FULTON AWARDS

FULTON Awards 2013

Concrete Beton

A celebration of excellence and innovation in the use of concrete

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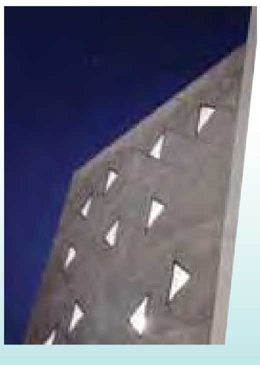

President's Message

It is my honour as President of the Concrete Society of Southern Africa NPC (CSSA) to present this Fulton Awards edition of the Concrete Beton. In this special issue we detail descriptions of all the entrants in the 2013 Fulton Awards and, of course, the winners!

The biennial Fulton Awards is arguably the most prestigious award that a project team can receive in the built environment sector of southern Africa. The Awards are held in honour of the late Dr Sandy Fulton who made a significant contribution to the concrete industry. The first Fulton Awards was held in 1979 and has grown to be one of the highlights on the industry's calendar. The mission of the CSSA is to promote excellence and innovation in the use of concrete and these awards reflect the very best use of this material in the country.

My heartiest congratulations to the winners of the iconic 2013 Fulton Awards. This is truly a great achievement and reward for the vision, hard work and effort put into your project. It was unfortunately not possible to make an award to a project in the Community Structure category.

I also wish to commend each and every one of the 26 entrants.The quality was exceptionally good and it is once again an indication of the high standard of our local industry. We can really say that the innovation and excellence of these projects can be compared to any project worldwide.

The judges had a very difficult task to select the winners amongst the many entries. The adjudication team included John Sheath, CEO of the Concrete Society of Southern Africa NPC; Peter Kleynhans, President of the South African Institution of Civil Engineering and Sindile Ngonyama, President of the South African Institute of Architects - they spent nearly three weeks visiting every project in the country and one in Namibia. Their contribution was essential to the success of the event and they were not only impressed by the projects, but also by the professional manner in which the project teams hosted them.

I would like to thank the administration staff of the Society - the team 'behind the scenes'. A large event such as the Fulton Awards requires an extremely diligent team to ensure a successful event. Thank you, Natasja and Jeanine for everything that you have contributed to this prestigious event and also to the Society in general.

Lastly, I wish to express my gratitude to the sponsors of this event, particularly AfriSam, Lafarge, NPC-Cimpor and PPC who collectively are our Anchor Sponsors. The event, would of course not have been possible without our sponsors and their generous donations. Thank you for being part of the development of our industry.

Yours sincerely,
Billy Boshoff

VISION: To be the most relevant forum for those who have an interest in concrete and to promote the related services of the CSSA members.

MISSION STATEMENT: To promote excellence and innovation in the use of concrete and to provide a forum for networking and for the sharing of knowledge and information on concrete.

Office Bearers: President: WP Boshoff (Prof), **Vice President:** R Maliehe, **Past President:** NP van den Berg, **Branch Chairs:** R McSporran, H Turner, T du Plessis, J Fortune. **Directors:** PRA Flower, BD Perrie and CD Kalis, **Chief Executive Officer:** PJ Sheath, **Administrator:** NL Pols, **Honorary Members:** WM Johns, DP Samson, CJ Thompson, AR Dutton, GF Loedolff (Prof), MO de Kock (Prof), MG Alexander (Prof), **the late** GS Gamble, **Editorial Committee: Chairman:** WP Boshoff (Prof), GC Fanourakis (Prof), GPAG van Zijl (Prof), EP Kearsley (Prof), HD Beushausen (Prof), **Editor:** C Dalglish, **Production:** Kris Srsa, Crown Publications, PO Box 140 Bedfordview, 2008. Printed by Tandym Print.

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COMMENDATION

The Adjudication Panel

The biennial prestigious Fulton Awards adjudication panel includes: Sindile Ngonyama, who was appointed by the National Department of Public Works to run the Contractor Development Programme and is currently a member of the Program Management Team for the Department of Public Works in the Eastern Cape; Chartered Marketer and CEO of the Concrete Society of Southern Africa NPC John Sheath has spent most of his career with a South African non-profit Institute and two multi-national companies. Industry stalwart Peter Kleynhans has chaired and held a number of posts on the Executive Board of the South African Institution of Civil Engineering.

Sindile Ngonyama

Sindile Ngonyama's career started in the Drawing Office, as a draughtsman for the Ciskei Government. In 1980 he received a bursary to study Architecture at the University of Cape Town.

In 1997 he formed an architectural company, Ngonyama Okpanum & Associates with Dr Okpanum, in East London. Within a very short period the practice expanded and had offices in Port Elizabeth, Cape Town and Johannesburg.

With the new democratic government in 1994, it became apparent that there was a growing need for development programmes. Ngonyama became involved with a number of initiatives, from setting up community development structures at no cost to establishing the Mdantsane Development Trust.

He was appointed by the National Department of Public Works to run the Contractor Development Programme. This Programme afforded Previously Disadvantaged Individual contractors to undertake contracts worth R5 million with great success. Ngonyama became part of the National Programme Management Team for Community Based Public Works Programme (CBPWP. This programme saw the roll out of projects, during this period, totaling R1 billion.

Ngonyama is part of the Eastern Cape's

Programme Management Team appointed by the Department of Public Works, to co-ordinate and manage the School Building Programme in the province, which has been running since 2002.

Peter Kleynhans

Over the past 30 years, Peter Kleynhans has served on several of the South African Institution of Civil Engineering's divisional committees as well as being Chairman of the SAICE's Finance and Administration Committee. Kleynhans also assisted the national office to put the Institution's management on a sound financial and business footing.

He was awarded the SAICE President's Award in 2002 for 'Meritorious Service' for his significant ongoing contribution towards the profession. In 2010 he was received the SAICE President's Award for 'Exceptional Voluntary Service'.

As a registered Professional Engineer, Professional Planner, and Professional Construction Project Manager as well as being a Chartered Engineer he has a broad range of experience, spanning more than 40 years. Kleynhans is a Fellow of the South African Institution of Civil Engineering (SAICE) as well as being a Fellow, or Corporate Member, of five other professional institutions in South Africa and the United Kingdom.

He owns and operates Mogwariepa Consulting, one of the independent businesses, providing consulting services to government departments.

John Sheath

John Sheath is a Chartered Marketer who has spent most of his career with a South African non-profit Institute and two multi-national companies.

As Marketing Director of Expandite, at that time part of the Burmah-Castrol Group, he was able to expand its industrial adhesives business through acquisition and by gaining several large contracts. Later as Marketing Director of the Burmah-Castrol Group company (Fosroc) he successfully merged two culturally-diverse organisations to form a strong, unified sales and marketing team.

As Marketing Manager of the Cement & Concrete Institute from 1996 he drove the transformation of the company over a period of 13 years into a technical marketing organisation. The Institute focused on growing the market for concrete for its members within the building materials sector of the construction industry.

Since January 2011 he has been the Chief Executive Officer of the Concrete Society of Southern Africa NPC, whose mission is to promote excellence and innovation in the use of concrete.

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The Fulton Awards

Concrete Society of Southern Africa NPC's most prestigious concrete awards began as a tribute to the late Dr Sandy Fulton for his outstanding contribution to the understanding of concrete, its development, and improvement.

Sandy Fulton was unquestionably one of the doyens of the international concrete industry with impressive achievements in research contained in 35 published papers.

He left a legacy of scientific and technological advances in the construction industry. The Fulton Awards continue as a celebration of the life and achievements of this remarkable South African. Through the Fulton Awards, the Concrete Society of Southern Africa NPC recognises and rewards excellence and innovation in the use of concrete. The Award is made symbolically to the structure and is presented to the entire team responsible for its construction, including the owner/developer, all professionals, and the contractors. The six award categories include: Civil Engineering Projects; Building Structure; Architectural Concrete; Sustainable Concrete; Innovative Construction; and Community Structure. This year the Fulton Awards attracted 26 entries, representing the most innovative, exciting and iconic projects from around the country. The team of judges travelled throughout South Africa to inspect the projects and determine the winners.

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Innovative Solutions

WINNER

DE HOOP DAM

– Immersion-Vibrated Roller-Compacted Concrete

De Hoop Dam will be one of the biggest dams in South Africa with a total concrete volume of more than 1,1 million m^3 of concrete including Immersion-Vibrated Roller-Compacted Concrete as well as Conventional Vibrated Concrete.

The impressive project is a worthy winner of two prestigious 2013 Fulton Awards categories, 'Civil Engineering Structure' as well as 'Sustainable Concrete'.

Construction of the dam commenced in June 2007 and the project is currently nearing completion. Significant improvements in the Roller-Compacted Concrete (RCC) mix design were implemented at the beginning of the dam construction. These led to a vast simplification of the construction process and allowed the highest construction rates ever achieved in South Africa, with a peak of more than 130 000m^3 of RCC placed in one month. This resulted in the Department of Water Affairs becoming a world leader in RCC Construction Technology and effectively developing Immersion-Vibrated Roller-Compacted Concrete (IVRCC).

The first international experience with IVRCC at De Hoop dam proved extremely successful and made it one of the most significant contributions of the last years to the RCC dam construction technology. A very workable RCC mix was designed that allowed placement with both roller compaction and with immersion vibration. During the preliminary trials in April 2009, it was proven that the new RCC mix did not require any additional grout at the point of placement and it could be directly consolidated by immersion vibration. IVRCC has been used against the formwork and rock abutment as interface concrete in the main dam achieving an excellent finish and an

extraordinary in-situ quality. Following this first experience, IVRCC has been further implemented in other projects.

The experience at De Hoop dam has been extremely useful in developing a new approach to RCC materials and mixes in South Africa. Former RCC dams built in the past by the Water Affairs Authority followed the low paste approach. RCC mixes were formerly placed at a water to cement ratio of about 0,9. Despite the relatively high water content, these mixes tended to segregate and the concrete was generally of a poorer quality than the traditional conventional concrete. As a result of this, the design team at De Hoop decided, from the beginning to follow a mix approach with a higher paste content that would also be easier to consolidate by roller compaction.

Crushed coarse and fine aggregate have been used from a quarry production installed in the future reservoir area. In the initial stages of the mix design, the envelopes of the aggregate grading curves were revised and allowance for the fine content of the sand was increased up to 10% passing 0,075mm sieve. Coarse aggregate following the SANS standard and with a maximum size of 53mm was used during the preliminary trials. In the original specified mix, the sand/total aggregate ratio was 41% and workability between 15 and 25 seconds.

The total cementitious materials content ranged between 180 and 190kg/m^3 with 70% pulverized fly-ash. The water/cementitious ratio was 0,62.

Investigation of the initial mix at the laboratory and on several test sections concluded that there was still a need for improvement. Although the mix behaved well at the laboratory (compaction and strength), the cores extracted from the test slabs showed some spots with segregation and, in some cases, lack of bonding between layers. During placement, the fresh RCC mix did not look like a typical high-pozzolanic workable mix. When dumped on the field there were still some signs of segregation at the bottom of the heap and the mix looked too dry. During compaction it was not possible to get much paste on the surface and there was no movement when walking on top of this concrete. These were all signs of a less workable and drier mix than desired.

The replacement of the conventional facing concrete by grout-enriched RCC was also tested in the early trials. Despite the fact that the

Team

- Client: Department of Water Affairs; Capital Projects
- Principal Agent: De Hoop Dam Consultants
- Main Contractor: Department of Water Affairs: Construction West
- Submitted by: Department of Water Affairs: Construction West

WINNER

surface finish was adequate, the vibration effort was high, even when adding a grout that had a water/cement ratio as high as 1,0. Some difficulties were experienced in achieving a good consolidation and bonding with the adjacent roller-compacted concrete.

In order to overcome these problems a more workable mix was suggested during an external review of the construction methodology and the placement procedures in 2009. The modifications suggested included: Maximum size of aggregate 38mm (instead of 53mm); slight modification of the overall gradation curve; fine aggregate 38% of the total aggregate (instead of 41%); cement (OPC) 60kg/m^3 (instead of 56kg/m^3); fly-ash 140kg/m^3 (instead of 130 kg/m^3); mix consistency between 8 to 10 seconds VeBe; a water content was increased from 114 to 125kg/m^3 (water /cementitious ratio kept at similar value as before) and use of a retarder admixture to achieve an initial set of the RCC of approximately 20 hours, to improve bonding between layers.

The main features of the dam are as follows: gross storage capacity 347,4million m^3; catchment area 2 865km^2; approximate length 1 017m; approximate height 88m; total excavation – dam footprint 415 000m^3; total excavation – quarry 1,3 million m^3; total estimated concrete volume of the dam 1,1 million m^3. The De Hoop Dam Project is a flagship project for the Department of Waters Affairs of South Africa and possibly one of the largest projects for the forseeable future. Water needs will be met in the Limpopo Province. Lessons learned and technological innovations will change how future projects will be addressed.

Judges' Citation

De Hoop Dam will be one of the biggest Roller-Compacted Concrete (RCC) dams in South Africa, with a total concrete volume of more than 1 million m^3. The judges were highly impressed with the attention paid to reaching the optimum mix design that yielded vast improvement in the Roller-Compacted Concrete. The work led to the use of immersion-vibration of the RCC, which, whilst not new to the construction industry, was a first in roller-compacted concrete dam construction. IVRCC was used against the formwork and rock abutment as interface concrete in the main dam, achieving an excellent finish and a high in-situ quality.

This also led to significant simplification of the construction process and allowed one of the highest construction rates achieved in South Africa, with a peak of more than 130 000 m^3 of RCC placed in one month. The De Hoop Dam Project is a flagship project for the Department of Waters Affairs and will address a significant portion of future water needs in Limpopo Province.

The judges had no hesitation in proclaiming this project the **winner of two of the 2013 Fulton Awards categories – 'Civil Engineering Structure' and 'Sustainable Concrete'.**

COMMENDATION

CHOTA MOTALA

– Incrementally Launched Bridge

Chota Motala Interchange has been operating at more than capacity for some time; and this has resulted in long traffic delays between Chota Motala Road and the N3 national highway. To improve capacity, SANRAL implemented the Chota Motala Incrementally Launched Bridge.

The new interchange received a commendation in the 2013 Fulton Awards 'Civil Engineering Structure'

The South African National Roads Agency Limited (SANRAL) and Mzunduzi Municipality investigated options as the N3 national highway traffic was confronted with slow moving or stationary traffic at Chota Motala. This stretch of road could be hazardous for road users. The Incrementally Launched Bridge proved ideal as there was very little disruption of traffic during construction and at the same time, the client's requirements were fulfilled in every respect. The bridge, situated on Ramp E of the interchange, carries traffic travelling on the Chota Motala Road towards Pietermaritzburg over the N3, and Chota Motala Road merging with the N3 national road towards Johannesburg.

