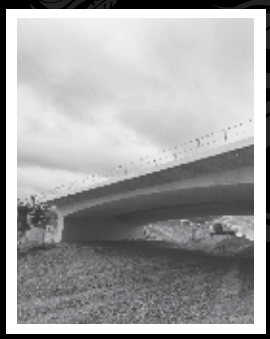
2015 Fulton Awards

Concrete Beton

FULTON Awards 2015

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To be the most relevant forum for those who have an interest in concrete.

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To promote excellence and innovation in the use of concrete and to provide a forum for networking and for sharing knowledge and information on concrete-related matters.

Design, layout and production:
DesignWright, Tel: +27 83 448 4264

Cover design: JS. Designs, Tel: 023 358 2919

Reproduction and print:
The Bureau, Johannesburg

OFFICIAL PUBLICATION OF THE
Concrete Society of Southern Africa NPC

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President's message

It gives me great pleasure to present this 2015 Fulton Awards edition of the Concrete Beton. This is also the inaugural in-house publication of the Fulton Awards edition of this journal. Judging by the quality of entrants for the Awards profiled in this publication, our industry is alive and well!

The Fulton Awards that are held every two years are affectionately known by some as the "Oscars of the Concrete Industry", illustrating the prestige that the awards command. These awards are held in honour of the late Dr. Sandy Fulton to recognise his contribution to research, development and understanding of concrete. With these awards, the industry, through the CSSA, recognises and celebrates design excellence, innovation and advances in the use of concrete in the southern Africa region.

The quality of the 24 entrants for the 2015 Fulton Awards continues to show the very high standard of work and quality that the southern African construction industry is delivering year after year. We surely should be proud of the achievements of the project teams from owners/clients to designers and contractors in delivering world-class projects that are showcased in these awards. Congratulations to the winners in the various categories and to those projects that have received the judges' commendations.

I would like to express my greatest gratitude to our esteemed judges who had an unenviable task of adjudicating and selecting the winners. The judges for the 2015 Fulton Awards were; Bryan Perrie, MD of the Concrete Institute and Sindile Ngonyama, President of the South African Institute of Architects. I thank our judges for their time and effort in visiting every site of every entrant all over the country and across our borders.

The success of an event of this magnitude would not have been achieved without our sponsors. On behalf of the board of the CSSA, I would like to express my gratitude to the sponsors of the 2015 Fulton Awards weekend, and a huge 'thank you' to PPC our Anchor Sponsor.

Finally, a hearty thank you to the 2015 Fulton Awards organizing committee, specifically our Head Office staff, Natasja and Marike under the leadership of our CEO John Sheath, for delivering yet another memorable event. Thank you to the CSSA Board for their time and effort in guiding the CSSA to much greater heights.

Enjoy the read and God Bless!!

Yours Sincerely
Tseli Maliehe
President – Concrete Society of Southern Africa

CONCRETE SOCIETY
OF SOUTHERN AFRICA

The Adjudication Panel

A unique aspect of the Fulton Awards is the fact that the judges visit the site of each submission in order to fully evaluate it. This provides entrants with a personal touch enabling them to present their projects face-to-face, and illustrate their great pride in what they have achieved. With the high quality of entries, adjudicating and selecting the 'excellent' is no easy task, but at the end of the day, we only have winners - because even in the act of entering and motivating the entry, the status of the project and the morale of those concerned are raised immensely.

Sindile Ngonyama

Sindile Ngonyama is a South African practising architect, who holds a Bachelor of Architecture degree, which he obtained in 1986 from UCT. He is currently the President of the South African Institute of Architects.

In the almost 30 years, of Sindile's professional career, he has been exposed to both public and private practice activities. This has influenced him in embracing the massive responsibility that architects have, in the enhancement of society lives. It is his belief that this responsibility should be even more prominent in the developing world, whereby factors such as poverty, high levels of illiteracy, poor health facilities and lack of basic shelter are everyday occurrences. Needless to state that these tend to outweigh available intellectual and financial resources in the developing countries.

Sindile's professional interests, amongst others, include:

- Conventional architectural engagements and
- Development or Implementation of Strategic Built-infrastructure Programmes.

In the last 5 years, Sindile has found himself involved in the adjudication of projects for various Awards Programmes and also being invited by various Institutions of Higher Learning, as an External Examiner for their respective final year student projects.

Bryan Perrie

Bryan Perrie has both a BSc and MSc in Civil Engineering from WITS and is a Registered Professional Engineer.

He started his career contracting throughout Southern Africa, and then joined the Cement and Concrete Institute, formerly known as the Portland Cement Institute. He served with the Institute for 29 years, the last 5 years as Managing Director. Following the demise of the C and CI in April, 2013 he has been involved with the creation of The Concrete Institute where he is currently the Managing Director.

Bryan has authored a number of books on Concrete Floors and Concrete Roads and sections of "Fulton's Concrete Technology". He has also authored a large number of papers for publication and presentation at local and overseas seminars, conferences and symposia.

He is a Board member of the Concrete Society of Southern Africa, a Council Member and Past President of the Southern African Road Federation, and a board member of the International Society for Concrete Pavements.

Bryan is a past member of the World Road Association's committee on Road Pavements. He chairs the South African Bureau of Standards Sub-Committee on Cement, Concrete and Concrete products and represents South Africa on ISO Technical Committee 71.

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Ibhayi Contracting has continued to grow, expanding into more specialized areas of Bridge Construction, Complex Structural Concrete rehabilitation and recently venturing into the Photovoltaic (Solar) Construction and Installation industry. Ibhayi Contracting has completed several very successful solar projects (Kalbuilt, Linde and Dreunberg) in the Renewable Energy Independent Power Producers Procurement Program in RSA.

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The Fulton Awards

With the celebration of the 2015 Fulton Awards, 36 years have passed since the awards were first launched in 1979 as a tribute to the late Dr Sandy Fulton.

This South African doyen of the concrete industry contributed enormously to the construction industry in general and international concrete technology in particular, and he left a legacy of notable scientific and technological advances.

Today, the Fulton Awards continue to recognize and reward excellence in the design of, and innovation in, concrete, and each year we witness the construction of world-class structures that have been entered, which easily compete with the best in the world. The Awards are made to the structure or concept, not to individuals. So they are presented to the entire team that is responsible for producing the structure, or creating the development, including the owner/developer and all associated professionals.

As the years have gone by, it became apparent that the rules and criteria had to change with the times, if the Awards were to maintain their high status in the industry and keep up with new technology. Past judges and stakeholders were canvassed for input into this aspect of the scheme, and this resulted in several changes being made to the 2015 awards in terms of the categories, and the judging criteria.

One thing that was not changed however, was the fact that the judges, as far as is practically possible, visit the site of each submission in order to fully evaluate it. Entrants greatly appreciate this personal touch and are able to present their projects face-to-face and illustrate their great pride in what they have achieved.

We thank all those involved in preparing submissions for their hard work and dedication to win a 2015 Fulton Award, and whether or not you have won this year, we urge you all to keep submitting the best that the South African concrete and construction industries have to offer.

Every year the concrete industry in South Africa is inspired by this showcase of excellence. ▲

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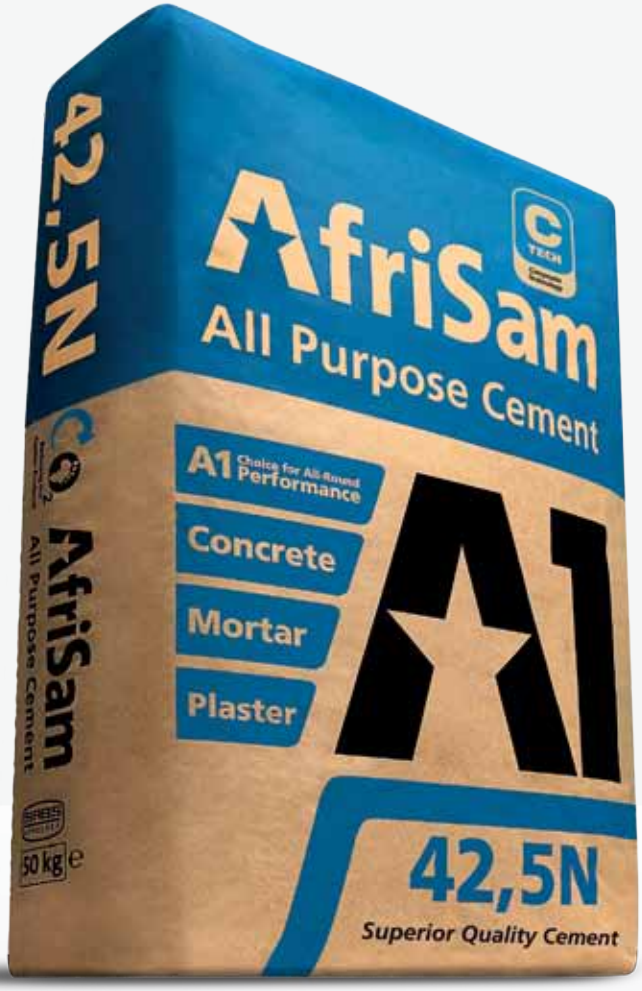

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A RECORD OF THE FULTON AWARDS OVER THE PAST 20 YEARS

Fulton Awards Awarded in	CSSA President	Fulton Memorial Speaker	Total number of Entries	Fulton Award Winners in Categories:					
				Civil Engineering Structures	Building Structures	Sculptures	Aesthetic Appeal	Design Concepts	Construction Techniques
1995	Prof M Alexander	Dr AK Mullick (India)	18	Main Concrete Structures, Alusaf Hillside Smelter	BMW Pavilion, V & A Waterfront, CT				
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, CT		Bosmansdam Road Pedestrian Bridge, CT	Mkomaas River Pedestrian Bridge, KZN	Durban Harbour Services Tunnel

Fulton Awards Awarded in	CSSA President	Fulton Memorial Speaker	Total Number 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 Entries	Total Number of Project	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 Pre-selection Scheme: New Overpass Bridges, Cape Town	15 Alice Lane Towers, Johannesburg

Fulton Awards Awarded in	CSSA President	Fulton Memorial Speaker	Total Number of Entries	Fulton Award Winners in Categories:					
				Civil Engineering Structure	Building Structure	Architectural Concrete	Sustainable Concrete	Community Structure	Innovative Construction
2013	WP Boshoff		28	De Hoop Dam, Steelpoort	SANRAL Head Office, Pretoria	Alexander Forbes, 115 West Street, Sandton	De Hoop Dam, Steelpoort		The Podium, Menlyn

Metolong Dam Pedestrian Bridge, Lesotho

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Metolong Dam Pedestrian Bridge

The new pedestrian bridge, over the Metolong Dam in Lesotho spans across a section of the dam where the tail-water on the Phuthiatsana River will be approximately 215 metres wide by 45 metres deep.

The design presented a challenge insofar as a cost-effective solution had to be found for a fairly long bridge, with a relatively light weight deck, to span a deep and steep-sided gorge. Of the alternatives considered, a prestressed concrete ribbon bridge seemed the most ideally suited for the task, particularly in an area where hard and massive sandstone was available for anchoring the bridge abutments.

