lizelle du Preez (lizelle@saicepdp.org) on 011 476 4100.

Register online: [www.saice.org.za](http://www.saice.org.za)
Our Fifth Know Your Sector Competition Winner!

Arvin Mothilal from Durban is the October winner of our monthly Know Your Sector Competition, and says he was simply elated when he received the news of his win. “I had a sixth sense kind of feeling when entering the competition that this win would be mine. This is certainly a silver lining to an incredibly challenging year and could not have come at a more opportune time, seeing as we are moving into the festive season. The prize money will be used to spoil my wife and kids over the Christmas period.”

Arvin also shared his enthusiasm about his work. “I am currently employed by AECOM SA where I work as a Design Technologist on many multi-disciplinary projects for commercial and industrial clients. I am passionate about the great technological innovation in BIM and VR and the integration within the civil engineering industry. I love that I am a pioneer in our industry contributing to the development of a more innovative future, inspiring growth and passion about civil engineering as a profession. I am grateful to be a part of this industry where there are always new opportunities to learn and develop new skills.”

He says that he is definitely The Family Guy. “My hobbies and interests include game nights playing charades with my family, whipping up scrumptious desserts with the kids even though I end up doing all the work and they do the messing and eating. I enjoy playing and watching soccer with my little guy and gardening with my daughter, and I especially enjoy spending quality time with my other half.”

Arvin’s dreams for the future are to use his line of profession to better himself and the world we live in and to help create a more sustainable and positive way of life for the future generation. “I aspire to always be better than I was yesterday.”

Know Your Sector Competition
Stand a chance to win R10 000 in cash!

In this month’s edition of Civil Engineering we are continuing our Fun Quiz to promote knowledge of our industry service providers. Simply click on the adverts (or the logos) of the participating companies to access their websites, and then search for the answers to the following questions:

Q1: Ctrack
With the Ctrack industry solutions such as mining and yellow equipment, mobile asset tracking and fixed plants, airports, agri solutions, small business and consumer solutions, your fleet and assets are … what?

Q2: Technocad
RebarMate is the reinforced concrete and detailing software module of the Technocad Civil Engineering software suite, which runs inside AutoCAD. For which specifications does RebarMate allow you to produce automated bar bending schedules?

Q3: Reinforced Earth (click on the logo on the front cover)
What two types of soil reinforcements can be used in Reinforced Earth® structures?

Q4: Standard Bank
Which one of the services listed on the questionnaire does Standard Bank offer to construction businesses specifically?

Q5: Nako Iliso
In which municipality is the Durban Point Promenade Project?

Q6: Geberit Southern Africa
Which of the options listed on the questionnaire is NOT a benefit of the Geberit Pluvia roof drainage system?

Q7: Allyson Lawless & Associates
For how many years have Allyson Lawless and Associates been developing and supplying structural engineering software solutions?

TO ENTER: Scan or click on the QR code to submit your answers (submissions, one per reader, will be collected until 31 January 2021, where after the winner will be announced from a random draw).

PS: Advertisers who wish to capitalise on the reader attention here by including their marketing messages into our monthly Fun Quiz should please contact Barbara Spence (barbara@avenue.co.za / 011 463 7940 / 082 881 3454).
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