Roadworks on the project included: upgrading Chota Motala Road from a four- to a six-lane urban arterial; widening and minor realignments to ramps and construction of a new directional ramp over the N3; upgrading the N3 national road by adding an additional fast lane in the median and rehabilitating the existing concrete pavement and widening the existing Sanctuary Road off ramp on the eastern side.

Structural work on this project comprised demolishing two bridges and constructing two; widening one bridge; new and lengthened culverts; and a number of retaining walls and median traffic barriers.

Once the decision was made to provide an incrementally launched bridge, it was logical to propose prestressed concrete as the construction material. The only alternative was a launched composite deck, consisting of an open steel box-girder with a concrete slab on top. An open box-girder could have been launched over the whole length of the bridge and later a concrete slab could have been cast above it. This option was not considered further for the following reasons:

- A composite steel bridge deck is generally more expensive than a

COMMENDATION

Team

- Client: South African National Roads Agency SOC Limited
- Principal Agent: Illiso/ Aurecon JV
- Main Contractor: Group Five
- Subcontractors: Structural Systems Africa; Metier Mixed Concrete
- Submitted by: Aurecon

Judges' Citation

This aesthetically pleasing, incrementally launched concrete bridge fully deserves a judges' Commendation in the 2013 Fulton Awards category 'Civil Engineering Structure'. Concrete was chosen for this bridge for its lower costs, the need for ultimate safety during construction, low maintenance costs and its long life-span.

Of special note was that the engineers, in the absence of an architect, paid particular attention to the aesthetics of the bridge and considered many aspects such as slenderness, span lengths, pier diameter, shapes of members, shadow and lighting.

The result is an elegant and aesthetically pleasing civil engineering structure that showcases concrete in an excellent manner.

concrete bridge deck. The construction of the concrete top slabs would have posed a safety risk to traffic below, negating the main advantage of the launch bridge.

- A composite deck has much higher maintenance costs than a concrete bridge,
- The required maintenance is difficult to undertake in the presence of heavy traffic above and below.
- Reinforced concrete is the most popular choice of construction material for bridges in South Africa because it offers the lowest initial costs, it provides the lowest maintenance cost, it has a long lifespan if maintained properly and it can be cast to any shape provided by the formwork.

The 220m long deck consists of a pre stressed concrete box girder with seven spans varying between 25,15m and 36,05m long, arranged symmetrically around the centre.

The piers vary in height from 6,245m to 15,913m, start off with a 2m circular section and flares out over the top 6m to a 3,6m diameter. The pier shape is reminiscent of a champagne flute and provides two support points to give torsional rigidity to the deck.

The shape, height and location of the piers make access for maintenance or replacement of bearings difficult. Access was therefore provided through the deck. Recesses are provided in the deck diaphragm beams, soffit and top of piers for this purpose. The horizontal alignment is a 175m diameter circle, with a straight vertical alignment of 0,5%. This results in a bridge geometry that is a three-dimensional circle in space - making the launching process extremely complicated.

Two methods were used to check and cross-check the bridge levels. The designers used an in-house developed computer program, whereas the contractor's temporary works designer used three dimensional drafting. Close correlation was found between the methods, resulting in high confidence in the calculated levels. The Eberspächer AH124 system was used for launching the deck. The jacks operate on a lift and slide cycle making use of friction between the bearing plates and the deck soffit, negating the requirement for pulling sticks or other temporary works.

The Formwork used for the Ramp E Incrementally Launched Bridge was designed by Formscaff and was made out of steel, to obtain a smooth F3 off-shutter finish. The formwork was supported on a jacking system, allowing it to be raised into position for concreting and then lowered for launching.

Extreme care taken with details and concrete finishes resulted in an aesthetically pleasing structure that will be a landmark on the Pietermaritzburg horizon for years to come.

CRCP & UTCRCP

Pavements

The N12 Highway road system in Gauteng is often referred to as 'the veins and arteries' of South Africa's economy. Since this highway cannot be congested and must be kept open in order to allow unimpeded growth, the South African National Roads Agency Limited (SANRAL) decided it should receive bypass surgery. As part of the Gauteng Freeway Improvement Project 560km of highway was upgraded. The mammoth project received a 'Civil Engineering Structure' commendation in the 2013 Fulton Awards as well as in 'Innovative Construction'.

Basil Read undertook design, planning and construction of Work Package K, which covers 9,7km of road on the N12 Highway between the Rietfontein Interchange and the Tom Jones Interchange in the East Rand. The task was to plan, design and use innovative techniques for the successful implementation of Continuously Reinforced Concrete Pavements (CRCP) and Ultra-Thin Continuously Reinforced Concrete Pavements (UTCRCP) that were constructed with an asphalt overlay.

Concrete pavements were chosen primarily for their 30-year life cycle and lower maintenance costs. As this is one of South Africa's most densely trafficked roadways, it seemed the logical infrastructure to implement.

The skills learned in concreting in roads can easily be transferred to the civil engineering and building sectors. This particular project was one of the first rolled out by the national roads agency, introducing UTCRCP at a high volume. While many hours of research may have gone into fibre-reinforced concrete, applying it in this environment bordered on ground-breaking experiences.

UTCRCP is a new technology to South Africa and a high quality finished product was achieved despite difficult challenges and conditions, not least of which was little scope for error. Conventional concrete pavements are rigid, usually 200mm thick, with large amounts of reinforcing (50t per km per lane) and are constructed either in panels with movement joints at set intervals or continuously reinforced throughout. Rigid concrete pavements are brittle and may be found to crack over time, given heavy loading conditions. While these cracks

COMMENDATION

may not result in failure of the pavement, they could give rise to water ingress. This scenario is accentuated in flexible bitumen- or gravel-based pavements over a similar time period. Movement of these cracks due to heavy wheel loads may create a pumping action, ejecting the water and fines dissolved in the solution and ultimately create potholes.

The idea behind constructing Ultra-Thin Continuously Reinforced Concrete Pavements was to create a pavement that was semiflexible. In other words, neither rigid nor flexible, a concrete pavement strong enough to with stand the loads that a conventional concrete pavement would, but flexible enough to handle the effects of shrinkage, dynamic traffic loads and temperature fluctuations through the seasons.

The result was a high strength (90MPa+) concrete pavement, 50mm thick, high yield mesh-reinforced, with steel fibre reinforcement in the region of 100kg/m^3. The main principle around UTCRCP was to eliminate the number of movement joints (where most concrete pavements fail), and to make the concrete less brittle by using steel fibres and mesh reinforcement, which would provide a better spreading of loads.

Basil Read partnered with the University of Pretoria, Chryso and the Cement and Concrete Institute amongst others, with regard to research work done on fibre-reinforced concrete and its application in UTCRCP pavements. The University of Pretoria was heavily involved in developing the correct concrete mix designs for the project, and it was the 33rd mix design that was eventually suitable for use on site. This mix design was used for UTCRCP throughout the entire Work Package K contract. UTCRCP was applied at the Mvoti Toll Plaza in Natal, on the N1 Freeway near the Huguenot Tunnel in the Western Cape between the Gilloolys and R21 Interchanges on the N12, adjacent to Basil Read's project in Johannesburg.

Team

- Client: South African National Roads Agency Limited (SANRAL) Northern Region
- Principal Agent: Aurecon/Vela VKE
- Main Contractor: Basil Read
- Subcontractors: University of Pretoria; Lafarge Cement; Chryso SA
- Submitted by: Basil Read

Potential problems and solutions as regards UTCRCP were shared on site. This information assisted Basil Read to decide on the best approach to take for the project. It was clear that the methods implemented in the construction of the UTCRCP needed to be streamlined in order to make it a success, especially on such a large scale.

One such implementation was the Terramite oscillating triple roller screed. After the concrete was compacted, it was rolled onto the surface with this screed. The hydraulically driven Terramite, however, made light work of driving forward. This meant that it took a significantly less amount of effort to manoeuvre the roller screed in the required direction, and consequentially allowed for much higher daily production rates and volumes.

It was in the implementation of Work Package K of the GFIP that fibre-reinforced concrete (reaching 90MPa and placed to 50mm levels over large surface areas) was for the first time successfully batched in vast quantities at a readymix plant.

While previous UTCRCP jobs used pan mixers on site, Basil Read elected to use a fixed pan mixer readymix batch plant, due to the growing number of variables. The group partnered with privately-owned Skyline Readymix who dedicated an entire batch plant and a fleet of readymix trucks to Work Package K.

This plant supplied up to 40m^3/day of UTCRCP. The plant was outfitted with four admixture units and a conveyor system, which was used to add steel fibres to the mix at a required rate to prevent balling of fibres in the mixture. As the lanes (3.75m wide x 50mm thick) required 0.19m^3/m on each lane it was only possible to progress 210m per day, per lane.

It was imperative that every batch of concrete used cement with the identical chemical composition - as a slight difference in the clinker could impact concrete properties, such as air entrainment, that would affect the ultimate strength of the concrete. Samples were randomly analysed to ensure quality. Initially, a CEM I cement was specified but this was later changed to a CEM II – the Lafarge Rapidcem (52.5N), a high early strength cement with a fixed percentage of fly ash. Comprising high quality raw materials to minimise product variability, Rapidcem offers high early and ultimate strengths and while fly ash is incorporated into the formulation, it can be further blended with fly ash due to the inclusion of a special strength enhancer.

Lafarge guaranteed a steady supply of consistent cement. With blended cement, it is imperative that the ratios of extender are kept to a uniform quality. Verification of outgoing product is undertaken on each tanker leaving the factory, a procedure that includes the determination of fly ash content using an XRF testing method.

When making the mix, it was essential to achieve the correct ratio between cement, sand, fly ash and silica fume. Particle size distribution of all materials and their impact on the mix flow characteristics had to be considered and as the sand had to have a specific grading, strict controls were implemented in order to ensure that the same sand was used in every UTCRCP batch.

SANRAL wanted both concrete pavements to have asphalt overlays in order to guarantee the International Rideability Index (IRI) of the roads. SANRAL required International Roughness Index readings for all roads at a maximum of 1,4. Concrete pavements normally achieve a reading of between 1,6 and 2, before the asphalt surface is applied to improve the riding quality. Basil Read was achieving readings of between 0,9 and 1,1 but although there was no need for the asphalt overlay, the roads agency insisted on uniformity throughout all GFIP projects.

Basil Read's team, assisted by some of the industry's most recognised specialists in their fields, has done much to illustrate the potential that this technology holds. With over 5 500m^3 of UTCRCP and almost 30 000m^3 of CRCP paved, this project has shown the scale of success that can be achieved through integration of research, design, skills, science, technical and adaptive methodologies.

Judges' Citation

The judges commend this project for its innovative and unique approach to the design of, and research into, the concrete designs for construction of the concrete pavements. Concrete was chosen for its relatively lower life-cycle cost, often underestimated or ignored by owners and constructors of roads. The resultant ultra-thin concrete proved to be of high strength (90MPa +), with a reduced number of movement joints, less brittleness through use of steel fibres, and better spreading of load owing to the mesh reinforcement.

This project's **Commendations in 'Civil Engineering Structure' and 'Innovative Construction' 2013 Fulton Awards** have shown how the integration of research, design, skills and science contributes to success.

WINNER

SANRAL HEAD OFFICE

The South African National Roads Agency SOC Limited (SANRAL) corporate head office in Vale De Grace, Pretoria, presented an opportunity to design a building that expresses the role the organisation plays in connecting networks of national roads and bridges to cities and towns nationwide.

The building design makes use of concrete to pay visual reference to flowing roadways and spanning bridges and is a worthy winner of the 2013 Fulton Awards 'Building Structure'. The building also received a Commendation in the 'Architectural Concrete' category.

The innovative use of concrete along with the use of sun screening and high-tech building systems contributed significantly to the energy efficiency of the building, which has been awarded the Green Building Council of South Africa (GBCSA) 4 Star Office V1 Design rating.

The client had a number of objectives for its new corporate head office development. These included: accommodation for 100 personnel; premium grade office space; energy efficiency and environmental specifications. The project was conceptualised as a 'connector building' accommodating three key divisions; Corporate Services, Engineering Services and Financial Services, each in its own wing of the building. The design included a large flowing lobby, much like a highway intersection, public space in the ground floor under the three office wings.

The ground floor connects to outdoor planted areas, canteen, and boardrooms that open onto landscaped terraces. The basement level provides staff parking and building services. The building design maximises natural daylight at work stations. The courtyards, or green lungs, between the buildings have natural cooling and shading benefits.

The use of a concrete was a very exciting choice – the visual and structural properties of concrete enabled a reference to the flowing roads and spanning bridges that SANRAL takes such pride in designing, constructing and maintaining. Another reason for using concrete was that the concrete roof presented an opportunity to design a green planted roof to take advantage of the thermal mass properties and optimise the energy requirements for the indoor climate control of the building. The building makes use of a concrete frame structure supporting the concrete roof and

Team

- Client: The South African Roads Agency SOC Limited (SANRAL)
- Principal Agent: Rouillard Consulting Engineers
- Main Contractor: GD Irons Construction
- Subcontractors: Pre-Form; Civil Concepts; Plantech Consulting Engineers
- Submitted by: Activate Architecture

suspended floors, which were designed using a beam and light weight hollow block system. The structural grid required to accommodate an optimal basement parking layout as well as the client's preference with regard to office layout, resulted in larger structural spans. A typical structural bay built using an onsite flat suspended slab design would have needed to be approximately 360mm thick with approximately 30kg/m^2 of steel reinforcing. Using lightweight precast hollow blocks supported by a concrete beam system, the suspended floor and roof slabs resulted in a 57% reduction in reinforcing steel (14kg/m^2) and a 20,5% reduction in the volume of concrete compared with the onsite flat slab option. The significant reduction in material used reduces the environmental impact of the building.

The building was constructed using concrete and a fly ash substitute (Ulula Fly Ash) a waste product from coal at Kriel Power Station and a water reducing BASF admixture. This reduced the quantity of Portland cement required for the project by over 30%, thereby further reducing the embodied energy of the concrete in line with the parameters set by the GBCSA. All the steel reinforcing used in the construction of the building was manufactured using 92% recycled ferrous content, thereby reducing the negative environmental impact of the construction by a significant reduction in the use of raw natural resources.

The Xeroscape roof garden has 350mm of soil and indigenous plants. The thermal insulation of the composition of the roof protects the space from outdoor thermal conditions, but more importantly; the depth/ thickness of the roof system vegetation, soil and structure results in an eight hour time lag on heat gain and loss via the roof, which flattens out the peaks and troughs in the heating and cooling cycles of the indoor environment.