TEAM

Location: Lesotho
Categories Entered: Civil Engineering Structure up to R100 million
Submitted by: Jeffares & Green
Client: Metolong Authority
Principal Agent: Jeffares & Green, Royal HaskoningDHV, GWC
Main Contractor: EXR Construction
Sub-Contractor 1: Structures Systems Africa

The bridge deck is continuous over two spans with respective lengths of 102 m and 127,5 m. The total walkway length, including the approaches over the abutments is 249 metres. The central support of the bridge consists of a 35 m tall reinforced concrete pier, seated on top of a sandstone cliff 15 metres above the river bed.

Jeffares & Green (Pty) Ltd, as part of the Lowlands Waterworks Joint Venture, designed the bridge for the client, Metolong Authority, at a remote location where the local communities on either side of the Phuthiatsana River need to have easy access to each other. This location was identified by the social consultants, in consultation with the local communities, as being a regular crossing point for trade, social interaction and access to other key villages such as Sefikeng and Thaba Bosiu.

The designers considered the use of pre-cast concrete elements advantageous, due to reduced construction time, as several tasks could be overlapped. In particular the deck panels could be manufactured before the abutments were in place. The use of pre-cast panels also

reduced the concrete work required in-situ, and a pre-stressed concrete ribbon type bridge seemed to be the most logical option to choose under difficult circumstances. Furthermore, significant use could me make of unskilled local labour.

The elements were launched from both abutments to ensure the stresses imposed were balanced. The launching rate of these deck elements met the designers' expectations, as all 84 elements were launched within a week. The extensive use of concrete elements will ensure that the bridge remains virtually maintenance-free for many years.

Most significant quantities for this bridge were 1,166 m^3 of concrete, 82 tons of steel reinforcement, 4620 MN m pre-stressing tendons and 37.2 MN pre-stressing anchorages. The tendered price for the Works (including VAT) was R9.5 million.

The final structure is of an innovative design that is cost effective, aesthetically pleasing, highly functional and environmentally friendly, by virtue of the fact that it does not have towers, stabilisers or large abutments that would impose on the rural landscape. Most importantly, it perfectly meets the needs of both the client and the community. ▲

Judges' Citation

The Metolong Dam Pedestrian Bridge is the first multi-span, prestressed concrete ribbon bridge in Africa and, at span of 230 m, the longest of its type in the world. The design was chosen for its cost-effectiveness, low maintenance and the fact that it lent itself to the use of local semi-skilled and unskilled workers.

As conventional software is unable to analyse catenary structures, the design had to be based on first principles. This was checked using a finite element analysis. Even with its very low natural frequency, the speed and magnitude of the oscillations remain within acceptable limits allowing the inhabitants to feel safe when crossing

The Metolong Dam Pedestrian Bridge is an aesthetically pleasing, highly functional and environmentally friendly structure as it does not have towers or large abutments which would impose on the rural landscape. The judges had no hesitation in proclaiming this project the winner of the Fulton Award in the category Civil Engineering Structure up to R100 million.

Stafford's Post Interchange

The project is located 40km east of Kokstad, in the southern region of the KwaZulu-Natal Province within the Ugu/Sisonke District Municipalities.

The former N2/R56 at-grade "T" intersection, split eastbound traffic from the Eastern Cape into two directions, i.e. traffic to the Natal Midlands (R56) and traffic to the South Coast area (N2), and vice versa. The geometry of the intersection favoured priority in the east-west N2-R56 direction, which was the intersection leg with the lowest traffic volume. This caused capacity challenges, reduced service levels, operational constraints and safety problems at the intersection.

SANRAL appointed Nathoo Mbenyane/DEC Engineering Joint Venture in December 2010 for the detailed design and professional services to upgrade the existing sub-standard "T" intersection to a grade-separated interchange. Group Five Coastal commenced the construction of the interchange in April 2013.

Several alternative structural configuration options and construction methods were considered for the interchange bridge. The partially re-aligned N2 is in cut, which favoured the selection of an overpass bridge. With the N2 being a four-lane undivided road, the use of a bridge pier at the road centre line was considered. However due to the rock being very deep at these centre piers, it was found that this was uneconomical and not possible, resulting in the requirement of a long central deck span. The road cut condition, combined with a desire

TEAM

Location: N2, Section 21 (KM44.30), KwaZulu Natal
Categories Entered: Civil Engineering Structure up to R100 million
Submitted by: Nathoo Mbenyane Engineers
Client: South African National Roads Agency SOC Limited
Principal Agent: Nathoo Mbenyane Engineers
Main Contractor: Group Five Coastal (Pty) Ltd
Sub-Contractor 1: Franki Africa
Sub-Contractor 2: NPC Cimpor (Pty) Ltd

to minimize the number of expensive supports due to risky founding conditions, led to the selection of a single-span portal bridge across the N2.

The bridge portal legs were founded with pile caps on 46 continuous-flight auger piles, at depths up to 17 metres in weathered, very soft rock shale. The 30° skew crossing of the re-aligned roads complicated the geometric design and construction of the portal structure bridge. It resulted in a wide skew opening clearance of 36 metres between portal legs.

The portal superstructure is a post-tensioned concrete voided slab deck. The deck soffit is curved, with the deck thickness varying from 2 metres at the portal legs to 1 metre at mid-span. The resulting span/deck ratio of 36 at mid-span, renders a unique slender deck, if compared to traditional deck slenderness ratios of between 20 and 25 on other road bridges in the SANRAL bridge network.

The curved deck soffit on the acute skew angle challenged the contractor to implement unusually innovative staging and deck formwork. The return walls behind the portal legs were specially designed and detailed to repeat and compliment the aesthetic features of the portal deck superstructure.

One of the project requirements was to design and construct a maintenance-free bridge. Therefore, the bridge has no bearings and no expansion joints. Contraction and expansion movements at the back of the portal legs are accommodated with customised road pavement layers and a glass-fibre grid underneath the asphalt surfacing at the bridge/approach road interface. ▲

Judges' Citation

This slender, post-tensioned portal interchange bridge deserves a judge's commendation. The unique slenderness of the curved deck with a slenderness ratio of a remarkable 36, compounded by the fact that the bridge spans at a 30° skew, resulted in significant design and construction challenges having to be overcome. The design of the bridge eliminated both bridge bearings and deck expansion joints thereby ensuring a low maintenance structure for the client.

The two-hour haul of concrete presented challenges in terms of logistics management and emergency intervention plans particularly when carrying out the large deck pours.

The result is a unique bridge which showcases how concrete can be used to construct an elegant maintenance free bridge structure in a remote area.

Umgeni Road Interchange

Upgrading of the Umgeni Road Interchange was required in order to reduce the traffic congestion on the busiest section of the National Route 2, in Durban, KwaZulu-Natal. The South African National Roads Agency Limited SOC appointed Hatch Goba for the design and contract administration for this project.

The project was co-funded by the eThekwini Municipality and the construction contract was awarded to the Rumdel Cape, EXR, Mazcon Joint Venture. The site is surrounded by residential properties, commercial properties, the Umgeni River, the Inanda Road Interchange and services which include bulk water and wastewater pipelines, a Transnet gas pipeline, heavy and medium voltage electrical lines and telecommunication cables. These constraints, together with the need to minimize disruptions to the extremely high traffic volumes, presented major challenges for the design of the interchange. These challenges were managed by careful geometric design of the new ramps and selection of bridge construction methods. The final design for the upgrade of the interchange included eleven new ramps and seven bridges.

The use of the incremental launching technique for the 205 m long Ramp D1 Bridge and 232,5 m long Ramp A1 Bridge, which cross over the N2 Freeway and Umgeni Road, prevented disruptions to traffic during the construction of these bridge decks. The restricted nature of the site meant that the launch path of these bridge decks had to be on inclined circles in space with small radii.

A unique feature of the project was that Ramp A1 bridge deck was constructed and launched from a 20 m high elevated casting yard. The elevated casting yard and the stunning sight of the two incremental launch bridges being constructed at the same time and crossing each other was a first in South Africa, and attracted a lot of attention.

The three bridge decks over Umgeni Road were designed to include precast beams to minimize disruption to traffic during construction. Twelve 30 m and twenty-three 20 m long beams were constructed off-site and were erected during overnight road closures when there was limited traffic on Umgeni Road.

The remaining bridge decks were cast in-situ and include two sections of pre-stressed, double barrel, box girder deck, a reinforced concrete voided deck and a reinforced concrete pedestrian bridge. The other concrete structures include approximately 750 m of cast in-situ box culverts, 1 650 m^2 of reinforced concrete retaining walls, 5 100 m^2 of mechanically stabilized earth walls, and 5 800 m^2 of rock anchored wall. A total of approximately 25 000 m^3 of concrete was used for this project.

Attention was given to the aesthetics of the concrete structures during design and construction. The bridge pier heads were designed to have elegant and unique fluted shapes. The excellent quality of concrete finishes produced has enhanced the appearance and durability of the structures on this project.

The Umgeni Road Interchange was a complex project which required meticulous attention to detail during both design and construction. The project is a showcase of the use of concrete in civil engineering projects and will have a major positive impact on Durban's travelling public. ▲

WINNER

TEAM

Location: Durban, KwaZulu-Natal
Categories Entered: Civil Engineering Structure over R100 million
Submitted by: Hatch Goba
Client: South African National Roads Agency SOC Limited
Principal Agent: Hatch Goba
Main Contractor: Rumdel Cape, EXR Holdings, Mazcon JV
Sub-Contractor 1: Lafarge South Africa Concrete
Sub-Contractor 2: Civilcon (Pty) Ltd

Judges' Citation

This project is a showcase for the use of concrete in civil engineering infrastructure as it encompasses two incrementally launched bridges, three precast beam and slab bridges, two cast in-situ pre-stressed box girder bridges, a voided deck slab bridge and a conventional reinforced concrete deck as well as reinforced earth retaining walls and a rock-anchored sprayed concrete wall. The two incrementally launched bridges being constructed simultaneously and crossing each other were a first for South Arica as was the fact that the casting yard for the one bridge was 20 m high elevated platform.

Uniquely shaped pier heads and excellent quality of the concrete finish enhanced the appearance of the structures. Both design and construction had to overcome the substantial constraints of being surrounded by residential and commercial properties, the Umgeni River, the existing high volumes of traffic through the interchange, multiple services and a Transnet gas pipeline.

Gouda Wind Farm

Gouda Wind Farm is Africa's first wind farm project in which concrete rather than steel was the primary construction material. Forty-six 100 m towers are being erected and the precast concrete segments required for their assembly were supplied by Concrete Units.

Each tower supports a three-bladed turbine which weighs 170 tons and delivers a maximum daily generating capacity of 3 MW. To date, South African wind turbines have been mounted on steel towers which have the disadvantage of being imported, and of carrying a comparatively low local labour and job-creation component. However, when wind turbine towers exceed heights of 80 metres the use of concrete towers becomes economically viable.