'Evapo-transpiration' also takes place and this helps to cool the building interior; the process occurs in the hot summer months when rain water that is attenuated in the soil results in a cooling effect on the concrete roof structure. The concrete green roof system significantly contributes to the indoor environment thermal control and is, in general, responsible for a 50% reduction in roof transmission loads. This reduces the overall cooling load demand of the HVAC system by 35%. The planted surface area of the site is increased by 1700m^2 using the concrete green roof design, compared with a conventional roof. The indigenous vegetation becomes a private entrainment and break-away area for the occupants of the building. The biodiversity of the site is also enhanced as the roof has become a nesting home for a number of indigenous birds; physically, environmentally and symbolically connecting the building to the landscape. The project required a high quality concrete finish. This, coupled with a tight construction timeframe, meant there was no margin for errors, necessitating careful design collaboration between the professionals and the contractor teams to ensure the successful outcome of the building.

The professional team was sourced by the client in an open tender in mid 2009 - the design and documentation process was undertaken in a five month period. The tender for the main contractor was an open public tender which took seven weeks. Construction started in mid-March 2010 and the client took occupation on April 1st 2011.

WINNER

Judges' Citation

This fascinating Green Building Council of South Africa 4-star rated building is a worthy **winner of the 2013 Fulton Awards 'Building Structure' and also received a Commendation in the 'Architectural Concrete' category.** The use of concrete, apart from the accepted reasons of cost effectiveness and low maintenance, was chosen as it provided a visual and structural reference to flowing roads and spanning bridges. The style typifies the projects that South African National Roads Agency SOC Limited has undertaken.

Concrete was used to produce a 'green roof structure' and planted roof garden. This takes advantage of the thermal mass properties of concrete and connects the building to its tree-lined suburban context. The design approach was particularly commendable as it conceptualised a 'connector building' linking the three main departments of the company via a large, flowing lobby, much like a freeway intersection. Great thought went into the positioning of the building vis-à-vis the natural slope of the land, its relationship to the main road, the views and visibility to nearby private homes.

The building achieved a certain playfulness through the use of concrete in the creation of interesting shapes, with finishes that were excellent and innovative and showcased the versatility of this unique building material.

The concrete for this building was designed and constructed using a fly ash substitute and a water-reducing admixture. This resulted in a reduction of 30% in the quantity of cement required, thereby reducing the 'carbon footprint' of the concrete in line with parameters set by the Green Building Council of South Africa.

Special attention was paid to shaping and proportioning the edges and corners of the concrete overhangs to give the roof a bridge-like feel and, at the same time, a high quality, flowing, elegant shape. The final finish provided a straight, smooth and uniform quality, as well as consistent colour and texture.

The courtyard of the building was designed to house an urban garden above the basement and the concrete planters, of flowing shapes, were particularly aesthetically-pleasing. Concrete fire-escapes featured high walls where the concrete has been softened and textured with a bush-hammered technique.

WINNER

115 WEST – Alexander Forbes

The new landmark headquarters for Alexander Forbes is one of the largest and most innovative buildings to be completed in South Africa in the past two years. The eight storey building can accommodate 2 500 people within a combined 35 000m^2 office space, six levels of parking and three entrances on different levels, to increase traffic flow in and around the building. The prestigious project is the winner of the 2013 Fulton Awards 'Architectural Concrete' category and also earned a Commendation in 'Building Structure' category.

The 100 000m^2 Four Star Green Star Design V1 rated building symbolises more than simply a new work space from where clients are served – it also symbolises a new beginning. The architecture features a continuous design of fluid curves. Sections of the façade incorporate S-shaped 'scallop' walls and wavy flowing lines are further incorporated throughout the interior of the building.

The role of concrete in the construction of this building was critical, not only in its obvious structural application, but also for specialist architectural elements. It is the expression of concrete that sets the building apart. Off-shutter concrete columns are an architectural feature of the project. Raked and vertical columns on the ground floor are 8,5m tall and moulded in a single cast. Self-compacting concrete was used due to the amount of reinforcement within the column and to obtain a quality finish.

Textured off-shutter concrete walls and S-shaped 'scallop' walls clad with Rheinzink form part of the office façades. Randomly placed pre-cast panels of varying sizes, combined with steel wire mesh, were used in

the construction of the basement façades. Creepers in planters behind the mesh, will in due time, create a green wall that will soften the look of the exposed basement.

Link bridges span the north and south atriums to link the large office plates for easy access between work spaces. The long spans of these bridges, along with the architect's request to keep the bridges as thin as possible, meant suspending them from the roof. Seven levels of suspended bridges meant that they had to be lightweight and constructed of steel and concrete. Construction took place as each plate was being constructed and all seven levels of bridges were supported temporarily on the lower level floor slab by means of a temporary supporting steel frame.

Smooth off-shutter concrete planter walls to create break-away meeting areas, which are linked by polished concrete walkways. In total, 45 750m^3 of concrete and 4 974 tons of reinforcement were used. At 100 000m^2 under construction, concrete was always going to be an integral part of the project.

From the complex raked columns to the in-situwalls, both smooth and textured, concrete was widely used in elements from floors to walls, roof, columns and landscaping.

The building programme took 19 months, so documentation and construction often ran concurrently and clear and consistent communications was vital. Given the extent of the project and the timeline for completion, the mammoth task was contracted to the WBHO/Tiber joint venture. It also meant that clear and consistent communication was critical.

Raked and vertical columns on ground floor stand 8,5m tall and are moulded in a single cast. The specialised formwork was generated in Revit Design and Revit Structure; and exported to AutoCAD in DWG format to the sub-contractor for construction. Minimum sizes were specified by the engineer and then sculpted by the architects, who pinched the noses of the columns to create a more elegant and sculptural form. There are two types: a Y-shaped branch that supports the cantilevered walkway, and a simple style that supports the building structure. Self-compacting concrete was used to support the amount of reinforcement within the column and to handle the difficulty of vibrating the concrete for 8,5m tall raked columns.

SA Pine shutter board cut into various thicknesses and widths was used as a lining in the shutters to create timber-grained, textured off-shutter walls for the north gable and south concrete walls. The textured finish

WINNER

also accommodated the varying quality of concrete finish, and construction joints could easily be hidden at the board edges. These walls were cast past the floor slabs to minimise horizontal construction joints, which meant that all floors slabs had to be tied to the concrete walls with either pull-out or dowel bars. To guarantee a quality finish, self-compacting concrete was also used for these off-shutter walls.

A further architectural feature was the S-shaped or 'scallop walls', on the east and west façades. The accuracy and finish required would normally have called for highly specialised formwork, at a high cost.

Peri used its girder wall formwork system, made up in 10m long units with special radius whalers to construct these curved walls with the same quality and tolerance, but at a much lower cost. A different texture was required by the architect for these walls, which were cladded with Rheinzink.

Planter walls, constructed from smooth off-shutter concrete, create various meeting areas in the planted and xeriscaped areas to the north and south of the building. Polished concrete walkways with exposed aggregates link the different meeting and break-away zones. Concrete

was chosen for its durability, texture and reduced maintenance costs. Complexity of design, coupled with intense programme constraints and the sheer scale of the project, made it a health and safety challenge for the contractor.

The WBHO/Tiber JV rose to the challenge and won the Gauteng Master Builders Association's top award in the GMBA annual Regional Safety awards as well as the FEM Super League Trophy for its health and safety achievements on the project.

Team

- Client: Zenprop Property Holdings
- Principal Agent: Capex Projects
- Main Contractor: WBHO/TIBER BONVEC JV
- Subcontractors: Paragon Architects
- Submitted by: Sotiralis Consulting Engineers

Judges' Citation

This new Alexander Forbes head office is an architecturally ground-breaking space with environmental sustainability being crucial to the design as the building is accredited by the GBCSA as 4-Star Green Star rated.

The judges were impressed with the use of concrete in this landmark office block within the Sandton economic node, and are pleased to declare this project **the winner in the 2013 Fulton Awards 'Architectural Concrete' category. The project also receives a Fulton's 'Building Structure' Commendation.**

This iconic building utilised concrete in structural, architectural and artistic ways. The timeline for the superstructure was eight months, during which a horizontal concrete area of 101 000m² and a total amount of 43 000m³ of concrete was poured.

The complex architecture is technically difficult and iconic, incorporating elements such as concrete double-storey raked columns and curved scallop walls. The off-shutter, raked and vertical columns, each cast in a single pour, are an impressive architectural feature of the structure, which creates elegant and sculptural forms, and also helps to reflect light inside the building.

Other special architectural concrete elements utilised were: smooth off-shutter roof soffits and overhangs; textured off-shutter concrete walls; precast panels on the basement façade; precast stair treads to the main entrance, smooth off-shutter curved walls integrated with landscaping and polished concrete walkways in the landscaped areas.

Due to its advantages, self-compacting concrete was used on all the vertical walls. This raised concerns due to high pressure on the formwork, so special high-tolerance box-outs were designed and manufactured for the entire project.

COMMENDATION

GAUTENG FREEWAY

The launch of the Gauteng Freeway Improvement Project (GFIP) signalled an exciting multi-billion rand commitment to upgrading and developing more than 500km of freeway within the province. The joint venture between the Gauteng Province, Ekurhuleni, Tshwane and Johannesburg Metros, under the guidance of the South African Roads Agency (SANRAL), was geared to provide an effective transport network. The project received the 2013 Fulton Awards Commendation in the 'Sustainable Concrete' category.

Gauteng, the economic heartland of South Africa, generates nearly 38% of the total value of South Africa's economic activities. By the turn of the century, it was evident that provision of road infrastructure had not kept pace with increased traffic demand, resulting in a road and freeway network that was over capacity.

Its aims included the promotion of social development, a reduction in the cost of doing business and sustainable economic growth. It also aimed to greatly improve accessibility to Gauteng's roads, while managing and reducing congestion issues. The first phase, comprising the upgrade of 185km of the most congested freeways in the region, was divided into total of 15 work packages.

Group Five, as lead contractor for the Siyavaya Joint Venture, with consulting engineers UWP/Nyeleti Joint Venture and KAS Joint Venture, was awarded Package E which, in turn, was divided into two sections, Packages E1 and E2. The 36 month project started in July 2008 and was substantially complete by July 2011, including a one month delay in mid-2010 for the Soccer World Cup event. Package E comprised a substantial upgrade to three interchanges, upgrading two busy intersections, widening the highway to five lanes and the construction of three bridges using the incremental launching method, a 70m long new bridge over the Natalspruit River at the N12/N17 intersection and a cut and cover tunnel. The longest of the incrementally launched bridges was a 420m long switch ramp. The incremental launching method has been successfully used by Group Five on long spanned bridges and in this case minimised traffic interruptions on the adjacent freeways. The new bridge was constructed using a conventional precast concrete I-beam construction method. Structural Systems Africa, which is 50% owned by Group Five, supplied the launching equipment, including the launching girder, manufactured by Group Five Steel.

SANRAL's requirement was that all structures should be functional yet aesthetically pleasing. In view of this, particular attention was paid by the consulting engineers to the design and by Group Five and the Siyavaya Joint Venture to producing fine quality off-shutter concrete throughout the project. Package E1 comprised a 12km section of the N3 to the south-east of Gauteng, between the Old Barn (Heidelberg) and Geldenhuys (M2) Interchanges, and included widening the N3 on both sides and upgrading the Elands interchange, including the construction of the switch ramp connecting the N3 to the N12.

Package E2 comprised a 4km section of the N12 between the Reading (R59) and Elands (N3) Interchanges. This section included the construction of two bridges over the N17 and Natalspruit River and another comprising a cut and cover tunnel at the Reading Interchange. The entire project involved the construction of 37 concrete structures which, as well as the above, included moving a 2,2m diameter Rand Water pipeline to accommodate the new ramp at the Elands Interchange and the construction of two new loops at Grey Avenue, Alberton, to eliminate a right-turn against oncoming traffic.

Whilst the majority of the freeways in the GFIP were widened along the

IMPROVEMENT PROJECT – Package E

median, the entire length of Package E was also widened along the outside lanes, resulting in major earthworks either side of the busy freeways.

One of the major challenges was the safety of the public and workforce, whose protection was a priority. Traffic accommodation was planned to the last detail and supported by the Metro police, whilst the site personnel were trained to comply with strict safety regulations. The bridge at the Reading Interchange comprises an aesthetically designed and constructed cut and cover tunnel approximately 345m long, divided into two sections measuring 162m and 63m respectively, and separated by an opening of approximately 38m. The tunnel, which diverts traffic from the R59 north directly onto the N12, passes under the widened section of the R59 south. To counter poor soil conditions, the structure is founded on heavily reinforced concrete foundations up to 16,5m deep. Due to the extreme contours of the site, the tunnel is on a sharp horizontal and vertical curve. To accommodate the curves, the tunnel was constructed in 10m straight segments using a movable shutter system. Moving along the base of the tunnel, the foundation of the shutter was forced to contort slightly to follow the vertical profile of the road, taking the super elevation into account, and thereby creating the symmetry required for the tunnel. Each joint was sealed with a waterproof bandage, while expansion joints were installed at every third joint.

The portal faces, which slope back at a gentle angle, are completed with precast concrete tiles, each one specifically designed and cast to fit the curve of the portal.

Widening the existing bridges at the Reading interchange by a lane's width of 2,6m was done in sections to reduce lane blockages caused by the scaffolding. Of the three launched bridges, the switch ramp – connecting the Elands Interchange over the N12 from the N3 East onto the N12 North - was the most challenging. Its purpose was the elimination of what had previously been a potentially dangerous transection between traffic from the N3 and N12 joining the M2 systems interchange. The bridge comprises a nine-span, single cell, internally post-tensioned 3,5m deep, concrete hollow box girder, located on a 378m radius horizontal-curve and constant longitudinal grade of approximately 0,37% falling from north to south. The final span lengths varied from 29m (span 1) to 70m (span 7). Two temporary piers were used to reduce the maximum launching span to 45m. The Siyavaya Joint Venture contracted with Afrimix to design and supply suitable concrete. The specification for the permanent structure called for 40MPa at 28 days, W-type concrete, but this would not have suited the production schedule and the joint venture team opted for a 60MPa mix.

Judges' Citation

Concrete's quality and strength were recognised by this joint venture team as being of paramount importance given the durability requirements for the several bridge and ramp structures and the tunnel on this project.

The quality of the concrete was under tight control, with the testing regime including durability tests such as oxygen permeability and water sorbtivity. The team opted for a 60MPa concrete for the permanent structures. This significant project is worthy of the judges' **Commendation in the 2013 Fulton Awards 'Sustainable Concrete' category.**

Team

- Client: South African National Roads Agency SOC Limited (SANRAL)
- Principal Agent: KAS JV/ UWP-Nyeleti JV
- Main Contractor: Group Five Civil Engineering
- Subcontractors: Afrimix
- Submitted by: Group Five Civil Engineering

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KOEBERG INTERCHANGE

The Western Cape Provincial government identified the N1 Corridor and the Koeberg Interchange, which serves as a primary freight route between Cape Town and Bellville central business district, as one of several in need of an extensive upgrade. The R690 million project received a commendation in the 2013 Fulton Awards 'Sustainable Concrete' category.

The contract required innovative design and close cooperation between the consultants HHO Africa and the contractors, Group Five and Power Construction's joint venture (PaardenEiland JV).

The project included: constructing directional ramps connecting the M5 with the N1; Ramp A: 640m long x 110,7m wide, which connected the M5 and N1 in a southerly direction; Ramp B: 690m long x 10,7m wide, in a northerly direction, which spanned the operational railway link between Cape Town CBD and Bellville.

An extra traffic lane was constructed on the N1 southbound and the northbound access was widened through the Koeberg Interchange to three lanes. From the Koeberg Interchange two additional traffic lanes were constructed to Sable Road. At Berkley Road the M5 was widened to create two additional lanes in each direction. The Salt River Canal was relocated 15m. The Koeberg Interchange was designed to handle up to 500 vehicles per day when it was first built in the 1950s, since then the volume of traffic increased and there was severe traffic congestion with 200 000 vehicles using the route daily. In order to cope with the influx of traffic associated with the 2010 Soccer World Cup the bridges were constructed using precast concrete elements, to maximise off-site production and minimise traffic disruptions during construction.

The precast concrete elements comprised:135 U-beams measuring 25m x 40m weighing 84 tons each; 130 T-beams used to widen the M5, each one of a different length to allow for the curve of the M5 ramp; 5 700m of designed balustrades; 3 500 reinforced-earth panels for the ramp entrance and exit points and a number of manhole lids.

To achieve the connection between the two arterials, which crossed the multi-track railway line between Bellville and Cape Town, this section was constructed in-situ. Safety regulations dictated that construction over the railway lines could only take place at night.

With much of the heavy lifting taking place at night, the use of precast concrete elements kept traffic disruption to a minimum without compromising the safety of road users or contractors. There were also a number of other challenges

including precasting and transporting the largest U-beams to date in South Africa without lane closures during peak hours as well as the construction of the longest road-over-railway bridge in southern Africa.

The team had to relocate cables and services of a major Telkom exchange as well as a City of Cape Town sub-station before they could start excavations for the piers that support the ramp structures.To accommodate the alignment of the new ramps – Salt River Canal was relocated 15m to the west of the M5 for a distance of 600m. An abandoned and undocumented World War II oil pipeline, used by the Royal Navy was discovered to be filled with oil. This had to be decommissioned and the oil drained before some 200m of the pipeline could be removed.

As with all road upgrade projects, traffic management was one of the major challenges that ran for the duration of the project. The safety of motorists, pedestrians and the workforce was paramount so all road closures and diversions were planned down to the last detail at the design stage to ensure constructability and at the same time, accommodate the major daily traffic flows.

Due to the position of the precast yards the heavy U-beams had to be transported across both inbound and outbound traffic. Exacting penalties for every 15 minutes of unapproved lane closures during working hours resulted in extensive night work.

To accommodate the design and the large quantity of reinforcing steel and post tensioning cable sleeves of the U-beams, a special concrete mix, comprising a new generation super plasticiser from Chryso, was conceived. This reduced the required mix water from a 160ℓ/m^3 to 140ℓ/m^3. With the low water demand and the super plasticiser a consistent workability of 175mm was achieved.

The innovation included an equal blend of 19mm and 9mm aggregate.

Team

- Client: Provincial Road Network Management; Transport & Public Works Western Cape
- Main Contractor: Group Five Civil Engineering/Power Construction JV
- Subcontractors: HHO Africa
- Submitted by: Group Five Civil Engineering

The fine aggregate ratios stayed the same as for the other mixes, but the minimum cementitious content increased to 480kg/m^3 in order to achieve a 55MPa minimum strength. The high workability mix proved to be a success with strengths of between 70MPa and 80MPa achieved.

The strength achieved at three days was more than the required minimum, and therefore the shorter of the large U-section beams could be de-moulded, stressed to 50% and placed in the yard to cure. After seven days the beams were stressed to 100% by which time the concrete had reached about 80% of its 28 day target strength.

However, due to their additional weight the longer beams were stressed to 50%, de-moulded and lifted into position before being stressed to 100%.

In total the project used 550km of stressing cable and approximately 24 000m^3 of concrete.

The project claims to be South Africa's largest U-beam construction contract and to have the longest unsupported railway crossings amongst its many technical achievements.

Since the completion of the project traffic moves smoothly over the interchange and not through it, thereby reducing the congestion in what was previously a bottleneck prone interchange.

Innovative design and construction was integrated to achieve a remarkable result, which benefits the lives of many road users and contributes to the success of Cape Town as a winning South African city.

This project has been deemed as one of the largest and most difficult infrastructure projects ever undertaken in the Western Cape.

Judges' Citation

The judges commend this project for the attention paid to the high performance concrete mix and the sustainability requirements. A minimum of 400kg cementitious content was maintained, the use of extenders was paramount due to the possibility of alkali-silica reaction, and when slag became unavailable, new mix designs utilising fly ash had to be developed.

The density of the concrete was increased further through the use of a special blend of natural sand and processed crusher sand, giving the final product the durability and longevity that is vital to this type of structure. The Koeberg Interchange received a **Commendation in the 2013 Fulton Awards 'Sustainable Concrete'** category.

FULTON Awards 2013 WINNER

PODIUM AT MENLYN

The Podium at Menlyn was designed to create an iconic, flagship, low maintenance building for the Emira Property Fund's new office development. This spectacular building has been a talking point ever since the first off-shutter concrete façade was revealed and is a worthy winner of the prestigious 2013 Fulton Awards 'Innovative Construction' award and the recipient of Commendation in the 'Architectural Concrete' category.

Podium at Menlyn aspired to incorporate a triangular geometry. The use of triangular geometry in the design of the curtain wall was one that was simplistic and remained only 2-Dimensional. The design team was looking for a material that would be able to incorporate a third dimension to the triangular forms of the façade. What better material than raw concrete to achieve this. The raw concrete is juxtaposed with the smooth curtain wall to create a harmonious balance in the design, leaving passers-by with a sense of curiosity as to how the building's concrete forms were created.

The seamless triangular union of glass and off-shutter concrete was inspired by ancient engraved artworks found in the Blombos Caves on the southern Cape coast of South Africa. They symbolise a bridge between a 77 000 year old culture and a futuristic South Africa. Inspiration was also drawn from the ancient Chinese Tangram dissection puzzle. This puzzle, consisting of seven flat shapes called tans, is put together to form shapes. The design team met the client's brief by transforming this ancient game into a magnificent triangular grid which features on the eastern and southern façades of the building in Phase 1.

The abstract design is produced as a modular unit that can be configured into a geometric grid, making the implementation of the design an exact science and representing a synthesis of mathematics, symbolic systems and art. Even the basement and lift lobby artworks make use of the tans to create a 'geometrical garden' within an urban space, giving the feeling of being in a digital landscape. The artwork transforms a once dull basement into an exciting space. The design suggests the archaic nature of its origins and the sophistication of 21st century technology. The monochromatic triangular façade consists of a three-shaded curtain wall of grey glass, which spans the soft curve of the building on the corner of Atterbury Road and Lois Avenue. This striking feature takes full advantage of its prime location directly opposite the Menlyn Park Shopping Centre. The curtain wall acts as a mirror, evolving in colour and intensity as the sun moves across the African sky. In some instances, the mottled façade appears as a single, uniform colour. Breaking the length of the southern façade, and anchoring the building on the northern side, the off-shutter concrete feature walls amplify the triangular module of the façades.

The triangular forms of the façade are now seen as a 3-Dimensional shape as opposed to the 2-Dimensional form of the curtain wall triangles. The creation of a 3-Dimensional triangle was a construction feat in itself. The triangular forms in the concrete façade were created by 35mm deep recesses. A further resolution for triangular windows was to allow natural light to filter into the internal office space.

The beauty of off-shutter concrete lies in its seamless and sculptural appearance and texture. During construction of the sample panel, different methods were explored in order to obtain the required effect. These

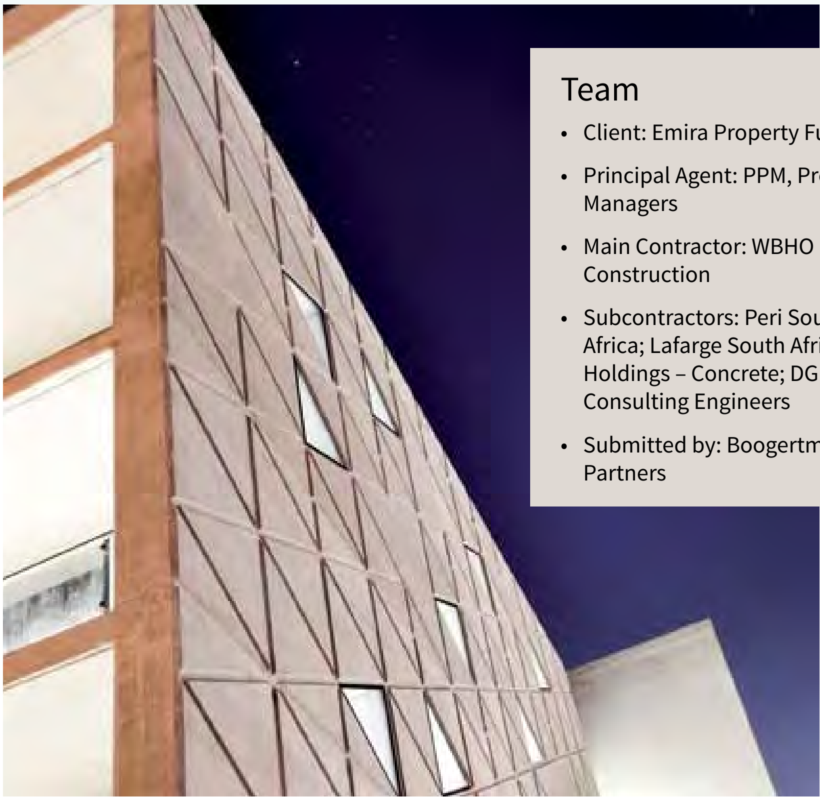
included: using fibre reinforced concrete and self compacting concrete and the use of pre-mixed concrete with a smaller aggregate. The structural engineer required that the concrete feature walls be part of the structural framework of the building – the contractor cast the feature wall simultaneously with the main frame building.

What makes this methodology unique is the fact that the building's entire façade was set out using the geometrical grid of the concrete feature walls. The construction joints in the concrete walls were required at specific heights in order not to impact the contractor's programme. Numerous consultations were held between the structural engineer, the off-shutter concrete specialist, the contractor and the architect.

Two sets of shutters were used for the construction of the three feature walls: a set of shutters was used for the feature walls in the eastern and western façades. While the second set was used for the fire escape stairwell on the southern façade. Utilising the same shutter for the construction of the two walls meant a saving of 40%.

WBHO used 360m^3 of Lafarge's Agilia Vertical self-compacting concrete and a total of 11 500m^3 of concrete.

The building's northern façade is divided into two main sections. The first section, affectionately known as the 'egg-crates', has off-shutter concrete sun-shading devices, created by a combination of concrete overhangs, which protect the office space from the midday sun throughout the year. The combination of walls and overhangs creates the 'egg-crates', which has a multi-functional patio overlooking the main intersection of Lois Avenue and Ingersol Road in Menlyn.The northern façade is exposed to direct sunlight throughout the day. To avoid excessive heat build-up, a double curtain wall system was designed. The top and bottom of the curtain wall are open to assist the stack effect of heat dissipation within this void.



Team

- Client: Emira Property Fund
- Principal Agent: PPM, Project Managers
- Main Contractor: WBHO Construction
- Subcontractors: Peri South Africa; Lafarge South Africa Holdings – Concrete; DG Consulting Engineers
- Submitted by: Boogertman & Partners

The main entrance is a celebration of space with the bold concrete entrance towering the full height of the five-storey building, to welcome each visitor to the 'jewel' of Pretoria.

The geometric grid continues throughout the interior of the building. Spontaneous triangular monochrome floor tiles on the floor of the lobby contrast playfully with the pure white glass wall cladding.A number of green principles include T5 light fittings, a VRV HVAC system, the double curtain wall façade, 765mm bulkheads and passive sun shading on the northern façade, and performance glazing to reduce heat loads substantially.

The Podium at Menlyn has become the gateway to the Menlyn economic node, which will provide an A-Grade business hub – 300 000m^2 of mixed use including retail, offices, hotels and residential units. The success of the project can be attributed to the unbeatable combination of limitless creative talent, project management expertise and a client who had complete faith in both of them.

There is a saying: 'Be so good they can't ignore you'; Podium at Menlyn has made this saying its own.

Judges' Citation

The Podium at Menlyn is the **winner of the prestigious 2013 Fulton Awards 'Innovative Construction' category** and receives a Commendation in the 'Architectural Concrete' category.

The judges were impressed by the use of concrete to incorporate a third dimension to the triangular forms of the building façade, thereby placing raw concrete side-by-side with a smooth glass curtain wall to create a harmonious balance and design.

The liberal use of self-compacting concrete in the construction of the building demonstrates an innovative approach to placing concrete.

Particularly impressive was the grid of triangles on the feature walls reproduced both externally and internally.

The beauty of off-shutter concrete is clearly displayed in this structure by a sculptural, textural and seamless appearance.

FULTON Awards 2013 COMMENDATION

MAHATMA GANDHI ROAD Sewer Ext Micro tunnel

The Mahatma Gandhi Road Sewage Pump Station occupies a prime site within the Durban Point Development Corporation's up-market zone. This required extending an existing 1 350mm diameter concrete gravity sewer line, a distance of 230m from the existing pipe station to the new location.

The Mathatma Ghandi Road gravity sewer and pump station services the greater Durban catchment area, including the central business district and Berea areas, from Umgeni River in the north and Umbilo River in the south.

The alignment of the new pipeline was required to run in the centre of the double lane main feeder road for the Point Precinct. Furthermore, there exists an historically protected building between the starting and finishing point, which meant a straight line design was impossible.

The site is located at the mouth of the Durban harbour in an area previously occupied by the mouth of the natural estuary of the rivers draining into the south Durban basin and, prior to that, by the mouth of the Umgeni River. A total of five boreholes were drilled along the sewer extension alignment. The team evaluated installation options within the site and the alignment constraints to be able to provide the client with recommendations.

The most favourable sewer pipe extension method was pipe-jacking using a micro-tunnel boring machine. Some of the challenges that had to be overcome included disruption to traffic on Mahatma Gandhi Road, a major urban road servicing the Durban Harbour mouth; numerous underground services; and launching the incoming sewer connection in the middle of the busy Mahatma Gandhi Road.

The micro-tunnelling machine manufactured by Herrenknecht was operated by Coleman Tunnelling Africa. The Micro TBM was an AVN 1200TC with a 'Mixed Ground' cutting wheel for 1200mm internal diameter jacking pipes.

The 221m tunnel consisted of a 113m straight section from the jacking pit; a 102m length arc with a 350m radius curved section – to bypass the protected historical Harbour Master Building; and a 6m straight section breaking into the existing harbour tunnel north shaft.