TEAM

Location: Gouda, Western Cape
Categories Entered: Civil Engineering Structure over R100 million
Submitted by: Concrete Units & Concrete Growth
Client: Acciona Windpower South Africa
Main Contractor: Oakleaf Investment Holdings 86 (Pty) Ltd

Unlike their steel counterparts, concrete wind-turbine towers come with high local-content inputs and, by default, carry a much higher job generating capacity. For example, over 95% of the raw materials for Gouda's concrete towers, including 500 MPa reinforcing steel, were sourced locally. Concrete offers other advantages over steel in that is a largely maintenance free and has a longer life-cycle.

A total of 782 segments were cast using five moulds. Mould sections, 20 metres long, were attached using laser technology and special jigs were used to ensure that the steel reinforcing was accurately positioned.

A maximum of five segments were cast daily. Various inserts and sockets were cast into the concrete segments to facilitate the installation of mechanical and electrical equipment inside the towers.

Gouda's tower segments were designed according to European structural concrete codes which allow cube strength of up to 115 MPa

as opposed to the SANS code which permits 60 MPa. The Gouda towers has a characteristic strength of 75 MPa, a strength which allowed Acciona's engineers to opt for lighter concrete sections. This added a further eco-friendly dimension to the project through less material usage and lower transport costs.

The tower segments were manufactured with self-compacting concrete (SCC), which is comparatively new to South Africa, and Gouda is the country's largest SCC project to date. Without it, the project would have been much more complex, involving external vibration and more expensive moulds.

Each completed tower comprises five 20 m high tapered concrete sections, and each section was assembled at Gouda using the precast concrete segments. The segments were joined in a vertical plane by inserting reinforcing and grout into the hollow chambers formed by the segments' two opposing channels. Once assembled, the tower sections were lifted into position by crane and joined in a horizontal plane using starter bars, ducting and grouting. The flawless execution of this process required extremely accurate casting and very tight tolerances.

The towers were designed to bend with the wind. This lateral movement is facilitated by the use of steel reinforcing inside the tower walls and additional strength was gained by linking six 90 mm steel cables from the inner wall of topmost tower sections to the concrete base of each tower.

Judges' Citation

The Gouda Wind Farm is South Africa's first wind farm project in which concrete rather than steel was the primary construction material for the tower support structures which are 100 m high and support the turbine and blades weighing 170 tons.

Each tower consisted of 17, 20 m long concrete segments precast in Cape Town and transported to the site near Wellington. In total some 782 segments were cast and transported in this fashion. The concrete segments were designed to the European code allowing higher cube strengths than the South African code. The concrete used was a self-compacting concrete with a characteristic strength of 75 MPa.

Ninety percent of the raw materials were sourced locally including the 500 MPa reinforcing steel. The Gouda Wind Farm Precast Concrete Towers is a first for precast concrete in South Africa and is therefore worthy of a judges commendation.

It is anticipated that the success of this project bodes well for the further use of concrete towers as South Africa's wind farm construction programme unfolds. ▲

Precast Bunkers and Overland Conveyor Foundations at Shondoni Colliery

Surge bunkers of 15 000 t and 4 000 t storage capacity are serving as buffers in the coal transportation line from the mine to the Sasol Secunda process plant. Both bunkers have the same type of structure, though the 4 000 t bunker is shorter.

The 15 000 t bunker is a horizontal containment structure with 10 (3 for the 4000 t) discharge chutes at 7.5 m centres, 76 m length by 19.5 m width and 28 m height, on four rows of columns, with a discharge deck at 11.2 m elevation, supporting the chutes discharging into a reclaim conveyor at ground level.

A structural steel grid of beams on top of the bunker supports the feeding tripper conveyor and is tying the columns across.

Longitudinal side walls, are sloped at 50° from top of the deck up to the external columns. There is a loading slide chute 10m wide in the mine side end wall, while the far end wall is totally flat. Pre-stressed diaphragm walls 4.2 m high, are provided at each cross frame to contribute to full discharge and structural strength.

An emergency stockpile of 15 000 tons capacity is added beyond the bunker, by increasing the tripper conveyor run on an elevated steel gantry over a reclaim conveyor tunnel. Folded retaining wing walls, 24 m high, contain the stockpile around the bunker.

The modular highly repetitive geometry of the structure allowed for efficient use of large precast elements in combination with cast in-situ construction in an innovative integrated "composite" structural concept, based mainly on constructability and cost criteria. In-situ

TEAM

Location: Sasol, Mpumalanga
Categories Entered: Civil Engineering Structure over R100 million, Innovation in Concrete
Submitted by: Lyonell Fliss & Associates (LFA)
Client: Sasol Mining Coal Division
Principal Agent: Logiman and Lyonell Fliss & Associates – JV Consultants
Main Contractor: Stefanutti Stocks Civils
Sub-Contractor 1: AfriSam SA (Pty) Ltd
Sub-Contractor 2: Preform (Pty) Ltd
Sub-Contractor 3: High Safety Training Academy (Pty) Ltd

Judges' Citation

The coal bunkers at Shondoni are an excellent example of "hybrid" or "composite" reinforced concrete structures as the benefits of precast are combined with in-situ concrete. The design used resulted in significantly less scaffolding at working at height during construction. Animated 3D models and 3D printing were used to ensure accuracy of every connection between precast and precast and between precast and in-situ.

The number of precast elements was reduced in the design to reduce the number of costly moulds and the design of an innovative precast sleeper foundation for the conveyor resulted in increased efficiencies in the precast yard. The quality of both the precast and in-situ concrete were of a very high standard and these massive structures are worthy of a judges commendation.

construction was used for heavier than 20 tons or non-modular elements, such as foundations, columns, and end and diaphragm walls.

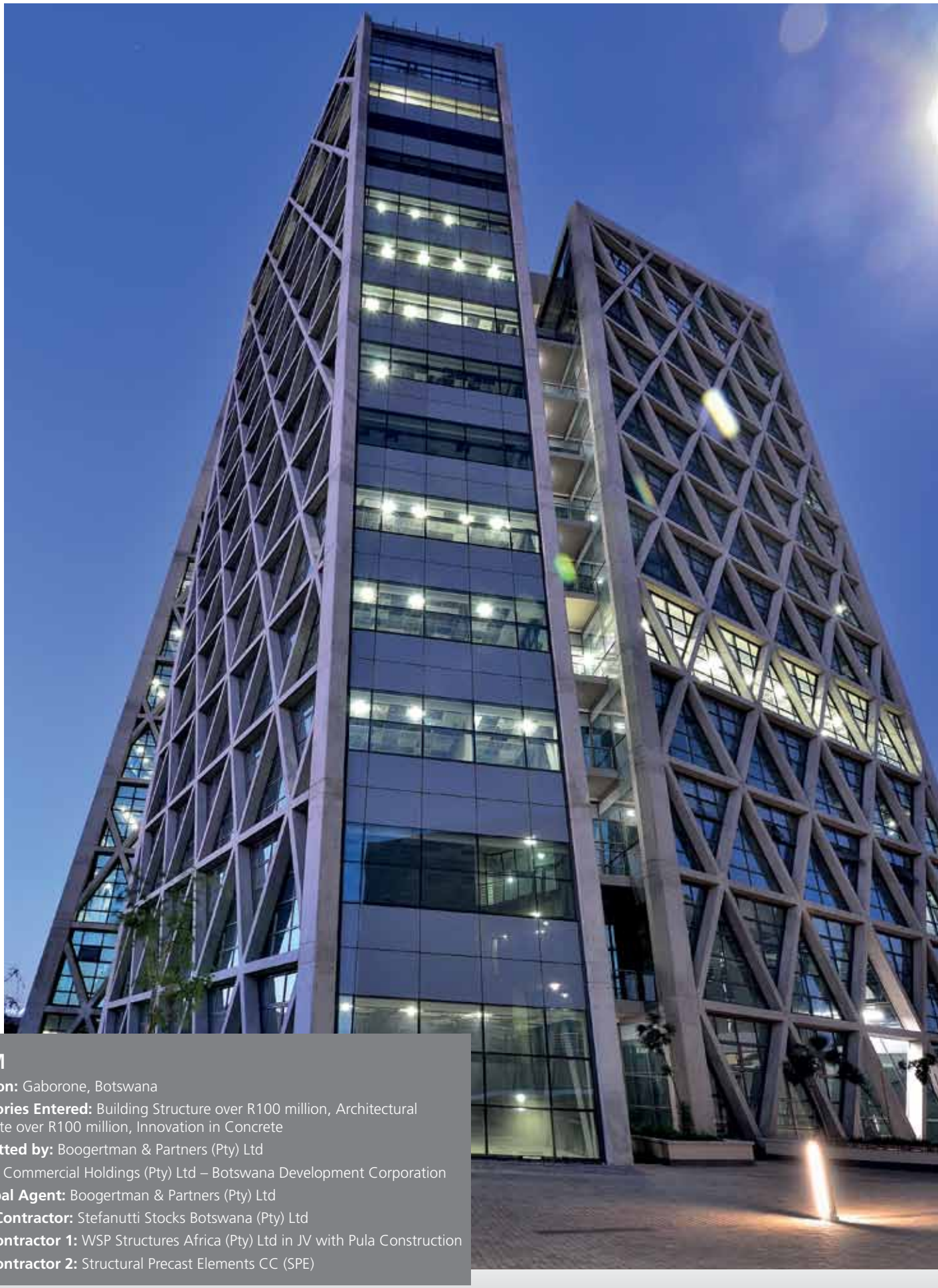
Precast construction was used for repetitive, modular elements lighter than 20 tons, such as horizontal and inclined beams and slabs, modular walls and permanent formwork. Connections of precast to cast in-situ or precast to precast, were cast in-situ. Pre-stressing was used to tie across the two lateral sides of the bunker through the diaphragm walls.

An original precast erection technique was developed, using the in-situ columns to support on top steel gantries for a remote controlled overhead crane, resulting in cost and time savings, safety and accuracy.

An innovative concept was developed for the 22 km overland conveyor which has over 7 000 modular, highly repetitive foundations.

It consists of using lightweight, precast sleepers and minipiles, which were connected together in composite frames. These use the ground shear resistance for stability as opposed to conventional gravity sleepers which gain stability through their mass of concrete.

This new concept resulted in substantial cost savings, speed of erection and increased stability (load tested on full scale prototypes), compared with conventional cast in-situ practice. ▲



TEAM

Location: Gaborone, Botswana

Categories Entered: Building Structure over R100 million, Architectural Concrete over R100 million, Innovation in Concrete

Submitted by: Boogertman & Partners (Pty) Ltd

Client: Commercial Holdings (Pty) Ltd – Botswana Development Corporation

Principal Agent: Boogertman & Partners (Pty) Ltd

Main Contractor: Stefanutti Stocks Botswana (Pty) Ltd

Sub-Contractor 1: WSP Structures Africa (Pty) Ltd in JV with Pula Construction

Sub-Contractor 2: Structural Precast Elements CC (SPE)

WINNER

Fairscape Precinct – Botswana

The brief was to develop a mixed-used precinct with a global iconic presence. The unique use of a triangular, precast diagrid structure reminds one of the facets on diamonds, a major source of income for Botswana.

This type of structure is more cost effective than steel. Steel was furthermore, not considered since the elements would have had to be manufactured in South Africa. This would have put constraints on the programme. The availability of specialist steel contractors in Botswana is also limited.

The use of concrete once again illustrated that it can be moulded to any shape and be given structural integrity to support a 15-storey building. Concrete will also require no maintenance.

The core of the building was traditionally constructed ahead of the floor slabs, and pull-out bars were provided in the core to anchor the slab to the core. On the slab edge the diagrids were placed in position and the slabs were cast against the diagrids, held in position with special anchors.

Unique, robust shutters were designed and manufactured for the pouring of the trapezoidal shaped raking columns. The building comprises four quadrants and the slabs and diagrids were constructed in a cascading, spiral fashion to the top.

Each equal-legged diagrid with its tapered profile is a special feature in itself. Stitching these elements together to make a structural veil that wraps the building gives the development a quality that will receive international recognition. The diagrid elements form the permanent façades of the building and were required to have a high quality finish.

Moulds were designed to be complete 'drop out' moulds and were designed and made with no external removable parts to accommodate de-moulding of the concrete elements. The advantage is that there are no unsightly 'bleed lines' on the concrete elements. Purpose-made hydraulic jacks were successfully utilised to force the 6.5 ton elements free from the moulds without breakages or damage to the elements. All 420 elements with about 50% variations were produced out of the same set of moulds, helping to make the precast sub-contract economically viable.

The use of the precast concrete diagrids as a structural element, and not only for cosmetic reasons, is uniquely different. It has not yet been done anywhere else in the world using concrete. Furthermore, precast concrete technology has been further developed and expanded in Botswana. ▲

Judges' Citation

The iconic office tower in the Fairscape precinct is the first building in Africa with diagrid facades and the use of precast concrete diagrids as a structural element is a world first. The fact that the diagrid is structural comprising precast triangular concrete elements is unique and being connected to the floor slabs has allowed the omission of all internal columns. The profile of the diagrid offers solar shading on all wings and ensures good runoff without obstructing views.

Besides the fact that this building has effectively used a hybrid method of construction combining precast and in-situ concrete, it has aesthetic appeal of its own. The precast units were constructed in "drop-out" moulds ensuring no bleed lines or fins on the elements. The method of construction also significantly reduced the amount of staging and scaffolding and thereby the amount of working at height. The judges had no hesitation in proclaiming this project the winner of the Fulton Award in the category Building Structure greater than R100 million.

Chevron Project Core

Being a global energy giant, Chevron prioritized the ideal of an environmentally sustainable Head Office.

To this end, the architect sought to achieve a building that is only built once – i.e. that the concrete structure forms the actual façade – challenging the widespread commercial practice of cladding with expensive additional layers of aluminium, granite or curtain walling. The philosophy being that, in a sustainable society, we cannot afford to build the same structure twice.

Chevron Project Core is a development in Century City for the Chevron South Africa (Pty) Ltd Downstream Head Office. It consists of approximately 7 500 m^2 site area and construction area of 18 500 m^2 – this includes a basement, ground floor, mezzanine parking level, two (1st and 2nd) office floors and a central courtyard. The project achieved a level 5 Green Star design rating and is in the process of attaining a level 5 Green Star as-built rating with the Green Building Council of South Africa.

Chevron Project Core has numerous innovative energy saving concepts and include the following:

- Underground concrete water tank to retain rainwater as potable water and water for irrigation.
- Double glazed window façade designed to allow for acoustic, thermal sealant and maximum natural light into the building.
- Future reclaimed water supply to the Virgin Active Gym to supply their pool with water.
- Full BMS system that regulates light and air temperature controls.
- Bio-digester installed in kitchen uses the kitchen waste to generate gas for hot water for kitchen dishwasher.
- Cycle lanes, cyclist ablution facilities to promote staff to travel with emission free transport.
- Series of sunscreens installed to control light levels and glare into the building and off the building façade.
- Large percentage of local sourced building materials with low VOC counts were used in the construction of the Project.

Further to the energy saving concepts the building's white concrete façade structure is remarkable in its design and build. The complexity in design and construction are the aspects worthy of special mention. Extensive time in planning the production, supply, formwork design

WINNER

FULTON Awards 2015

TEAM

Location: Century City, Cape Town, Western Cape
Categories Entered: Architectural Concrete over R100 million, Innovation in Concrete
Submitted by: Stefanutti Stocks
Client: Chevron International Ltd PTE
Principal Agent: Turner Townsend
Main Contractor: Stefanutti Stocks
Sub-Contractor 1: Louis Karol
Sub-Contractor 2: Lafarge SA (Pty) Ltd

and placing of the white concrete resulted in an off-shutter, white concrete building that is a landmark in the Western Cape. The white concrete production and placing left the construction and supplier team with a huge challenge that took many trial and error sampling in order to achieve the desired result. This scale of white concrete construction has never been done in the Western Cape. ▲

Judges' Citation

In this project, the concrete structure forms the actual building façade to create a sustainable building. The exposed concrete structure used a white concrete to achieve an effect reminiscent of travertine marble. This was a very large scale use and resulted in a number of challenges being overcome. These included reducing contamination of the raw materials, the use of special shutters and release oil.

Special attention was paid to the design of the exposed concrete elements to provide passive cooling and sun shading to the north-east and north-west facades. Joints were concealed in deep shadow lines and oversized ferrule holes were made a feature. The slab edges were tapered to create an illusion of crispness and precision. This project was a worthy winner of the Fulton Award in the category Architectural Concrete greater than R100 million.

WINNER

Gouda Wind Farm

Gouda Wind Farm is Africa's first wind farm project in which concrete rather than steel was the primary construction material. Forty-six 100 m towers are being erected and the precast concrete segments required for their assembly were supplied by Concrete Units.

Judges' Citation

The Gouda Wind Farm is South Africa's first wind farm project in which economic investigations dictated that concrete rather than steel should be the primary construction material for the tower support structures which are 100 m high and support the turbine and blades weighing 170 tons. The use of concrete for the towers ensured better structural stability especially at the height of 100m supporting massive blades moving at high speeds.

The use of concrete for the towers and particularly the use of high strength self-compacting concrete are highly commended. Some 16 500 m³ of SCC was used in the 782 segments. The attention to detail in the precast yard, transport to site and erection on site was excellent. The level of quality control by a third party was also extremely high.

There were a number of innovations both in the design of the precast yard including being able to turn some of the segments prior to transport, and in the method of construction and handling.

This project is a justifiable winner of the Fulton Award in the category Innovation in Concrete.

TEAM

Location: Gouda, Western Cape
Categories Entered: Civil Engineering Structure over R100 million
Submitted by: Concrete Units & Concrete Growth
Client: Acciona Windpower South Africa
Main Contractor: Oakleaf Investment Holdings 86 (Pty) Ltd

commendation

Precast Bunkers and Overland Conveyor Foundations at Shondoni Colliery

Surge bunkers of 15 000 t and 4 000 t storage capacity are serving as buffers in the coal transportation line from the mine to the Sasol Secunda process plant. Both bunkers have the same type of structure, though the 4 000 t bunker is shorter.

Judges' Citation

The coal bunkers at Shondoni are an excellent example of "hybrid" or "composite" reinforced concrete structures as the benefits of precast are combined with in-situ concrete. Animated 3D models and 3D printing were used to ensure accuracy of every connection between precast and precast and between precast and in-situ. Very high tolerances were required for both concrete sections and protruding bars to insure correct interlacing.

High strength concrete was used to ensure mould turnaround and high abrasion resistance. The precast and in-situ elements are structurally integrated though monolithic in-situ connections and prestressing.

An additional innovation was the design of the precast-sleeper-on-minipiles foundation for the 7000 conveyor frame supports. The precast sleepers added to the efficiency of the precast yard.

The innovation in both design and construction of the massive bunkers and the conveyor supports earn a commendation from the judges.

TEAM

Location: Sasol, Mpumalanga

Categories Entered: Civil Engineering Structure over R100 million, Innovation in Concrete

Submitted by: Lyonell Fliss & Associates (LFA)

Client: Sasol Mining Coal Division

Principal Agent: Logiman and Lyonell Fliss & Associates – JV Consultants

Main Contractor: Stefanutti Stocks Civils

Sub-Contractor 1: AfriSam SA (Pty) Ltd

Sub-Contractor 2: Preform (Pty) Ltd

Sub-Contractor 3: High Safety Training Academy (Pty) Ltd

commendation

Fairscape Precinct - Botswana

The brief was to develop a mixed-used precinct with a global iconic presence. The unique use of a triangular, precast diagrid structure reminds one of the facets on diamonds, a major source of income for Botswana.

Judges' Citation

The judges commend the design approach applied in conceptualizing this project, as at the onset the designers developed the concrete diagrid elements as drivers for both structural and architectural design solutions for this iconic building. The added advantage of this system is the fact that the 600mm depth and shape of the elements enabled a pleasing balance between maximum capitalisation of the views whilst enhancing solar performance of the building.

This building is another excellent example of "hybrid" or "composite" construction. The unique design of the "drop-out" moulds ensured a superb concrete finish with no bleed lines or fins on the elements. This project further developed the use of precast concrete in Botswana.

TEAM

Location: Gaborone, Botswana

Categories Entered: Building Structure over R100 million, Architectural Concrete over R100 million, Innovation in Concrete

Submitted by: Boogertman & Partners (Pty) Ltd

Client: Commercial Holdings (Pty) Ltd – Botswana Development Corporation

Principal Agent: Boogertman & Partners (Pty) Ltd

Main Contractor: Stefanutti Stocks Botswana (Pty) Ltd

Sub-Contractor 1: WSP Structures Africa (Pty) Ltd in JV with Pula Construction

Sub-Contractor 2: Structural Precast Elements CC (SPE)

special commendation

The Cement & Concrete Cube (C3)

The Cement & Concrete Cube is a 21st century Enterprise Social Media platform which delivers on the stated and perceived information sharing and collaboration needs of the industry as a dynamic solution.

CEMENT & CONCRETE CUBE

At the same time it reinforces PPC's strength beyond the bag ethos for the benefit of the cement and concrete industry. It is envisaged that the content and scope will grow over time to become the one-stop go-to source and resource for the Built Environment in South Africa, and the African continent.

This platform is an innovative solution in the South African cement and concrete information landscape.

The C3 facilitates collaboration, web-based interaction and information sharing between team members, industry leaders, students and built-environment enthusiasts. . Participants are able to post blogs, wikis, documents, graphics and comments in private or public interest-groups on this platform. Registered users are also able to connect to experts to exchange information.

Salient features of this platform are:

- Crocodoc: a programme which renders documents into HTML format which affords users the facility to assess the appropriateness of the content, before using bandwidth to download large documents.
- Serendipity search engine: a Google-like "intelligent" search facility which automatically extracts metadata and builds the document taxonomy to facilitate efficient searching on multi-media content linked to the C3 platform.

What truly makes this platform a unique offering, is the incorporation of paid-for-content in the form of technical journals and book subscriptions from the EBSCO aggregator, by means of special licensing agreements which will give expert users access to current full-text international research in the field of cement and concrete.