Due to the length of the tunnel and curved section, two intermediate jacking stations, with eight 646kN and 700mm stroke hydraulic cylinders were installed to reduce the jacking pressures on the front pipes. Intermediate jacks were installed at 33m and 133m behind the machine. Laser Guidance System was fixed in the jacking pit, to the set reference alignment and grade to monitor the relative position of the TBM cutting head. The laser target position was then relayed to the control cabin to allow the operator to effect steering adjustments as necessary. When the tunnel reached the curve, a Gyro Scope Guidance System was used to control the line and level.

The systems were checked manually using standard surveying equipment every 40m to ensure that the positioning systems remained accurate. The TBM reached the end point within a deviation of less than 20mm, testament to the accuracy of the guidance system.

The client's requirements included gaining access to the sewer line in the area – the 1 200mm internal diameter reinforced concrete pipe, designed for a 100-year life span, was used. The

reinforced, 145mm thick wall concrete pipes with characteristic strength of 40MPa were designed taking into consideration the known fact that the Durban marine environment is highly corrosive. This, combined with the fact that the concrete sewer pipe would be below the saline groundwater table, required high durability concrete.

Although the extrados of the pipe will be permanently submerged, measures had to be put in place to minimise material attack by salt water. These materials included stainless steel collars and rubber seals for pipe joints. A special grade (AISI 32507) duplex stainless steel was used for its resistance to pitting corrosion. To eliminate chemical (sewage gases and hydrogen sulphide) attack to the concrete, the pipe intrados was lined with 'cast-in', continuously welded thin sheet of HDPE.

The selection of the pipe material in this application was based on constructability and corrosion 'resistivity'. Although concrete may not be as good as HDPE in terms of corrosion resistance, the strength requirement for the jacking operation made concrete the first choice. The combination of concrete for strength, HDPE liner for corrosion and duplex stainless steel collars resulted in a final design of the pipes that achieved all the objectives of the brief. The design of the jointing system also gave the flexibility for the pipe jack to negotiate the 350m radius without having to construct additional reception shafts. These protection measures will enhance material durability to achieve the intended 100 year design life and beyond.

Team

- Client: eThekwini Municipality - Water & Sanitation
- Principal Agent: Goba
- Main Contractor: Group Five
- Subcontractors: Coleman Tunnelling
- Submitted by: Goba

Judges' Citation

The judges awarded the Mahatma Ghandi Road Sewer Gravity Extension Tunnel, in Durban, a **Commendation in the category 'Innovative Construction' 2013 Fulton Awards.**

Innovative construction techniques were used on this project, which involved the extension of a gravity sewer by approximately 221m.

Given the constraints of the site, which were numerous, the team selected the pipe-jacking method of construction using a micro-tunnel boring machine. Concrete was the chosen material for the pipe, owing to its strength for jacking and corrosion resistance. Due to the difficulty in gaining access in the area, the reinforced concrete pipe was designed for a 100-year life span.

The entire pipeline extension was jacked forward from the rear end of the pipeline and the judges commend the team for overcoming challenging design constraints and the innovative way that the final construction was approached.

22 WELLINGTON

BDO South Africa's striking new R90 million Johannesburg headquarters at 22 Wellington Road, in Parktown, was constructed within an extremely tight 12 month construction programme.The development is a joint venture between BDO South Africa, the world's fifth largest accountancy network and Alchemy Property Investments.

BDO decided to demolish the existing building and construct an entirely new one to accommodate its specialist divisions that were previously located in Houghton and Parktown. The civil work started during March and April 2011, with construction following immediately afterwards.

The new building will house more than 1 000 members of staff, constructed on a 4 085m^2 stand, the 8 500m^2 five-storey multi-tenanted office complex has four levels of parking, providing a total of 11 000m^2 of parking across 367 bays. BDO occupies three floors with tenants taking up the remaining two floors.

In total, the main contractor Murray & Roberts Building cast 9 700m^3 of concrete. A natural, off-shutter wood-grain finish for the castings was accomplished by nailing marine ply with a 3mm and 6mm pattern onto the formwork.

Each set of formwork lasted between four and six casts before the marine ply had to be replaced.Walls on the northern façade and similarly the southern façade, had to be cast without horizontal casting joints. The walls form part of the structure and, because of the angles involved, the corners had to rebuilt each time, and the mould had to be redone as the forms moved up to the next slab.

The western façade also presented a challenge to the team. Although the casting principle remained, holes had to be left in the fourth floor slab to work through, owing to a cantilever on the fourth floor. Labour intensive methods were used to hoist formwork to and from the fourth floor and to cast concrete through to that level.

The most challenging section was the construction of part of the north-east sloping picture frame wall where the team had to construct 120m^2 of soffit a vertical shutter for the supporting sloping wall. The panels were built on the ground and lifted into place. Each panel weighed about three tons and the work was undertaken at a height of over eight metres. The formwork panels were lowered into position by crane.

The new office block has been described by observers as a vibrant new landmark in Parktown. The face brick work required a more complex approach than unusual to meet the heritage requirements of the Parktown Residents Association. In total, Murray & Roberts Buildings cast 9 700m^3 of concrete and used 960 tons of steel reinforcing. A total of 413 000 face and stock bricks were used and 14 850m^2 of walls were plastered. Formwork to decks totalled 19 000m^2, with 1 970m^2 of wall formwork for the external façades. A total of 475 people, including sub-contractors, worked on site at the peak of the project.

Team

- Client: Alchemy Property Asset Management
- Principal Agent: Baseline Project Management
- Main Contractor: Murray & Roberts
- Subcontractors: Paragon Architects; Form Scaff/Fix Form; Macsteel Reinforcing; Lafarge South Africa
- Submitted by: Sotiralis Consulting Engineers

Allandale Road/N1 Interchange bridges and Le Roux Overpass

South African National Roads Agency Limited (SANRAL) as part of the Gauteng Freeway Improvement Project constructed five new bridges on the 21km stretch of road between the Buccleuch Interchange in the south and the Brakfontein Interchange in the north.

The R1,654 billion project took 40 months to complete and increased the number of lanes from eight to 12. The mammoth task was undertaken by consulting engineer, BKS, and a tri-party joint venture between Grinaker-LTA Roads & Eathworks; Moseme Road Construction and Boitshoko Road Surfacing and Civil Works.

The original Ben Schoeman Highway was constructed as a four-lane dual carriageway and, at that time, provision was made for the design to increase to a six lane dual carriageway. This meant that all overpass bridges were designed with horizontal clearances to accommodate three lanes per direction.

Between the Allandale and Buccleuch interchange the annual daily traffic exceeds 159 000 vehicles and between the Old Johannesburg Road and Brakfontein interchange, over 110 000 vehicles. The project aimed to improve capacity and reduce traffic congestion and the friction caused by high traffic volumes and choking at on-ramps.

Between the Buccleuch and Allandale interchanges, the freeway was widened from three to six lanes per direction. This is the first 12-lane freeway section in South Africa and required widening of the bridges over the Jukskei River and Maxwell Drive. Additional road reserve was needed to accommodate the wider road.

Between the Allandale and New Road Interchanges, the freeway was widened to five lanes per direction with short auxiliary lanes at the Allandale interchange northbound on-and southbound off-ramps.

The 40-year-old Allandale Road and Le Roux Avenue Bridges did not have sufficient horizontal clearance to accommodate five lanes and six lanes per carriageway, respectively, and had to be demolished and replaced. The freeway bridge over Alexandra Road also had to be widened and retaining walls constructed to keep the toes of cut and fill within the road reserve.

Between New Road and Old Johannesburg Road (Rooihuiskraal) Interchanges, four lanes in each direction were provided with continuous auxiliary lanes between the on-and-off ramps of consecutive interchanges. The main purpose of the continuous auxiliary lanes is to reduce the friction caused by merge and diverge movements at on- and-off ramps and to minimise the choking congestion effect.

To fit four lanes, per carriageway, underneath the existing bridges designed to accommodate 3 x 3,7m lanes per carriageway, the lane widths had to be reduced to 3,4m and the outside shoulders to 1,5m. The effective width of the median shoulder is 1,7m. These lane and median shoulder widths were adopted over the entire length of the freeway.

Between the Old Johannesburg Road (Rooihuiskraal) and Brakfontein Interchanges, the freeway was widened to five lanes per carriageway, which increases to six when approaching the Brakfontein Interchange. The Nellmapius Road Bridge, over the Ben Schoeman Freeway, did not have sufficient horizontal clearance to accommodate five lanes

per carriageway and had to be demolished and replaced.

The Allandale Interchange was a major part of the project - almost half of the earthworks and structure quantities were allocated to upgrading it. Traffic had increased to such extent that it was not possible to upgrade the old diamond interchange sufficiently to acceptable levels of service. The interchange had to be replaced and the new interchange now provides a free flow interchange system with an additional carriageway overpass and new directional ramps and loops.

Five new bridges were constructed at the Allandale Interchange. The deck width of the two bridges carrying Allandale Road Westbound and Allandale Road Eastbound over the Ben Schoeman Freeway is 16,1m and 28,48m respectively. Both bridges have four-span continuous decks with main spans of 22,2m and end spans of 13,34m. The main spans consist of precast, prestressed, M-beams in a pseudo box girder configuration. The end spans are in-situ reinforced concrete voided slab decks. Elevation of the bridge decks is enhanced by the use of precast concrete panels. The end span elevations are grooved to simulate the main span panels. The substructure for these bridges comprises multiple column type piers and wall type abutments with return walls.

The columns and abutment walls are provided with fluting to form an aesthetic finish. Due to the very high abutments, buttress walls instead of tapered walls were used for structural and economic reasons.

Concrete provides a cost effective way for a bridge designer to shape structures in order to project a specific aesthetic idea.

In the case of these bridges, reinforced concrete, pre-tensioned pre-stressed concrete, post-tensioned pre-stressed concrete, precast reinforced concrete and in-situ cast concrete were all used effectively to design and construct.

Using the design principles of durable concrete, coupled with good construction quality assurance on concrete cover, placing, compacting and curing, ensures that these bridges will be maintenance friendly and live up to their 100 year design life.

Team

- Client: South African National Roads Agency Limited SOC (SANRAL) Northern Region
- Principal Agent: BKS
- Main Contractor: Aveng Grinaker – LTA/Moseme/Boitshoko JV
- Subcontractors: Civilcon
- Submitted by: BKS

DF MALAN HIGH SCHOOL
– Multi-purpose activity centre

DF Malan High School in Bellville has gained an international reputation for academic excellence. The governing body took the decision to build a new multi-purpose activity centre for concerts, dances, dinners, exhibitions, assembly, examinations and sports training.

With 1 040 learners attending the tertiary facility, the biggest challenge was to effect quick, efficient construction of a robust, elegant space. Apart from noise, access, time and budget constraints, the design and materials had to complement the existing visual landscape and school complex.

Van Biljon Barnardo Architects and Isipani Construction collaborated with KLS Consulting Engineers and the Portland Group to provide an innovative solution using precast and in-situconcrete.

Large scale hollow core precast concrete panels, 160mm x 1200mm x 4700mm long, manufactured by means of the extrusion method, could be installed faster than other conventional robust materials. A 50MPa strength was specified, 40% less weight and a high thermal quotient.

A vertical H-shaped off-shutter cast concrete column system, between 7,6m and 8m high, was designed into which the precast panels could be slotted first to form the foundation beams and then the walls. The panels were hoisted individually and carefully manoeuvred into place with the panel ends sliding into the column slots.

No strip foundation was required as the columns were designed to withstand major lateral force and at foundation level the panels rest on the column footings. The precast panels stacked between the columns created a high, open space with pertinent horizontal modular banding, both inside and on the exterior of the building. The structure was held together by exposed steel roof trusses.

The panels were cast and erected within four days and all 375 linear metre panels were placed in position within 10 days after casting commenced. These panels are robust enough to withstand the site installation process and future occupancy wear and tear. This construction method reduced construction time and costs.

The architectural concrete elements perfectly complement the design of the school.

Team

- Client: D F Malan High School, Bellville
- Principal Agent: Van Biljon Barnardo Archiects
- Main Contractor: Isipani Construction
- Subcontractors: KLS Consulting Engineers
- Submitted by: Van Biljon Barnardo Archiects

KWAMSANE COMMUNITY

– Access Roads and Pedestrian Facilities Phase 2

The South African National Roads Agency SOC Limited (SANRAL) recognised the need to reduce the potential for accidents on a section of the N2 national road near Mtubatuba, which passes through the township of KwaMsane.

Goba was appointed by SANRAL as the consulting engineer for the design and construction supervision of the KwaMsane Community Access Roads and Pedestrian Facilities, Phase 2.

This community project included upgrading three interlinked access roads, the Western Collector, the Eastern Collector and the N2 underpass, using Continuously Reinforced Concrete Pavement (CRCP).

The existing potholed roads resulted in pedestrians and taxis using a portion of the N2 as a collection and drop off point, as the other roads were almost impassable, particularly in the wet season.

The Mtubatuba local municipality was unable to effectively maintain the roads, which was caused by a weak pavement and sub-grade structure. In addition to the 2,8km road upgrade, additional pedestrian sidewalks were constructed along the Eastern Collector and N2 Underpass to ensure the safety of learners at the two nearby local schools.

SANRAL and Goba identified the need for a road system that was safe, provided pedestrian access and required minimal future maintenance. A number of options were considered but the CRC pavement was selected as it was an ideal choice of material for a labour intensive project.

The project was undertaken as a community upliftment project with stipulated community participation goals. In order to maximise benefits to the community on this project it required that the concrete was batched on site by means of hand labour and mechanical mixers.

In order to minimise future maintenance of the road, the concept of a perpetual pavement was introduced and a 150mm thick CRC pavement with an unsealed tied and keyed longitudinal centre line joint was designed and constructed. This pavement structure would also provide a sustainable solution for the local Mtubatuba Municipality. The CRC pavement thickness was modelled using the design traffic loading obtained from data from the UCOSP Quarry located on the eastern side of the N2. The Cement and Concrete Institute's cncPave software was used to optimise the steel diameter and steel spacing required. Load transfer across the centre line of the half-width constructed pavement was by means of tie bars and a cast in-situ keyway. The side drains were tied to the concrete pavement to eliminate the need for a sealed joint, further reducing the maintenance liability.

Team

- Client: South African National Roads Agency SOC Limited (SANRAL)
- Principal Agent: Goba
- Main Contractor: Mazcon Civil and Building Contractors
- Subcontractors: Amajika General Trading 2
- Submitted by: Goba

MANGAUNG INTERMODAL

– Public Transport Facility

Situated in the heart of the Free State in Bloemfontein's Central Business District is one of the biggest public transport facilities in Africa.

The Mangaung Metropolitan Municipality appointed Vela VKE Consulting Engineers in conjunction with their Joint Venture partner, Incline Architects, as principle agents and designers of this flagship project.