International research has shown technology and communication drivers are: knowledge management, innovation and collaboration. The C3 fits this model for the internal PPC environment, across the African continent. As a dynamic solution, C3 makes information easily accessible for improved efficiency and productivity.

TEAM

Location: National

Categories Entered: Innovation in Concrete

Submitted by: PPC Ltd

The streamlined interaction with experts will also ensure an increased flow of information and knowledge transfer.

The platform enables internal and external users to access various levels of information. Experts and thought leaders will be able to inform and influence the industry through this network. ▲

Judges' Citation

While this entry was in the Innovation in Concrete category, the judges felt that it did not truly fit into this category but nevertheless deserved a Special Commendation. The C3 is an innovative information sharing platform and its ability to upload and share information in all formats (e.g. documents, spreadsheets, images, video clips, graphs etc.) is unique. This platform also incorporates paid-for-content from the technical journals allowing users access to full-text international research.

Two additional features include the ability to render documents into HTML format allowing users to assess relevance of the document before using bandwidth to download large documents and an advanced search engine which recommends relevant content based on historical access and usage. This submission fully deserves a Special Commendation.

GIVING YOUR BUSINESS THE STRENGTH TO GROW.

At PPC, we pride ourselves in offering customers more than just cement. This has led to a modus operandi that we call "strength beyond the bag", as we passionately invest in meaningful initiatives and projects that advance our customers and the entire industry's excellence.

We know that the success of our business relies heavily on the success of our customers – that's why at PPC we offer more than just cement to our customers. Our Strength beyond the bag is demonstrated in our commitment to our customers – hear what our customers have to say!

PPC STRENGTH GUARANTEED

PPC CEMENT

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Revelstone Cape Pty Ltd,
Cape Town

"PPC has been our cement supplier from day one. There is definitely an element of trust that has been built over the years, and we believe in their product 110%. The support we get in terms of technical support is something we only get from PPC and you won't just find that anywhere else."
Revelstone Cape Pty Ltd

Lefika Concrete Products,
Eikenhof, JHB

"Our company uses PPC cement as a primary raw material for the production of kerb stones and paving blocks which helps in the consistent and efficient curing rate in the production process of our products."
Lefika Concrete Products

Gallant stone,
Northriding, JHB

"We use large amounts of OPC in all of our ranges and we are yet to be disappointed. The staff are always helpful, friendly and professional with dependable deliveries."
Gallant Stone

16 E Tona Sand & Bricks,
Ga-Rankuwa

"I've worked with a lot of big companies but I don't get the same treatment that PPC gives me. They keep checking up on me and when I order I know I am guaranteed cement the next day. They really do care about their customers."
16 E Tona Sand and Bricks

Dry Mortars and Plasters

The challenge was to develop a high quality, dry-mix concrete mortar capable of being delivered, in its dry state, rapidly and efficiently to replenishable, weatherproof silos, pre-located on construction sites for "on-demand" mixing and application by the client.

After dry-mix concept was perfected, a long-term source of aggregates for the mix was established, and the design of weatherproof replenishable silos for on-site storage was completed. A pilot plant was then set up at Pronto's Pretoria West readymix concrete plant to prove the overall concept, which it is believed is a world first in the method of delivery of dry-mix to the construction site.

The technical challenges revolved primarily around the elimination of moisture from the aggregates. Suitable means to achieve sufficiently low moisture levels were researched over a number of months, and first site deliveries and testing of the product took place at selected construction sites in Gauteng. Site test at an early stage of R&D also proved that the plaster render product could be successfully pumped from the silo area to the work position.

Concurrent to these product proofing tests the logistical aspects of delivery of 34-ton capacity storage silos to the construction sites were being perfected, coupled with the replenishment methodology and ordering/administrative system.

To this end, a heavy-duty transport truck was specially designed and adapted with hydraulic load arms to transport the 34-ton capacity silo to site. This vehicle, known as the silo placing unit (SPU), when loaded with the silo containing a 17-ton TCB load of dry-mix, is road-legal to standard truck-and-load specifications.

In just two years from concept, Pronto dry-mix was ready to be launched. A dedicated plant was constructed at the Midrand premises, and the plant challenges and problems were steadily and surely overcome. The product was progressively fine-tuned and perfected, from technical aspects relating to aggregate size and shape - to moisture content of the final mix – to transport, delivery, admin and ordering systems. Production is tightly controlled through regular testing, carried out by an independent SANAS accredited laboratory to ensure compliance to SANS 1090:2002.

Today, Pronto's dry-mix mortar and related production, delivery and ordering system has earned its valued and respected position in South Africa as a reliable efficient, high quality product – playing an essential role in the supply of specialised mortars to the construction industry. ▲

TEAM

Location: Midrand, Gauteng
Categories Entered: Innovation in Concrete
Submitted by: Pronto Building Materials (Pty) Ltd

Spring Grove Dam and Appurtenant Works

The 37-metre high, roller compacted concrete (RCC) gravity Spring Grove Dam near Rosetta in Kwazulu-Natal is the main component of Phase 2 of the Mooi-Mgeni Transfers Scheme.

Water from the dam is transferred from the Mooi River catchment to the Umgeni River catchment to augment water supply by 60 million cubic metres per year for about five million domestic and industrial users in the Durban and Pietermaritzburg regions. AECOM was appointed by TCTA in 2009 to undertake the design, construction monitoring and project management.

The project team developed a wet paste concrete mix, using the one developed for De Hoop Dam's design mix, as a basis from where it further developed the technology of reduced cementitious content to create an optimised, workable mix.

The design mix, developed through a phased approach, was first tested in a laboratory using the materials proposed by the Engineer during the tender phase, and then tested in a laboratory again using the materials proposed by the Contractor.

A full-scale trial test section was also constructed on site using the design mix developed in the laboratory to further optimise it before construction of the RCC gravity structure commenced.

The workability of the mix, nominal segregation and construction techniques were tested in on-site conditions. Coring, sampling and testing of the RCC trial section was also carried out to compare the characteristics of the RCC trial section with the design requirements.

The success of this wet-paste design mix was due to its adherence to the elongation and flakiness index specifications of aggregate used in the mix, which ensured that it met the required compressive and tensile strengths. This shows that a reduced cement content can be used to create workable RCC mixes and impermeable concrete for dam structures.

The cost comparison (using Spring Grove Dam contract prices) with the design mix used at De Hoop Dam indicated a saving of R85 per cubic metre of RCC for the Spring Grove Dam mix. The reduced cementitious RCC design mix thus produced a cost saving of approximately R8.5 million in the construction of Spring Grove Dam. If used in larger dams with higher volumes of RCC, even greater cost savings could be achieved.

The optimised wet paste concrete mix developed on this project was a first in South African dam building. It was the first design RCC mix with a reduced cementitious content (160 kg per m^3 of concrete) in the world, meeting international design and construction criteria and was published at the 6th International Symposium on Roller Compacted Concrete (RCC) dams in Zaragoza, Spain in October 2012. ▲

TEAM

Location: KwaZulu Natal

Categories Entered: Civil Engineering Structure over R100 million, Innovation in Concrete

Submitted by: AECOM (Pty) Ltd

Client: TCTA

Principal Agent: AECOM (Pty) Ltd

Main Contractor: Group Five

PPC IMAGINARIUM

The Imaginarium aims to become the primary creativity awards platform dedicated to fostering innovation among emerging artists and designers in South Africa. It builds on the legacy of the 22-year old PPC Young Concrete Sculptors Awards.

Art and design are major contributors to innovation. Innovation provides solutions to the key issues facing people; communities; countries and the world as we all strive for a better and more sustainable future – a "Better Life for All".

The primary aim of the PPC Imaginarium Awards is to recognise innovation and design using portland cement-based concrete as a primary inspiration and/or material. The programme will incentivise, award, nurture, profile and assist emerging South African artists and designers, permanent residents well as students, including foreign students with study permits.

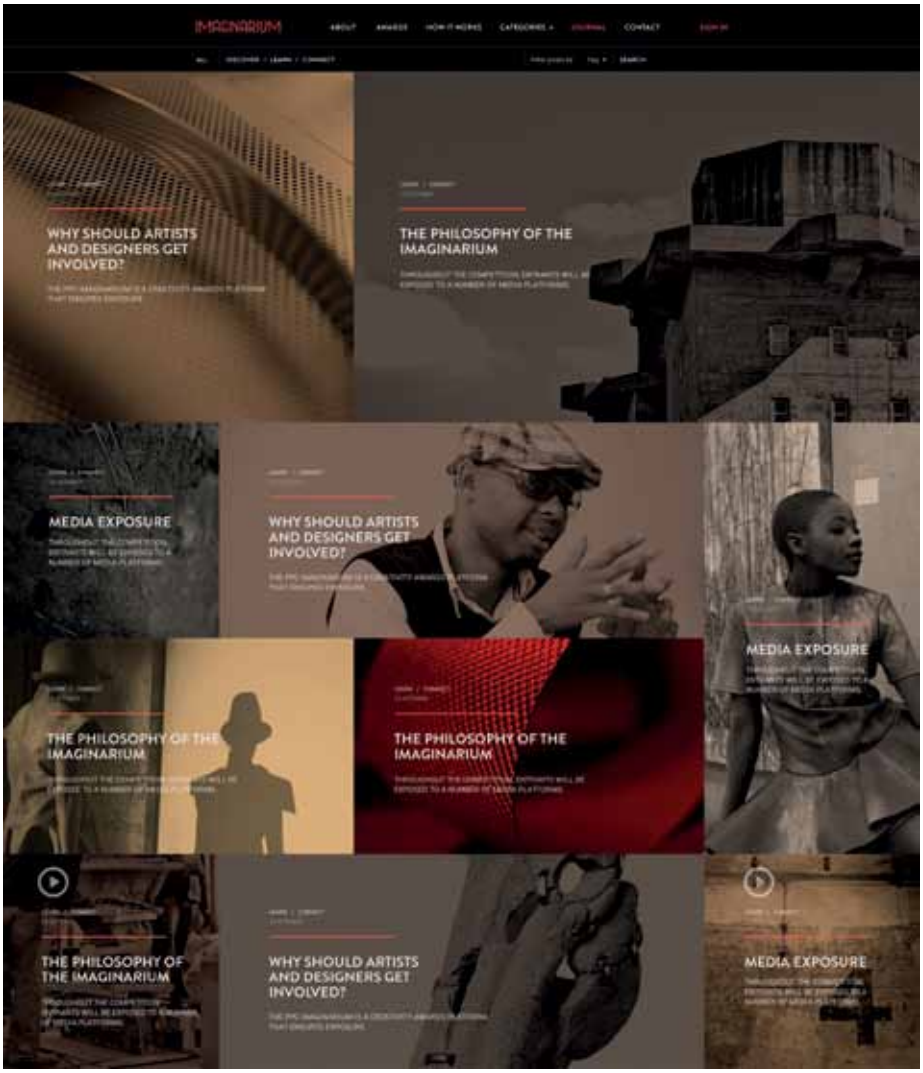
The Award is unique in its combination of offering financial benefits, mentoring, workshops, exhibition opportunities and promotion in the media as well as allowing for online exposure and sales.