The municipality required a public transport node to accommodate the existing taxi rank, bus services such as Greyhound and Translux, a rail link and retail services.

Structural off-shutter concrete was chosen due to its durability and low maintenance as well as being vandal-proof.

The multi-storey reinforced concrete building was designed to include informal trading facilities on the first, second and third levels. There were a number of infrastructure challenges including accommodating sewerage pipelines.

Vela VKE performed the geotechnical investigations and assessment. The natural stormwater canal site required a piling system 8m below natural ground level. The ground water and collapsible sides called for continuous flight auger piles to be installed. With the canal being approximately 6m deep, the columns (piers) situated inside the canal required pad foundations at a depth of approximately 1,5m to 2m.

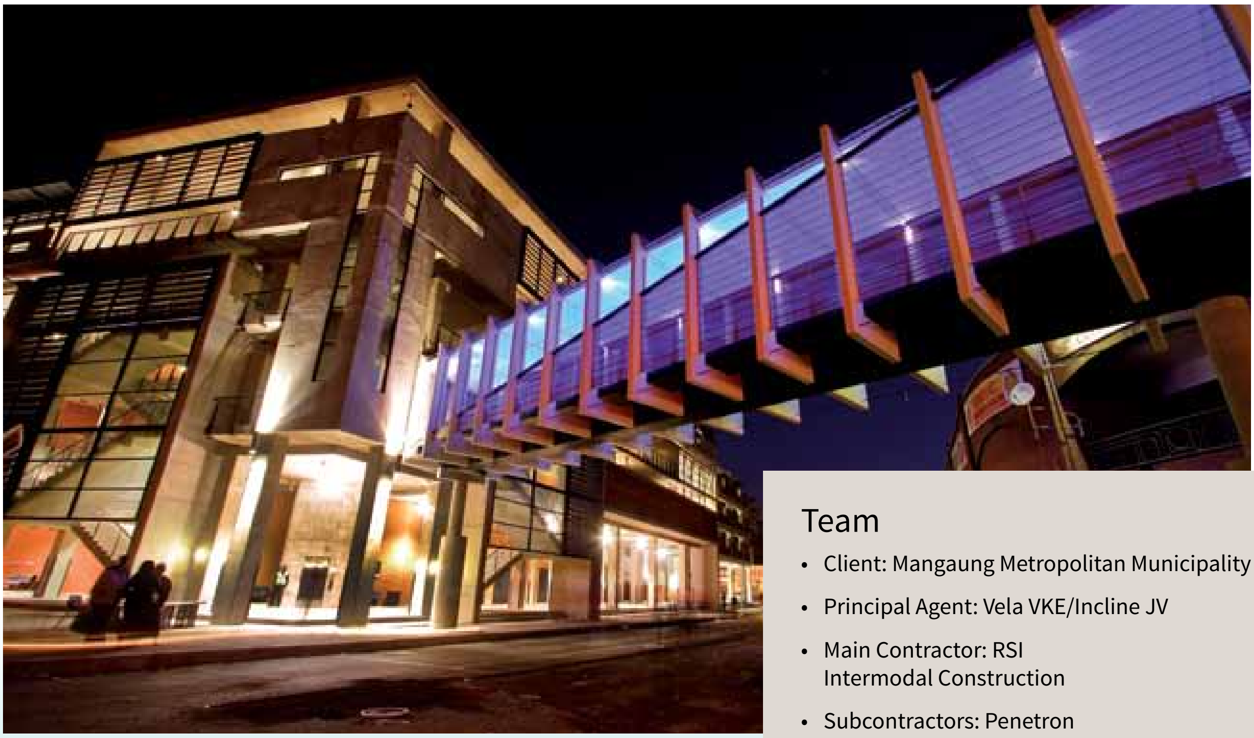
Three large diameter sewer lines 900mm, 600mm and 375mm as well as a 160mm diameter main water line had to be either accommodated, or relocated, in order to minimise the changes to column layout during construction. Innovative transverse ground beams with additional columns were designed to distribute forces around these sensitive and brittle pipes. Special measures also had to be taken while piling to prevent the pile from damaging the existing sewerage infrastructure.

The team constructed CFA pile foundations, post-tension floors, off-shutter concrete columns and walls, perimeter walls and framework, sewerage inlet and outlet infrastructure.

The in-situ and post-tension concrete slabs were used to optimise the design of the floor, with considerable vertical in-situ off-shutter concrete panels to achieve the architect's aesthetical requirements. A total of 23 500m^3 of concrete was used, 1 600 tons of reinforcement and 160km of post tension cabling.

The project also included 223 tons of structural steel for steel canopies and staircases and a further 74 tons of steel for the Hanger Street Pedestrian Bridge linking the existing bus rank with the new facility.

A unique feature of the building is the complex off-shutter concrete lines that the architect achieved by means of wall formations, recesses and cantilevers. The building was designed to be sustainable with natural light and ventilation. The innovative project met all the client's requirements and was completed within the budget and timeframe allocated.



Team

- Client: Mangaung Metropolitan Municipality
- Principal Agent: Vela VKE/Incline JV
- Main Contractor: RSI Intermodal Construction
- Subcontractors: Penetron
- Submitted by: Vela VKE Consulting Engineers (Part of the SMEC Group)

MOSS KOLNIK INTERCHANGE

– Overpass Bridge

Rapid urbanisation around Arbor Town and increased traffic volumes on the N2 national road required an upgrade of the Moss Kolnik Interchange. The South African National Roads Agency SOC Limited appointed Royal HaskoningDHV (RHDHV) as the principal agent for the Moss Kolnik Interchange Overpass Bridge.

Existing traffic patterns show that 25 000 vehicles commute in each direction daily. The large Arbor Town regional shopping centre is situated adjacent to the N2 northbound route, and occupies a strip of land previously used by the Umbogintwini Golf Club.

It was impractical to incorporate any part of the existing Moss Kolnik Interchange Bridge in the upgrade, mainly owing to geometric incompatibility. The interchange layout required widening Moss Kolnik Drive, on the south side of the existing road, which provided an opportunity to construct the new bridge in two stages. Traffic had to be accommodated on the existing deck and also on the existing off-and-on ramps.

The existing bridge had to be replaced with a new structure, with substantially longer spans over the N2 carriageways, a wider deck to accommodate six traffic lanes and a pedestrian walk-way.

At the conceptual design stage, consideration was given to: the primary structural form; configuration of components; method of construction, and bridge construction. Concrete was strongly favoured for its economy and durability and also for its amenability to meeting geometric requirements and aesthetic styling. Structural steel was found to be uneconomical because of the particular geometric requirements and its unsuitability for site, 300m from KwaZulu-Natal coastline.

The superstructure of the new bridge comprises a continuous insitupre-stressed concrete box girder deck, constructed in stages with a 38m span over the north-bound carriageway; a 42m span over the southbound carriageway and adjacent ramps; and a 21m east end span. The architect has visually 'softened' the deck by curving the pier faces and the intersection of the deck soffit and sides to improve the aesthetic appearance of the structure.

The piers comprise partial V-shaped reinforced concrete columns. The abutments consist of reinforced concrete bank seats with ear-wings to support the parapet end blocks. The abutments are also supported by precast concrete piles driven to a predetermined set in very dense sand. The combination of pre-stressed and reinforced concrete components has proved to be technically suitable and economical for a number of interchange bridges in the past and was the most realistic solution in this instance.

Materials include the use of fly ash, slag and silica fume constituents, all waste by-products from power plants installations.

Team

- Client: South African National Roads Agency SOC Limited (SANRAL)
- Principal Agent: Royal HaskoningDHV
- Main Contractor: Steffanutti Stocks Civils KZN
- Subcontractors: Jeffares & Green
- Submitted by: Royal HaskoningDHV

N3 –12 ELANDS INTERCHANGE – Switch Ramp Bridge

KAS JV, a joint venture between consulting engineering firms Knight Piesold as lead consultant, Gibb and PD Naidoo & Associates, was appointed by the South African National Roads Agency SOC Limited (SANRAL) to design and construct Package E1 of the Gauteng Freeway Improvement Project.

The project required creating additional lanes on a 12km stretch of road along the N3-12 dual-carriageway between Heidelberg Road and the Geldenhuis Interchange.

This complex interchange system connects the N12 and N3 freeways, and crosses over and provides access to Rand Airport Road. The interchange experienced severe congestion in peak periods as N3 north-bound traffic joined the M2 east/west motorway at the adjacent Geldenhuis Interchange.

The purpose of the new Switch Ramp was to minimise congestion from weaving and switching, N3 northbound traffic destined for the M2 onto a dedicated elevated ramp through the Interchange leading directly to the M2 off-ramps.

The Elands Interchange Switch Ramp Bridge is an impressive 400m long, horizontally-curved concrete feature bridge designed for and constructed by the incremental launching method of construction, to satisfy SANRAL requirements that the bridge be constructed under uninterrupted traffic flow through the Interchange. The incremental launching method of construction of the bridge deck was adopted for design, thereby completely eliminating any otherwise restrictive deck staging formwork.

Concrete as the construction material was undoubtedly the only choice for this bridge, in terms of cost, constructability, long term durability and minimised maintenance requirements.

In-situ concrete, both reinforced and post-tensioned, was used for the construction of all foundation, substructure and superstructure elements of the bridge, with precast reinforced concrete being used for bridge deck parapets. All in-situ concrete was sourced from a commercial ready-mix plant, using dolomite coarse and blended fine aggregates throughout. Conventional placing methods were used for accessible locations and heights, with pumping methods for elevated substructure pours and for all deck segment construction. All concrete compaction was undertaken with conventional poker vibration methods.

Specially designed early high strength, high slump pumped concrete was used for the heavily reinforced and congested deck segments, which were constructed in two or three separate casts from bottom slab, webs to top slabs. To reduce differential shrinkage and any resulting potential crack development, the time between casts had to be kept to a minimum, requiring early stripping of any interfering internal side formwork for subsequent casts. Also, in order to satisfy the very tight programme for construction of the deck segments, stressing was required to be undertaken within three days of completion of the final cast, followed immediately thereafter by launching. All these time and strength constraints were successfully met by the purposely designed concrete mix.

Off-shutter concrete with conventional finishing methods was used throughout the bridge on all exposed surfaces, with resulting good and aesthetically pleasing concrete finishes being achieved.

The 400m long horizontally-curved bridge consists of a permanent nine span, continuous 3,5m deep, post-tensioned concrete box girder deck, supported on reinforced concrete piers and spill through type abutments on spread footing foundations on rock at relatively shallow depth. The pier immediately adjacent to the N12 northbound carriageway is the exception, being founded on large diameter bored piles taken through the road embankment fill and socketed into the underlying rock, so as to eliminate an otherwise deep and costly laterally supported excavation alongside the roadway.

Team

- Client: The South African National Roads Agency SOC Limited(SANRAL)
- Principal Agent: KAS JV (Knight Piesold, Gibb, PD Naidoo & Associates)
- Main Contractor: Siyavaya Highway Construction JV; (Group Five Construction – Lead contractor)
- Subcontractors: Structural Systems Africa
- Submitted by: Gibb

FULTON Awards 2013

NOMINATED

NEW OFFICE FOR BUHRMANN & PARTNERS

The new office for Buhrmann & Partners is located on a narrow 1 500m^2 cul-de-sac low-density office development in Klein Windhoek. The area is gradually being transformed without sacrificing its distinct residential scale.

Apart from the nearby Aigams Shopping Centre and the UN Building, single and double storey structures prevail. The client, an engineering company that provides civil, structural and project management services, proposed demolishing the existing structures but retaining and integrating the garden in the design.

The company's three partners had to be accommodated in separate offices with views over the garden. Other requirements included maximising available bulk, the introduction of a water element and, more importantly, the use of off-shutter concrete.

The client's distinct preference for concrete as the material of choice presented a creative opportunity to design a building of restrained simplicity where not only structure but also detailing and finishes would serve as a mute advertisement of the owners' engineering profession.

Simplicity and transparency were the overriding design aspirations. A long concrete beam with impressive clear spans was designed as a prominent circulation axis, demarcating a clear approach to the building for both visitors and staff, and separating the production from the support service zones. It also serves as a unifying element that ties the various building components and staff parking into a single architectural structure. Perhaps the most striking visual feature, however, is a broad butterfly roof that stretches almost the entire width of the site. A metaphor for a wide-spreading acacia, it defines the generous main working space. Conceived as a double volume container, the large draughting office has a winged and centrally cantilevered concrete roof with clearstory windows to the south and north to ensure sufficient daylight. Individual offices and discussion nodes in the north and south are attached to the glazed façades as cubed pods framing views of the garden from within. A generous roof overhang shades the glazed façades of the main space to the north whilst horizontal louvres provide shading for the three office pods.

Forming a building threshold from public to private and physically separating building from garden is a linear water element. The office pods are recessed below the floor line and appear to be floating. Public, semi-private and private domains within the building are clearly defined. A brightly coloured curved wall element shields the clustered service elements from the fierce west sun. A minimalist and robust approach was followed in the choice and application of materials, details and finishes: mindful of low maintenance, exposed structural elements are used alongside unadorned concrete, steel and aluminium, timber and glass.

An integral component of the Bührmann & Partners building, sustainability was approached from a pragmatic point of view by complying with basics such as correct orientation, prevailing sun angles, shading and effective shading devices, climatically appropriate fenestration and effective lighting, evaporative cooling, rain-water harvesting, and the appropriate use of materials and finishes. It is steeped in the belief that those decisions that shape an individual project have implications not only for its inhabitants, but also for the shaping of the surroundings and for the use of the available resources.

Team

- Client: Buhrmann & Partners Consulting Engineers
- Principal Agent: Wasserfall Munting Architects Inc
- Main Contractor: M A T T Construction
- Submitted by: Wasserfall Munting Architects Inc

NEWCLARE ROAD-UNDER-RAIL UNDERPASS

The Johannesburg Devlopment Agency's Rea Vaya Bus Rapid Transit route through Coronationville and Newclare has necessitated a new road-under-rail crossing. This links Price and Hoy Streets. Concor Civils, a Murray & Roberts construction company, was tasked with designing and constructing the road-under-rail underpass project in Newclare.

During the 18-month project, Newclare to Westbury rail traffic remained operational and it is believed that this is the first structure of this size to be jacked into an operational railway line embankment, without interruption to railway traffic.

The 52,5m long underpass is 12m wide, allowing for two road lanes of 3,7m each and two sidewalks of 2,3m. The structure was constructed in two halves, one 28m long, the other 24,5m long, with the structures meeting on the centre line of the railway.

The project team comprised consulting engineers Vela VKE with structural design provided by Concor Civils and lateral support design by Jones & Wagener. Esorfranki Geotechnical constructed the lateral support and conducted the jacking, with Concor Civils undertaking the concrete construction. AfriSam supplied all the concrete and provided technical advice.