The imaginarium campaign - a unique approach

The PPC Imaginarium platform was mentioned as ground breaking in the way it embraces digital inbound marketing at the AU Frontier Advisory Group Forum on social media in Africa (Dion Chang, 22 July 2014). The initial launch and awareness campaign from June-August 2014, relied heavily on social platforms (Facebook, Twitter, YouTube and Instagram) and an interactive website, to build awareness and encourage designers to sign up. Thought leaders in each discipline are profiled on all platforms and provided with 'social media packs' to allow them to post to their own existing social networks. Website banners have been posted on several of the main digital creative websites and online content provided to digital publications. This was supported by a total of 12 hands-on workshops at various universities around the country, posters at all the major design schools in SA, 2 kg 'Imaginarium' cement bags which incorporates info and an entry form, and an integrated media campaign. It has been supported by video installations, pop-up 'selfie' Imaginarium photo boots (which obtained an additional 1 800 e-mail contacts) and information.

As part of the support campaign (September-November 2014), all registered participants received weekly inspirational newsletters with updated information and videos. Preliminary judging took place based on online conceptual submissions with final entries of manufactured products being received and judged at five collection points around the country.

Semi-Finalists work will be curated and exhibited nationally at premier galleries and the Design Indaba, raising public awareness in Pretoria and Durban. ▲



TEAM
Location: National
Categories Entered: Innovation in Concrete
Submitted by: PPC Ltd

Group Five is a diversified construction, infrastructure concessions and services group

Skilled and experienced to deliver any aspect of an infrastructural project, including concept development, manufacturing, construction and operations as well as maintenance.

"Proud to be considered worthy of a Fulton Award"

Spring Grove Dam, Rosetta, KwaZulu-Natal, South Africa

Stafford's Post – N2 South, Harding, KwaZulu-Natal, South Africa

Mahatma Ghandi Pump Station, Durban, KwaZulu-Natal, South Africa

Group Five Coastal (Pty) Ltd
KwaZulu-Natal Region: 41 Island Circle, Riverhorse Valley, Effingham, Durban 4051 |
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GREEN BUILDING COUNCIL

Ethics Institute of South Africa

Department of Environmental Affairs Headquarters

From the outset the brief from the Department of Environmental Affairs, for the design of their new HQ in the City of Tshwane, was based on the importance of producing a structure that reflects the culture of the Department, the way they work and function and what they stand for in terms of purpose, beliefs and service to the country and the community.

The design had to respond to environmentally sensitive and sustainable architecture and yet be equally respected by international dignitaries, visitors and tourists, but above all, be a home for the Department to be proud of and to remain memorable and beautiful that will inspire generations to come.

The site location is of significant importance as it forms the entrance of the northern end of the Nelson Mandela Corridor, which is regarded as a gateway to the Tshwane inner city. The importance of this project in its location, and housing of the Department of Environmental Affairs, reflects the commitment to set the standard to other developers, government institutions, PPP's and private enterprises, to strive for environmentally-friendly buildings with a six-star green building rating.

The land shape, orientation and topography provided the opportunity to string a series of large space, effective office wings along a North South central spine that enabled centralization of the support services and to keep the floor plates as open and multifunctional as possible. The orientation of the wings allowed for green spaces between the wings as well as allowing enough sunlight.

The space is distributed evenly over 3 floors throughout the site that promoted horizontal integration with the use of wide corridors and staircases, instead of vertical high rise with banks of lifts

Each office wing includes a central atrium with internal planting at ground level and clerestory windows above the roof to enhance natural light into the building. This also encourages natural ventilation using the stack effect and night flush ventilation.

The building is conceived as three distinct elements, consisting of the utilitarian machine-like office wings; the organic central reception building and the 'bridge structure' thread that link all of the elements together.

TEAM

Location: Pretoria, Gauteng
Categories Entered: Building Structure over R100 million, Architectural Concrete over R100 million, Innovation in Concrete
Submitted by: Boogertman & Partners (Pty) Ltd
Client: Imvelo Concession Company
Principal Agent: Aveng Grinaker LTA
Main Contractor: Keren Kula Aveng Grinaker LTA JV

The central block, set out mathematically from the golden section and Fibonacci sequence, is in the shape of a Nautilus shell whose shape is determined by nature and it forms the main entrance, public spaces and function facilities at the ground floor with the Directorate at the upper levels. This shape is inclusive and draws visitors into the reception, whilst also being reminiscent of growth and progress spiralling out from a defined origin point. Oversized concrete fin walls were used here to effect additional shading and to emphasize the shape on plan when viewed from eye level.

The architectural design represents a coherent response to a host of complicated requirements by the Client team, including spatial, cost, environmental, operational and security considerations. The architectural team believe that we have not only met but exceeded the requirement and simultaneously created a beautiful building which will inspire all who work and visit there. ▲

102 Rivonia Road

The prestigious new 102 Rivonia Road commercial office development was commissioned by Eris Property Group with the aim of providing a high-quality and modern building with optimal visibility and access to major transport amenities, while also reflecting a culture of integration, professionalism and excellence.

The development also serves to symbolise its main tenant, Ernst & Young's growing presence in Africa through the use of form, local materials and finishes.

102 Rivonia is situated on a high-visibility site directly adjacent to the Gautrain station, providing direct access to Oliver Tambo International Airport via the Gautrain and placing the tenants at the heart of Sandton, South Africa's economic hub. The building consists of two conjoined towers, one of which is the new 9-storey head office of Ernst & Young and the other a 14-storey multi-tenanted office. The development recently achieved a 4-Star Green Star SA Office Design V1 rating from the Green Building Council of South Africa (GBCSA).

Two major challenges were encountered during the construction of these facilities: the need to deliver an exclusive, high-quality Green Star rated building within an extremely tight construction deadline, and, despite its ideal location, the confined nature of the site, which meant that limited space was available for construction.

The project team was able to complete the project on time, ready for occupation by tenants, thanks to the innovative use of a post-tensioning system, combined with the use of 60% fly-ash containing concrete, which significantly sped up construction process due to its ability to gain higher strengths in a shorter amount of time.

The confined nature of the site was overcome by well-planned construction logistics, as well as the implementation of a unique construction method, which saw the building finished from the bottom up, without the need for 'bird-cage' scaffolding, resulting in more available space in the areas below during the construction phase.

Through the implementation of innovative construction methods and the use of concrete, the project team successfully delivered a Green Star-rated building within a tight deadline and created a flagship head office which is an outstanding symbol of Ernst & Young's growing presence in Africa. ▲

TEAM

Location: Sandton, Gauteng
Categories Entered: Building Structure over R100 million
Submitted by: Aurecon
Client: Eris Property Group
Principal Agent: Aurecon
Main Contractor: Murray & Roberts
Sub-Contractor: Amsteele






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Steyn City Clubhouse

With over half the estate dedicated to parkland and open spaces, Steyn City's brand promise is a lifestyle that is in tune with nature. Walking trails, mountain bike routes, horse trails and acres of interconnected green parks, allow people to feel like the city has disappeared. The Steyn City clubhouse further enhances the estate's commitment to nature.

While most golf clubhouses do their best to stand out in the most ostentatious way possible, and to overshadow their natural environment, the Steyn City clubhouse goes out of its way to do the opposite.

The highlight of this clubhouse is the way it blends in with nature on multiple levels. The most spectacular of which is the concrete roof structure – supported by an engineered slab, this landscaped roof allows the building to blend into the landscape, creating an almost magical illusion of 'now you see it, now you don't'.

TEAM

Location: Fourways, Johannesburg, Gauteng
Categories Entered: Architectural Concrete over R100 million
Submitted by: Boogertman & Partners (Pty) Ltd
Client: Steyn City Properties
Principal Agent: Metrum Project Management
Main Contractor: Gothic Construction
Sub-Contractor: Pure Consulting (Pty) Ltd

Not only does concrete make the 'blend into nature' concept possible, it also allows the project to look green and be green. The concrete roof helps to regulate the thermal mass of the building, as it absorbs solar energy during the day and then shifts the load entering through the roof to night when the rest of the external loads are not present. The activated concrete slab for the clubhouse lounge also acts as thermal storage and removes the peak cooling load of the west-facing façade. This system is also more energy-efficient when the doors are open, than cooling/heating with an air-based system.

Another unique and unusual feature of the clubhouse is its unconventional cladding. While other buildings import materials, this building's primary cladding consists of excavated rock from the site itself filled into Gabion Baskets. So by re-using and recycling the material, the effect on the environment is minimized, and the effortlessly natural look of the clubhouse is further maximized.

Versatile, beautiful and environmentally-sustainable, concrete has allowed the architects of the Steyn City clubhouse to create the greatest magical trick of all in architecture: a stylish, energy efficient clubhouse that instantly disappears into nature. ▲

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PORTSIDE

Portside, the latest and tallest addition to Cape Town's skyline, boasts in excess of 57, 000 m^2 of rentable area with a gross construction area of 114, 547 m^2 over 32 floors to a height of 139 m at a total project cost of R1.6 bn.

This AAA grade commercial development has achieved a 5-Star Green Star South Africa V1 Office Design rating as awarded by the Green Building Council South Africa (GBCSA) – the first tall building in the country to achieve this certification – and is currently being assessed for a 5-star Green Star as-built rating.

The progressive architectural design materialized as a reinforced concrete superstructure, clad with a fully glazed curtain wall façade. The entire primary structural system comprises reinforced concrete as the main construction material due to its versatility, strength properties, cost effectiveness and propensity to facilitate the extremely fast-tracked construction programme.

The majority of the total 58 502 m^3 of concrete was prepared at a batch plant adjacent to the building site and placed using a hydro-static pump, pumping the concrete to heights exceeding 140 metres. Various concrete grades and mix designs were specified and developed to meet both the design and construction programme requirements, where seven-day 'turn-around' times were sought between casting subsequent floor slabs. As part of the commitment to sustainable design, a final 46.3% cement replacement with industrial waste products was achieved across all concrete used.

Innovative design and construction techniques were employed to meet the local seismic design requirements of the Western Cape. This included intricate design and detailing of the structural stability system to suit the construction programme requirements and a hydraulically powered 'self-climbing' formwork system to form the concrete cores. Precast construction was also implemented for the lowest level parking slab by means of precast concrete panels with a polypropylene fibre reinforced topping – resulting in a saving on large quantities of imported fill and reduced programme time for this area of works.

The success of the Portside development exemplifies the importance of a collaborative design and construction environment and meticulous planning in delivering such an impressive product within the boundaries set by numerous constraints. It is within these boundaries that pure innovation was born and implemented in design and construction, through exploiting the various advantages afforded by concrete as the primary construction material. ▲

TEAM

Location: Cape Town CBD, Western Cape
Categories Entered: Building Structure over R100 million
Submitted by: WSP Group Africa (Pty) Ltd
Client: First Rand Bank and Old Mutual
Principal Agent: SIP Project Managers, Metrum Project Management, Absolute Project Managers
Main Contractor: Murray & Roberts Western Cape

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Warrenton Bridge

The Warrenton Bridge Project entailed the construction of a new bridge and approaches on National Route 18 crossing the Vaal River on the northern outskirts of Warrenton.