This unusual and challenging project began with the construction of the lateral support, by creating two semi-complete box cuts, one on either side of the embankment, close to the railway platforms to reduce the jacking length. Originally it was intended that both structures would be jacked simultaneously to maintain a stable embankment. The team placed vertical micropiles on the line of the excavation to keep vertical displacement of the railway lines to a minimum. Reinforced concrete strip foundations were cast within the box cut formed by the lateral support, utilising a steel sliding surface and steel guides on the sides to keep the structure on track throughout the jacking operation. The top surface of the steel sliding surfaces was placed within 0.5 mm, using a specially designed adjustable support and grouting system.

Team

- Client: Johannesburg Development Agency
- Principal Agent: Vela VKE
- Main Contractor: Concor Civils
- Subcontactors: Esorfranki Geotechnical; AfriSam
- Submitted by: Coralynne & Associates

About 5m from the final jacked position, both structures were unstable due to the large soil and rail loading. Therefore, to maintain stability over this crucial construction stage, it was necessary to anchor the back of the structures during the last 5m of jacking by placing rock anchors on either side of all four walls and constructing a steel cross-head over the top of each wall. Double steel sliding plates were built into the top of each wing wall, with Teflon pads placed below the steel cross-heads.

As the structures were jacked forward, the initially vertical tendons simply displaced to an angle of 2.3° degrees, representing the friction angle of Teflon to steel.

This proved a pleasant surprise to the site teams, who had anticipated jacking the cross-head backwards as the structures moved forward.

The Hoy Street structure weighed 1 100 tons and required a jacking force of 1 200 tons, while the Price Street side weighed 1 140 tons, needing a jacking force of more than 1 000 tons. The individual walls on each structure were sometimes jacked with different forces in order to provide limited steering of the structures.

The two structures met exactly as expected on the centre line of the project, with the final gap of 150 mm partially sealed using gunnite. The construction of road works, a pedestrian bridge over the railway lines, sidewalks and drainage concluded the project, with a final completion value of R29,5 million.

PROTEA HOUSE

Team

- Client: Richard Goldstein
- Principal Agent: Studio Mas
- Main Contractor: Bos & Punt
- Submitted by: Hulme & Associates

Protea House is a striking residential structure, located at the foot of Lion's Head, in Fresnaye, Cape Town. The client's brief was to create a unique residence, connecting two homes for an extended family.

The decision to use exposed concrete was to show that concrete need not be considered only as a structural material. Inspired by the cliffs of Table Mountain, the façade is an abstracted cliff-face built out of off-shutter concrete. The concrete recesses and ridges are designed to support the growth of endemic air-plants and succulents to ultimately mimic nature.

The textured finishes and relief work set against the landscaping are good examples of how the beauty of concrete can be used to greatly enhance the end product.

The urban nature of the site, the parameters of the local authority's zoning scheme and the client's desire for a large garden resulted in a perimeter block typology.

The choice to conceive the structure as a series of flat slabs supported by concrete columns and load-bearing masonry was made on sound engineering rationale. No other material could combine as many qualities to achieve the same result.

Almost from the outset, the client had expressed a desire to see off-shutter concrete as the final aesthetic finish and this substantially guided the design process. While several alternatives were considered for the textured areas, the final shuttering choice consisted of horizontally placed timber boards. Additional shuttering to create the recesses were fixed to this. The timber boards were fixed to conventional proprietary steel shuttering, which offered the robustness to the system to allow it to be lifted as a unit.

The problem of successfully releasing the shutter without damage to the vulnerable recesses was identified at an early stage.

While several ideas were workshopped, in the final choice, polystyrene was faced with timber plywood to provide enough flexibility in the recesses for successful release. Off-shutter concrete work is always going to present challenges and this project was no exception.

Meticulous detail was paid to the shuttering design as nearly every shutter was unique. The design of the shutters had to be cognisant of: the maximum size the crane could hoist; the maximum size of the concrete pour; sequence of casting to control shrinkage; and the positions of cold joints. The concrete used was 30MPa, with a Penetron waterproofing additive in all external concrete elements. The concrete was provided by Lafarge with a slump of between 90 and 120mm.

The wall thickness was increased to allow the pouring of the concrete to be via a 110 diameter pipe, extended to the lower sections of the wall shuttering to reduce the risk of honeycombing. Curing was done with a proprietary spray-on curing compound.

Extensive use was made of wide concrete brows above the door openings. These brows allowed the door heights to be limited and, at the same time, form a wide shading element. The brow concrete was partly suspended from the reinforced concrete slabs with thin steel plates.

The success of this project relied on acknowledging input from everyone on the team.

THE READING INTERCHANGE

– Cut and cover tunnel structure

The Reading Interchange was selected by the South African National Roads Agency SOC Limited (SANRAL) as one of the Gauteng Freeway Improvement Project (GPIF) focus points. The design team was requested to incorporate artistic and aesthetic elements in the design in order to create a visual experience for the road user over and above the functional solution to the traffic issues.

The UPW Consulting/Nyeleti Consulting Joint Venture was awarded the Reading Interchange Cut and Cover Tunnel Structure Package E2, of the GFIP project. Nyeleti Consulting was responsible for the structural design, while UWP Consulting was tasked with the geometric alignment and road design. Siyavaya Joint Venture was appointed the main contractor.

The design team proposed a cut and cover tunnel structure that would divert traffic from the R59 north directly onto the N12 east ramp, under the R59 south. Besides its many other practicalities, this solution could be constructed without any disruption to traffic.

The total length of the structure is approximately 345m long, divided into two tunnel sections measuring 162m and 63m respectively, separated by an open gap of 38m and retaining walls measuring 120m in total. The gap is essentially a safety element providing natural light in the event of power failures and assisting in the expulsion of carbon monoxide fumes from the tunnels.

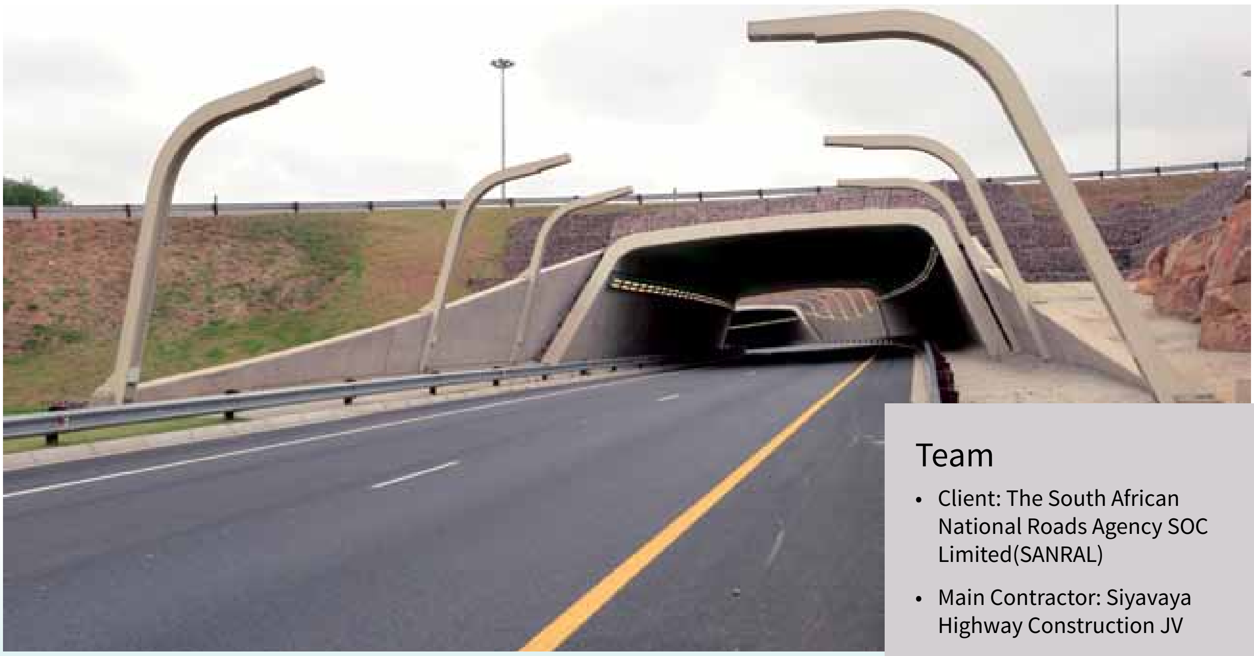
The tunnel alignment is on a slight vertical curve with a 276,4m horizontal radius and varying super elevation. With a complex geometric layout, a balance had to be found between what is aesthetically preferred to what can practically be constructed. To enable the designers to strike this balance it was decided to model the complete tunnel structure in a three dimensional AutoCAD model. A straight segment length of 10m long provided the best combination of visual effect and ease of construction.

The tunnel structure is ideally suited to be constructed using cast insitu reinforced concrete. The segment length and formwork was designed to enable each segment to be cast continuously in one pour.

LED lighting was used to project green light on the ceiling of the tunnel and thereby creating a special and distinctive atmosphere when driving through the tunnel. Special light masts were also designed and installed at the start and end of the tunnel. WMS Architects was involved from the start of the detail design phase and provided architectural input which was incorporated into the design. Several details were slightly modified and adjusted to provide a more pleasing and aesthetic end result.

The Reading Interchange cut and cover tunnel structure is not a complicated 'world first' type structure, but rather a combination of fundamental, tried and tested engineering elements that were put together with care and attention to detail.

This project is testament to the fact that a functional and aesthetically pleasing structure can be achieved without spending large amounts of additional funds.



Team

- Client: The South African National Roads Agency SOC Limited(SANRAL)
- Main Contractor: Siyavaya Highway Construction JV
- Subcontractors: UPW Consulting; WMS Architects
- Submitted by: Nyeleti Consulting

SEPHAKU CEMENT
– Aganang Plant

From design and fabrication to construction delivery, Aganang, Sephaku Cement's R2,8 billion flagship integrated clinker and cement production plant is a concrete superstructure. It showcases the use of concrete as a material of choice in the production of cement and in the design flexibility and durability of concrete.

Sephaku's plant, Aganang, a Setswana name which means 'empowering each other', aims to live up to its name and marks the beginning of the cement manufacturer's role as a key industry player, in the South African cement industry.

The project is also an example of the sheer scale of construction and productivity that is possible through concrete usage. It is an exhibition of massive civil engineering construction scale, impressive efficiencies and intricate precision, combined with a dimension of pragmatic innovation.

As one of the largest privately funded capital projects in the country, a total of 120 000m^3 of concrete was used and 17 600 tons of structural steel. To put it into perspective, Johannesburg's world class Soccer City stadium used only 80 000m^3 of concrete and 8 000 tons of structural steel. The Aganang plant has an operational capacity of producing 6 000 tons of clinker per day and 1,2 million tons of cement per annum, with storage volumes of 56 000 tons. For the clinker silo beam alone, a civil structure that started 7m below ground level, concrete sliding required two 38m boom pumps and two stationary concrete pumps.

Its clinker silo is one of the largest single storage bunkers in South Africa. The kiln is also the longest burning and biggest single kiln in the country. Raw meal silo storage capacity accommodates 20 000 tons, along with pre-blended stockpiles that extend the length and breadth of four rugby fields. The cement silos also have the capacity to store approximately 22 000 tons of finished cement product. Construction began in September 2011 and old and new techniques and methodologies were merged to create the gigantic plant.

The overall quality of plant design reflects intelligent solutions, specifically pertaining to the way in which rebar was delivered, as well as construction of supporting steel structures. The result was delivery of epic efficiencies and excellent project management.

For example, some 13 000 tons of rebar was processed through on site bending yards, with a team of just seven rebar workers typically bending six tons and placing four tons of rebar per day. Through stringent quality control holding points, the project owner managed the high speed delivery.

Aganang is the first South African based clinker and cement producer in the market in over 70 years. With Sephaku Cement being the recipient of the largest African investment into South Africa.

Not only will Aganang generate sustainable employment opportunities for South Africans but it will contribute to economic growth through its participation in the country's value chain; consistently contributing through revenue generation and related tax contributions.

Team

- Client: Sephaku Cement
- Principal Agent: Sephaku Cement
- Main Contractor: Sinoma Construction International
- Submitted by: Sephaku Cement

THE QUARTER

The project developed by the owner/contractor, JNM Construction, designed the retail shopping centre to include offices, a showroom and food quarter.

The simple uncluttered concrete architectural lifestyle complex aims to offer a pleasant local shopping experience. JNM Construction have developed a number of buildings in the area ranging from commercial, light industrial to a church.

The contractor has worked with tilt-up construction for a number of years, as a highly efficient and cost effective methodology compared to standard construction methods in South Africa. As a member of the Engineering Council of South Africa, Head of JNM Construction, Brent Youens sought to improve the quality and finishes in this specialised area of concrete construction.

The Quarter, a small 2 400m^2 shopping centre with parking for 112 vehicles, is the newest development in Ballito's suburban paradise, on KwaZulu-Natal's north coast within 10 minutes drive from King Shaka International Airport.

Planning was extremely important as there was no available space off-site to prepare the concrete panels. An intricate plan was developed with the engineer to cast the walls panels on the ground and then hoist them into place with cranes. Approximately 150 panels were lifted over two stages spanning five days. The entire project was completed within six months.

The shopping centre was an ideal property for this type of construction given the relatively flat open site and design considerations. By utilising tilt-up construction the project was completed timeously and achieved substantial savings in operational costs.

Team

- Client: JNM Construction
- Principal Agent: Hugh Fraser Architect
- Main Contractor: JNM Construction
- Subcontractors: Slabbert & Associates

UNISA - Florida campus

The existing UNISA Florida Campus on the West Rand needed to increase its capacity and the R427 million project included three additional buildings – a four-storey main building, a three-storey engineering block as well as a single-storey agricultural facility.

SSI Engineers and Environmental Consultants (trading as Royal HaskoningDHV) provided the structural, civil, electrical and mechanical services, while HMZ Architect's were responsible for the design and WBHO, as the main contractor.

The client stipulated that all the existing university facilities had to be operational during the construction of the new buildings. This included continuous connectivity for learners, which required the contractor to be particularly careful not to damage services to the existing buildings.

Team

- Client: University of South Africa (UNISA)
- Principal Agent: HMZ Architects
- Main Contractor: WBHO
- Subcontractors: HMZ Architects; SSI Engineers & Environmental Consultants; (Trading as Royal Haskoning-DHV)
- Submitted by: SSI Engineers & Environmental Consultants; (Trading as Royal Haskoning-DHV)

Concrete was the most appropriate material, offering flexibility of design, longevity, corrosion resistance, strength and overall performance to meet the building's operational requirements.

The engineering structures consist of five buildings namely mining, electrical, industrial, mechanical and civil. These structures are three storey, framed, reinforced concrete structures founded on pad and strip footings. The building frames are divided in average 6m grids with 255mm thick suspended floor slabs supported on reinforced concrete beams of varying sizes. The engineering buildings also have 6 ton cranes operating in the mining, industrial, mechanical and civil buildings. Due to the high engineering equipment high live loads of $10kN/m^2$ were adopted in the design. All roof coverings were structural steel frames with metal sheeting.