Bridge B0067 is a concrete structure consisting of cast in-situ, reinforced concrete substructures founded on rock, and a superstructure comprising a beam and slab type deck of precast pre-tensioned beams and cast in-situ reinforced concrete deck slabs.

The bridge is 368 metres long, consisting of 16 spans of 23 metres and is square to the river. The top of the deck is approximately 9 metres above the rock in the river bed. Bridge and road aesthetics received great attention from the designers.

Both abutments consist of reinforced concrete retaining wall type abutments, with splayed wing-walls founded on spread footings.

The fifteen piers consist of twin-reinforced concrete wall type columns on spread footings. The piers have an elegant tapered shape and the side walls are fluted with river-facing ends rounded and finished off with a capping beam. The completed piers have a delicate appearance for their size.

The superstructure of each deck consists of 9 precast pre-tensioned beams with reinforced concrete diaphragm beams at the ends of the deck and at third points in the span. The beams were cast on site on specially constructed concrete pre-tensioning beds. The deck slab is a cast in-situ reinforced concrete slab with reinforced concrete precast planks manufactured on site and used as permanent formwork between the beams.

The bridge deck width is 14.76 metres with two 3.7 metre wide traffic lanes, two 1.5 metre wide road shoulders and two 1.5 metre wide sidewalks, separated from the roadway by means of F-shape traffic barriers. The sidewalks have precast concrete pedestrian railings.

The bridge deck is supported on elastomeric bearings under each beam. The 5 bridge deck expansion joints are steel claw and neoprene rubber glands in concrete nosings and the bridge is provided with lighting to improve the traffic safety.

The construction procedure was governed by the nature of the river crossing and environmental management plan. The construction of an access causeway provided a large platform from which the foundations of the bridge could be excavated to rock, and was also used for the construction of all the piers and for the cranes using tandem lifts to place the beams. It was also used for the movement of all materials, plant and equipment.

TEAM

Location: Warrenton, Northern Cape
Categories Entered: Civil Engineering Structure up to R100 million
Submitted by: SNA Civil and Structural Engineers (Pty) Ltd
Client: South African National Roads Agency SOC Limited
Principal Agent: SNA Civil and Structural Engineers (Pty) Ltd
Main Contractor: Civilcon Pele Kaofela JV
Sub-Contractor: Freyssinet Posten (Pty) Ltd (Bearings and Joints)

The environmental requirement was that this temporary causeway should have a minimum impact on the river, and that it should be removed with minimum disturbance to the river without the deposition of silt downstream.

The project ensured that substantial benefits were gained by the surrounding communities by the employment of both local persons and SMME's, training 92 persons and promoting skills transfer.

The new bridge will eliminate traffic delays occasioned by the old single lane bridge constructed October 1931, provide safer pedestrian and cyclist crossings of the river and eliminates traffic diversion as a result of the old bridge being inundated during high river flows. ▲

Mahatma Gandhi Road Sewage Pump Station

The current Mahatma Gandhi Road Sewage Pump Station occupies a prime site within the Durban Point Development Corporation's (DPDC) up-market development zone. It has occupied the site bounded by Mahatma Gandhi Road and Albert Terrace since about 1959.

Because the current pump station occupies a prime site within the DPDC up-market development zone, a proposal was made that the pump station be relocated at a site adjacent to the north shaft of the recently commissioned Durban Harbour Tunnel. This is some 250 metres from the original position.

The screening chamber is the structure where the raw sewage first enters the Pump Station. This chamber consists of a common channel which then splits the flow into four separate channels. Three of these channels contain front rake screens which screen the sewage to a size of 50 mm. The fourth channel is an overflow channel. These screens protect the pumps from objects such as boulders, bricks, rags and tree branches.

Space was a constraint on the site which included underground structures from a previous project. To maximize usage of the site it was decided to modify the existing shaft structure used to install the Harbour Tunnel in 2005/2006. Approximately one third of this structure in plan was available for use in the new pump station. The inside of this structure was excavated down to the required level and has been used to house the screening equipment mentioned above.

The Dry Well/ Wet Well is the main chamber in the Pump Station structure. This was constructed adjacent to the existing Harbour Tunnel shaft structure effectively resulting in a three-sided rectangular structure with dimensions of 16 m wide x 20 m long. The three new walls were constructed using the diaphragm wall technique to a depth of 17.5 m.

A diaphragm wall consists of excavating the ground and replacing the removed material with Bentonite which effectively gives the remaining ground stability such that the trench does not collapse. Once the excavation reaches the correct level and panel width, a reinforcing cage, which has been pre-assembled is then lowered into the bentonite and concrete is then installed via "Tremmie" pipes into the bottom of the trench. As the concrete level rises, the bentonite is displaced until the concrete reaches the top level. A concrete capping beam is then constructed over the top of the walls to give structural integrity to the walls.

Once the walls were complete, the ground within the walls was removed via a combination of excavation and dredging to a depth of 14.5 metres.

A 3.5 m thick mass concrete plug was poured via "Tremmie" pipes under the water to form the base of the structure. This 1 100 m^3 continuous concrete pour was one of the largest underwater pours ever undertaken in South Africa. The water was then pumped out leaving the outer shell of the subterranean structure.

Internal walls, access stairs and mezzanine floors were then constructed within this shell to form the various internal components of the Pump Station.

The five metre high surface structure was semi-submerged two metres below ground level, which resulted in the main working structure only being three metres above final ground level. The roof of the structure was sloped in several directions to create the illusion of a natural sand dune-type structure. The entire roof of the building is being covered with grass and shrubs to give the finished product a natural feel. ▲

TEAM

Location: Durban, KwaZulu Natal
Categories Entered: Civil Engineering Structure over R100 million, Innovation in Concrete
Submitted by: Hatch Goba
Client: e'Thekwini Municipality
Principal Agent: Hatch Goba
Main Contractor: Group Five
Sub-Contractor: Esor Franki

City Deep container terminal pavement and foundation renewal through concrete recycling

Murray & Roberts Infrastructure was awarded a construction contract by Transnet Capital Projects for new concrete paving, civil services and electric lighting at its City Deep Container Terminal in Johannesburg.

Murray & Roberts Infrastructure broke up and reused about 86% of the old worn concrete pavements at the City Deep Container Terminal, which amounted to about 123 840 m³ of the 144 000 m³ concrete, which would otherwise have been disposed of at landfill sites.

The old pavement was crushed to a G5 material specification and re-used as base and sub-base material. It is estimated that about R14 million would otherwise have had to be spent on the procurement of new aggregate and on transport. A further R3 million was saved on not having to dispose of the demolished concrete pavement and underlying on site stabilised layer and mine sands. The job value at tender stage was approximately R202 million.

In addition, Murray & Roberts Infrastructure presented two innovative concrete designs. High volume pulverised flue ash concrete (HVPAC) was used and several slabs of geopolymer concrete were poured for long term evaluation, a first for South Africa.

Geopolymers are a type of inorganic polymer that can be formed at room temperature by using industrial waste or by-products as source materials to form a solid binder that looks like and performs a similar function to Portland cement. Geopolymer binders can be used in applications to fully or partially replace Portland cement with important environmental, technical and often cost benefits, including an 80% to 90% reduction in CO_2 emissions and improved resistance to fire and aggressive chemicals.

The specification for the Transnet City Deep Container Terminal was a maximum of 35% Pulverised Fly Ash (PFA) replacement. This is considered a high replacement of clinker/cement. The concrete used about 63% to 70% replacement of raw milled clinker with siliceous PFA, almost double the maximum specified limit on most construction projects. Using this quantity of PFA alters the concrete hydrate in such a way that the durability/service design life of the elements is increased.

Through the deeper understanding of advanced re-crystallisation (ARC) technology attained at the Murray & Roberts' Concrete Centre of Excellence (CCE), the capabilities and limitations of high volume PFA substitution were understood. Applying and understanding several additional variables, it was able to use HVPFAC without the normal restrictions of high volume cement replacement.

It also reduced the quantity of virgin river sand needed. A high volume of fly ash in this concrete design also reduced the water demand, improved workability, minimised cracking due to thermal and drying shrinkage and enhanced durability in terms of reinforcement corrosion, sulphate attack and alkali-silica expansion. ▲

TEAM

Location: City Deep, Johannesburg, Gauteng
Categories Entered: Civil Engineering Structure over R100 million, Innovation in Concrete
Submitted by: Coralynne & Associates cc
Client: Transnet Freight Rail
Principal Agent: Murray & Roberts Infrastructure
Main Contractor: Murray & Roberts Infrastructure
Sub-Contractor 1: AfriSam SA (Pty) Ltd
Sub-Contractor 2: RSC
Sub-Contractor 3: Wearne

Isando Pedestrian Bridge

The Isando Pedestrian Bridge stands as a visible marker to the current efforts to overhaul and upgrade the freeways in and around Johannesburg.

With a total length of 446 metres the bridge and its approaches connect the Isando Rail Station with the OR Tambo International Airport (Johannesburg). The structure is well used with some 9 000 commuters crossing each day. The new bridge replaces two sub-standard footbridges that were a legacy of urban planning in the early 1970's. Commuters predominately used one of the 2 metre wide bridges with the other remaining unused.

The new footbridge's 4.5 metre wide walkway now provides a much improved level of service to the surge of commuters who exit the trains in the morning peaks.

Dubbed the "Walking Wonder", the concept design for the Isando Pedestrian Bridge was the selected by an invited design competition.

TEAM

Location: Kempton Park, Gauteng
Categories Entered: Civil Engineering Structure up to R100 million
Submitted by: SMEC South Africa (Pty) Ltd
Client: South African National Roads Agency SOC Limited
Main Contractor: Raubex Construction (Pty) Ltd

Because of the site's position the South African National Roads Agency SOC Ltd. (SANRAL), identified the importance of creating an interesting aesthetic at a reasonable cost.

The new footbridge main structure crossing the highway is a 126 metre long cable-stayed bridge. The bridge has a unique appearance in that the two unsupported towers are inclined at 11 degrees in opposite directions.

The central 126.4 metre long section of the bridge has a 4-span configuration with spans of 25.4 m, 14.8 m, 22.2 m and 64.0 m. The superstructure consists of a continuous composite steel box girder with a 5.4 metre wide concrete deck slab. The 64.0 metre long main span is supported by two vertical planes of fanned cables that are anchored into the back spans. A main feature of the bridge is its two un-braced, cigar-shaped steel pylons. One leans forwards at 11 degrees and the other backwards, hence the bridge's name.

The bridge is a testimony to an engineer's ability to create original structures that combine economy with aesthetics. Unseen ingenuity is perhaps the integral abutments and connections that minimise the number of expansion joints required in the ramps, and the complex interaction between the structure and its piled foundations. ▲

Model Kloof Pedestrian Bridge and Walkway

The Model Kloof Pedestrian Bridge and Walkway project is a SANRAL, community development project located in Ladysmith, KwaZulu-Natal. The project connects communities that previously were required to use the busy national road shoulder or cross at grade in order to reach employment and education opportunities.