The engineering building was designed with two sections, the upper part consisting of civil, mechanical and industrial engineering and the lower part comprising mining and electrical engineering, with a connecting walkway.

This concrete structure consists of columns, beams and slabs up to roof level. At roof level, a ring beam supports the steel roof structure. It was designed to accommodate the gantry cranes in each building, which necessitated the inclusion of large roll-up doors to provide sufficient access to the various engineering areas. These floors were designed as a composite structure and due to the steel being exposed in a high risk fire area, the beams were treated with fire-retarding coatings.

Due to the poor soil conditions, high loads and proximity of existing buildings and services, 68 piles were cast. Where the depth was insufficient to cast the piles, large pad footings where designed to transfer the load to the ground layers. One area required shotcrete to avoid subsidence around existing footings. Retaining structures were used to create the basement and a central tunnel, nicknamed the 'Gautrain Tunnel' designed to accommodate the building's centralised services.

The buildings were made up of concrete columns with concrete plant rooms and a steel roof structure. Two other buildings used a structural steel portal structure with brickwork infill. The most exciting and challenging structural elements were the architectural 'steel trees' feature that was used as a covering canopy structure.

RHDHV coordinated all services in the main building basement area through the use of the computer program Revit. The exercise was used to minimise clashes of services during the installation.

UNIVERSITY OF PRETORIA

- Aula Foyer Project

The Aula Theatre has been classed as a Heritage Building and located at the University of Pretoria, the venue is commonly used for the university's graduation ceremonies and events. As the oldest operational theatre, the 550m² building required upgrading to improve its usability during inclement weather.

After prolonged consultation with the national heritage authorities, it was agreed that the new foyer would be constructed on the side of the existing building.

The creation of large access openings would link the existing concrete side wall to the new foyer. After a careful analysis of the existing structural frame and detailed modelling, new access openings were created, which mirror the style of the heritage building.

The space within the new building has been optimised through the construction of a structural six-sided column, which functions as a vertical service shaft.

This stylish, tree-like structure also inconspicuously houses the Heating, Ventilation and Air-Conditioning (HVAC) plant room recessed within the splayed space below the roof slab of the new foyer, ensuring that air-conditioning equipment is not visible in elevation.

Team

- Client: University of Pretoria
- Principal Agent: ARC Architects
- Main Contractor: Stefanutti Stocks
- Submitted by: Aurecon SA

Concrete has proved the most popular choice for the construction of commercial and institutional buildings in South Africa. This is partly due to being cost efficient and lower in maintenance costs. Concrete also offers the ability to construct complex structural shapes to comply with architectural design requirements.

The new foyer had to match the original concrete foyer and provide a functional and aesthetically pleasing space, which will cater for the university's ever increasing number of under-and-post graduate students.

The project team is extremely proud to be associated with the completed project.

WITS SCIENCE STADIUM

The new Wits Science Stadium combines the conversion of an existing sports stadium into five large scale auditoria, to accommodate 1 570 students, twenty tutorial rooms, which seat 830, the construction of three double volume laboratory space with bench seating for 1 100 students.

Located on the relatively underdeveloped west side of the Braamfontein Campus the decision was taken to utilise reinforced concrete as the primary structural material.

The existing stadium comprised of reinforced concrete frames, with precast seating spanning between frames. The main design challenge entailed rebuilding the raked seating at an optimal angle. The continued durability of the existing stadium concrete structure was a major factor in the viability of the overall project, given the prohibitive costs associated with demolishing and rebuilding a new structure.

The front part of the auditoria was formed by a new three-storey reinforced concrete coffered slab structure. On the second floor, large upstand beams were used to span the plant areas over the auditoria, with spans of up to 20m.

One of the primary design concepts of the laboratory section of the building is the emphasis on making science accessible. Hence, all three laboratories have extensive glass window areas, framed in a visible concrete structure. The laboratory building was conceived as open space, to provide large teaching spaces and clear lines of sight. This 17m clear span was achieved using shaped reinforced concrete 'fin' frames, with trough slabs spanning between the frames. The troughs have aesthetic appeal, and relatively large surface areas, resulting in efficient heating and cooling via piped water (TABS) system.

The NEC Target Cost form of contract provided a significant advantage to the project, by forcing the design and construction teams to work together to come up with efficient solutions. This had a major impact in bringing the project in on time, within budget and at the required quality level.

The feature staircases and platforms that rise inside the colonnade posed challenges. The requirement to minimise column pours, to ensure straight and uniform columns, required the use of threaded connectors, to construct the corbel beams that support the staircases. From a technical concrete point of view, many of the visible vertical elements are tall and slender, requiring the use of self-compacting concrete.

Concrete's versatility and ability to be formed in geometric shapes, the aesthetic beauty of off-shutter concrete, durability and robustness of off-shutter concrete resonates with the existing concrete buildings on campus.

The end result is a world class facility that entices the visitor into the world of science. The imposing yet engaging concrete structure epitomises the vital support role that science has today and tomorrow. The durability of concrete will ensure that this complex stands the test of time, as the backdrop to the focal public space on the West Campus of the University of Witwatersrand.

Team

- Client: University of Pretoria
- Principal Agent: ARC Architects
- Main Contractor: Stefanutti Stocks
- Submitted by: Aurecon SA

WORCESTER INTERCHANGE

The Worcester Interchange project was a successful Public/Private Partnership (PPP) financed by the Golden Valley Casino, Breede Valley Municipality, SANRAL, Worcester Land Trust and Altona Development.

The Worcester Interchange bridge, is an eye-catching and unique structure which symbolises the vision of structural engineers to meet the fundamental requirements. The bridge was completed within 18 months at a cost of R17,19 million. The overall project, including the interchange and road upgrades, cost R105,8 million.

The bridge consists of four spans which cross the N1 at right angles. The substructure consists of Y-shaped piers with capping beams supported on spill through abutments and is supported on 1 080mm diameter oscillator piles founded on rock. The main spans and end spans are 21m and 13m in length respectively. The beam and slab type deck has an overall width of 16,66m, which includes a carriageway width of 11,9m and two 1,8m wide sidewalks.

The roadway and sidewalks are separated by means of 800mm high F-shape barriers. At the outer piers, the deck was made continuous for live loading. The deck expansion joints at the abutments are buried below the surfacing and at the centre pier a claw type joint is present.

The precast beams are supported on rubber pads. The balustrades consist of precast concrete frames with structural steel infill, except at the bridge supports

The South African National Roads Agency SOC Limited (SANRAL) required an interchange at Worcester to cope with the increase in traffic along and across the N1 at the town. The interchange forms part of the long term planning for the N1/N2 Winelands Toll Highway Project.

where the panels were made solid and cast in situ. The design concept was based on the requirement that the deck construction method would not need any staging over the N1 carriageways. This was achieved by using a beam and slab type deck, consisting of precast inverted T-beams and in-situcast top and bottom slabs. The main span beams were prestressed with post tensioned cables, but the shorter end span beams have conventional reinforcement. The `cantilever' parts of the deck top slab, which carry the sidewalks, were constructed using precast slabs of average length of 2,62m, which were supported on structural steel ribs attached to the edge beams.

The steel ribs were hot-dip galvanised and painted and bolted to the edge beams before being lifted into position. Anchoring of the ribs to the in-situcast part of the top slab was achieved by means of steel ties, which formed part of the rib fabrication.

After placing all the precast beams using a 220t crane, the bottom slab of the deck was formed by filling in between the beams. At the outer piers, the deck was made a continuous part of the cantilever slab, each side of the pier was cast in-situin order to accommodate the top steel over these supports. After finishing the in-situcast part of the top slab, the precast slabs were installed and finally the top slab was completed by filling in the 600mm wide casting gaps between the slabs.

New construction technologies and techniques have led to the ease in creating unique aesthetical features using concrete as a construction material. The durability and strength of concrete has made it a logical choice for bridges for many years and still remains one of the most used construction material worldwide.

Team

- Client: South African National Roads Agency SOC Limited
- Principal Agent: South African National Roads Agency SOC Limited
- Main Contractor: Martin & East
- Subcontractors: Darson Construction
- Submitted by: Nadeson Consulting Services

A RECORD OF THE FULTON AWARDS AT A GLANCE

Fulton Awards Awarded in	CSSA President	Fulton Memorial Speaker	Total No of Entries	Fulton Award Winners in Categories:					
				Civil Engineering Structures	Building Structures	Sculptures	Aesthetic Appeal	Design Concepts	Construction Techniques
1980	MA Vasarhelyi	-	13	Public Library, Sasolburg		-	-	-	-
1981	GD Bendall	-	15	Preheater Tower, De Hoek	CSSA & School of Concrete Technology, Halfway House	-	-	-	-
1982	CJ Thompson	Dr D Davis (RSA)	9	Glenwood Tunnel, Durban	SATS Container Workshops, Cape Town	-	-	-	-
1983	KC Tucker	SC Watson (USA)	12	Bloukrantz Bridge, Cape	Port Control Building, Port Elizabeth	-	-	-	-
1984	EPJ van Vuuren	Prof D Billington (USA)	26	Tutuka Power Station No 2 Chimney, near Standerton	Cape Provincial Administration Head Office, Cape Town	-	-	-	-
1985	A Dutton	F La Due (USA)	18	Main Dam, Otjivero-Gobabis Regional State Water Scheme	No winner.	-	-	-	-
1986	DP Samson	Prof W Hestor (USA)	23	Stellenberg Interchange Bridges, Cape Town	Precast Acoustic Drapes - Natal Provincial Theatre Complex	-	-	-	-
1987	JE Hodgkiss	Mrs A Smithson (UK)	21	Lethabo Boiler House Structure, near Vereeniging	Human Sciences Research Council Building, Pretoria	-	-	-	-
1988	JE Hodgkiss	R Lacroix (France)	16	FW de Klerk Bridge, Vereeniging	No winner	-	-	-	-
1989	RJ Snowden	Dr J Davidovitz	22	John Ross Bridge over the Tugela River	NG Kerkkompleks, Somerstrand	-	-	-	-
1990	PC Graham	D Lee (UK)	21	Swartklip Interchange Bridges, Cape Town	South African Trade Mission, Maputo	-	-	-	-
1991	CJ Lloyd	TW Kirkbridge (UK)	29	Malibamatso River Bridge, Lesotho Highlands Scheme	Klein Constantia New Maturation Cellars, Cape Town	Untitled Relief Panels	-	-	-
1992	VE Blackbeard	EC Chaplin (UK)	41	KSM Mill Complex, Pietermaritzburg	Bophuthatswana Parliament Building, Mmabatho	Untitled Concrete Sculptures, Medfem Clinic, Sandton	-	-	-
1993	D Peters	R Choy (Australia)	30	No winner	The Oaks Pavilion,& North Stand, Newlands, Cape Town	Cape of G H Nature Res Gateway. Mould for Panoptic Gaze	-	-	-
1994*	MG Latimer	P Matt (Switzerland)	21	Tugela River bridge, No B351, N2, Durban – Richards Bay	Shanti Nikatan – House of Peace, Westville, Natal	Woman Dancing, Princess Daisy Boat, Soma Tree	-	-	-
1995*	Prof M Alexander	Dr AK Mullick (India)	18	Main Concrete Structures, Alusaf Hillside Smelter	BMW Pavilion, V & A Waterfront, Cape Town	-	-	-	-
1996	CH Waterson	J Pierce (USA)	17	Johannesburg Stadium, Johannesburg	Standard Bank Centre, Johannesburg	-	-	-	-
1997	BA Raath	Sir Michael Fowler (UK)	13	Harper Road Bridge, Johannesburg	Eastgate Centre, Harare	Conch Structure, Lalucia Ridge Office Estate, Umhlanga	-	-	-
1998	PRA Flower	Dr G Rosenthal (RSA)	12	Katze Dam, Lesotho Highlands Scheme	Administration & Academic Building, University of PE	-	-	-	-
1999	DP Samson	L Mills (RSA)	16	New Black River Bridge, Cape Town	No winner	-	Driekoppies Dam, Mpumalanga	Post-tensioned Precast Concrete Reservoirs, Mpumalanga	Cooling Tower Shells, Majuba Power Station
2001	G Maritz	-	34	Mozal Aluminium Smelter, Mozambique	Tokara Winery, Stellenbosch,	-	SA Jewish Museum, Cape Town	Sandton Convention Centre, Sandton	Finger Jetty, port of Richards Bay
2003	PRA Flower	-	23	Maguga Dam, Komati River, Swaziland	Apartheid Museum, Johannesburg	-	No award	Westcliff Estate, Johannesburg	Morland Millenium Bridge, Umhlanga Ridge
2005	VA da Silva	-	29	Mohale Dam, Lesotho Highlands	Constitutional Court, Hillbrow, Johannesburg	-	Nelson Mandela Bridge, Johannesburg	Chapman's Peak, Cape Town	Mohale Dam, Lesotho Highlands
2007	DC Miles	-	29	Impala Platinum Mine, No 16 Shaft, Rustenberg	Athlone Soccer Stadium, East Stand, Cape Town	-	Bosmansdam Road Pedestrian Bridge, CT	Mkomaas River Pedestrian Bridge, KZN	Durban Harbour Services Tunnel
Fulton Awards Awarded in	CSSA President	Fulton Memorial Speaker	Total No of Entries	Fulton Award Winners in Categories:					
				Civil Engineering Project	Building Project	Unique Design Aspects	Concrete in Architecture	Construction Techniques	Special Category: Repair and Maintenance Project
2009*	FB Bain	-	28	Berg Water Project, Franschhoek	Soccer City Stadium, Soweto	Moses Mabhida Stadium, Durban	Soccer City Stadium, Soweto	Cold Weather Concreting on the Letseng Diamond Mine Project, Lesotho Highlands	Concrete Retrofitment Solutions Utilised At The Van Der Kloof Dam Spillway Bridge, Van Der Kloof Dam
Fulton Awards Awarded in	CSSA President	Fulton Memorial Speaker	Total No of Entries	Fulton Award Winners in Categories:					
				Civil Engineering Project	Building Project	Unique Design Aspects	Concrete in Architecture	Construction Techniques	Innovative Technologies
2011*	NP van den Berg	-	31	Blackburn Pedestrian Bridge, Umhlanga	Ubuntu Education Centre, Port Elizabeth	Mountain House Roofs, Cape Town	Ubuntu Education Centre, Port Elizabeth	Hospital Bend Preselection Scheme: New Overpass Bridges, Cape Town	15 Alice Lane Towers, Johannesburg

Notes:
Up until 1994 the Fulton Awards were named in terms of the preceding year (the year in which the projects were substantially completed). From 1995 onwards they were named in terms of the year the Awards were made. In 2009 the names of the Fulton Awards Categories underwent a slight change. In 2011 the names of the Fulton Awards Categories underwent a slight change.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