SANRAL and engineering consultants Royal HaskoningDHV used this as the first pilot project for Greenroads in South Africa, thereby showcasing a concrete structure within the framework of the international Greenroads arena and highlighting South Africa's ability to introduce sustainability into a socio-economic mix in the local built environment.

Concrete was chosen in order to achieve a continuously smooth, visual aesthetic along the entire length of the curved / varying depth structure. The bridge serves as a gateway to Ladysmith from the Newcastle side, and thus any kinked steel or rough welds would be unacceptable. Post-tensioned concrete also allowed the long central span to be shallow, stiff and heavy enough to eliminate any risk of bounce or footfall induced movement.

In-situ concrete as the main construction material was critical in ensuring that the project team could maximise the use of local labour on both the bridge deck and walkway.

The project includes best-practices for design and construction from the American Greenroads Manual. Also included were best-practices contextually relevant to sustainable infrastructure development in South Africa. The local concepts were focused on job creation, skills development and road safety education which are not adequately represented in the American version. The project clearly added value to stakeholders and local community.

Despite the project's small size, the site hosted four full-time learners which contribute to the continuity of expertise in the design of concrete structures. Two of the in-service trainees were sourced from the local community by the project's CLO and two others were identified by SANRAL and were involved in the following important tasks related to the concrete structure:

- Testing concrete cover in line with SANRAL's durability specifications
- Checking post-tensioning extensions and graphing the results
- Working alongside the carpenters and shutter hands
- Checking of quantities
- Verifying post-tensioning layout as per working drawings

The project was also used to develop in-house skills through mentoring of a technician who designed and detailed the structural widening of the Bell's Spruit Bridge and Diamana Spruit Culvert. The design and site experience gained on this project will play an important role in his future application for registration as a professional technologist.

Lessons learned about existing Greenroads credits, combined with best-practices in socio-economic development, contributes to the formation of the localised version being developed by the Greenroads South Africa Technical Development Committee. This ensures that sustainability concepts on concrete structures form part of holistic green infrastructure growth rather than being implemented in project-to-project silos.

The project is critical in the localisation process making it the Model Kloof Pedestrian Bridge and Walkway, the country's first "Greenroads South Africa Pilot Project" as the concept is rolled out to the concrete industry. ▲

TEAM

Location: Ladysmith, KwaZulu Natal
Categories Entered: Civil Engineering Structure up to R100 million
Submitted by: Royal HaskoningDHV
Client: South African National Roads Agency SOC Limited
Principal Agent: Royal HaskoningDHV
Main Contractor: Afrostructures (Pty) Ltd

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Low heat of hydration concrete for Metolong Dam

Realising that heat of hydration would be a significant concern in the construction of Lesotho's Metolong Dam, Lafarge South Africa assisted the project by developing concrete mix solutions based on an innovative premium technical cement and classified siliceous fly ash from Ash Resources.

Metolong Dam is an 83 m high roller compacted concrete (RCC) dam with a design crest length of 280 m, approximately 35 km from Lesotho's capital, Maseru. In South Africa, cement for water infrastructure projects is traditionally dominated by CEM I products. Engineers and contractors are understandably cautious about changing established practice. Lafarge South Africa had phased out CEM I cements and had a complete range of innovative fly ash enhanced products. They needed to convince the Metolong Dam project team of the merits of a fly ash enhanced, CEM II type product.

Addressing the contractor's heat of hydration concerns, Lafarge South Africa proposed their premium technical cement type CEM II 42,5R. This innovative formulation is a low heat cement and also has the capability of being extended further on site with additional fly ash. The engineers and the contractor were not familiar with this versatile, high performance product and it took a two-year determined campaign, with strong technical support from Lafarge South Africa's accredited civil engineering testing facility, Quality Department Southern Africa (QDSA), to achieve a change in mindset and the commercial breakthrough.

The main contractor, Sinohydro, a top-ranking global construction and hydropower group, is involved in a range of projects on the African continent, and has worked on major international projects such as China's Three Gorges Dam, the world's largest water scheme.

Sinohydro established an on-site batch facility to provide the estimated requirement of 330 000 m³ of RCC and 40 000 m³ of conventional vibrated concrete (CVC) for the construction of Metolong Dam.

QDSA was requested by the consultants and main contractor, Sinohydro to conduct laboratory evaluations and develop proposals for the design of the RCC and CVC mixes. The outcome was, based on QDSA's recommendation, Lafarge's type CEM II 42,5R premium technical cement and classified siliceous fly ash from Ash Resources' Lethabo plant. These were used as binder material, with the RCC mix containing 66%, and the CVC mix (grade 25/38) 52%, of fly ash respectively.

With excellent workability and flowability, the concrete mixes performed exceptionally well, exceeding the contractor's expectations. RCC placing routinely achieved 1 000 m³ per 12-hour shift. The consistent quality of the cement and its good strength performance also enabled the contractor to systematically reduce the cement content of some of the mixes from the initial conservative design levels.

The longer term impact is that Lafarge South Africa has achieved a significant technical breakthrough in the choice of CEM II cement for RCC dam construction in Southern Africa. ▲

TEAM

Location: Lesotho
Categories Entered: Innovation in Concrete
Submitted by: Lafarge SA (Pty) Ltd
Client: Sinohydro Corporation (Lesotho) Limited
Main Contractor: Sinohydro Corporation (Lesotho) Limited

Sundays River Bridge

The 14.23 km pavement of section 11 of the National Route 2 between Soutwerke and Colchester started showing signs of distress and displayed extensive cracking with generally poor driving quality.

In view of this, SANRAL appointed the Semenya Aurecon joint venture (JV) to rehabilitate the route, which is located north of the Coega River at the Hougam Park intersection. The route runs in a north-easterly direction where it terminates at the intersection to Colchester.

The appointment included the detail assessment stage, detail design and documentation stage. During the detailed assessment stage, it became clear that the development of the Coega Industrial Area would generate traffic to the extent that a dual highway would be required by 2015. The traffic growth estimates assumed were relatively conservative and did not take into account the optimistic predictions of land take-up in the Coega Industrial Development Zone.

After considering the structural condition of the existing road, the economic and financial viability of road upgrades, as well as road capacity implications, it was proposed that the existing two-lane road be upgraded to a four-lane divided highway. This meant that a new bridge had to be constructed alongside the existing bridge over the Sundays River.

TEAM

Location: Eastern Cape
Categories Entered: Civil Engineering Structure up to R100 million
Submitted by: Aurecon Semenya JV
Client: South African National Roads Agency SOC Limited
Principal Agent: Aurecon Semenya JV
Main Contractor: Concor Holdings
Sub-Contractor 1: Ibhayi Contracting

Following a detailed hydrological and hydraulic analysis, it was found that the existing bridge was too low to accommodate the design flood with the required freeboard. The existing bridge deck therefore, had to be raised by approximately 2.3 metres.

The bridge site is approximately 3 km from the ocean in a very corrosive environment and the decision to use concrete as the construction material for this project was based mainly on its excellent durability characteristics. The existing concrete bridge was constructed in 1971 and the only visible corrosion was to non-structural precast fender panels that are situated in the tidal zone.

Pre-stressed concrete beams were used for the main structural elements of the deck, with a composite precast permanent shutters and in-situ concrete deck slab. Expansion joints are normally high-maintenance elements and the precast beams were thus made integral over three spans to reduce the maintenance requirements to the minimum.

It is believed that no other material would have provided the required durability at a low initial cost, while giving the designer's the freedom to use practically any shape that can be provided with the formwork.

The construction of the new bridge over a perennial river with challenging foundation conditions as well as raising the deck of the existing bridge required innovative design solutions and construction techniques which makes this project a testament to the excellence in the use of concrete. ▲

Upgrading of three historic arch bridges over the Orange River

Three historic concrete arch bridges over the Orange River floodplain near Keimoes, Northern Cape, were upgraded, primarily for safety reasons.

The safety improvements involved the widening, raising and rebuilding of two concrete arch bridges at approximately 2,5m higher elevation to prevent overtopping of the structures during large flood events. The third and largest of the bridges, a ten-span concrete arch bridge, was at a higher level and the existing deck was therefore retained as a functional tribute to the heritage of the original bridges and was unsymmetrically widened.

These structural improvements facilitate the emergency evacuation of island-based communities during flood events. The widening of the bridges facilitated the safe passage for vehicles simultaneously in two directions (from only one direction previously), and safe passage for pedestrians and cyclists along SANRALs Route R27.

The bridge design component was conducted with the mind-set of preserving the heritage value of the existing structures. The original form of the bridges, the arch configuration, and the detailing of the various structural elements was afforded strategic consideration during the design phase to preserve the overall appearance of the historic concrete arch bridges. As much of the original fabric of the concrete arch bridges was retained and incorporated into the works, wherever feasible.

The retained existing deck of the ten-span arch bridge required strengthening and substantial widening to improve the load-carrying capacity for modern, very heavy traffic loads. The soffit curvature of the arches made it difficult to effectively introduce an externally bonded system. Instead an internal, post-tensioning system was considered, in combination with additional cast in-situ concrete elements.

The history of frequent flood events along the Orange River motivated the pre-cast reinforced concrete, composite, arch and slab solution for the widening of the bridges. The final deck cross sections comprised twin decks, with the precast portions that consist of L-shaped and inverted T-shaped arched beams. An opening between the decks can accommodate future services, without affecting the appearance of the bridge when viewed in elevation. Horizontal thrust forces at arch springings are transferred to the abutments by means of thrust bearings.

The top slabs were linked by means of infill slabs. A 100 mm thick concrete pavement, fully bonded to the deck top slab was specified for all the arch bridges in view of overtopping, minimal maintenance and durability considerations.

Temporary horizontal, post tensioned, tie bars provided structural stability and serviceability limit state compliance to the precast arches during construction, and were removed once the cast in-situ portion of the decks had been completed.

The successful completion of the bridges resulted in a proud monument for the region and all involved. This project's success was celebrated at the official opening ceremony, presided over by the Department of Transport, and held as integral part of the South African Government's "20 years of freedom" campaign. ▲

TEAM

Location: Keimoes, Northern Cape
Categories Entered: Civil Engineering Structure over R100 million, Innovation in Concrete
Submitted by: AECOM SA (Pty) Ltd
Client: South African National Roads Agency SOC Limited
Principal Agent: AECOM SA (Pty) Ltd
Main Contractor: Botes & Kennedy Manyano

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Construction of three bridges over National Road 8 at Thaba Nchu

UWP Consulting (Pty) Ltd (UWP) was appointed by SANRAL in March 2009 to carry out the investigations and design work required for the upgrading of a section of the N8, Section 11 (N8/11) at Thaba Nchu in the Free State.

A very important aspect of the brief was to increase safety of both pedestrians and vehicles crossing and/or accessing the national route along this section. The two overpass bridges provided safe crossings of the national route for both pedestrian and vehicular traffic.

The original brief included the design of a new interchange at the intersection with S109/S110 at km 58.7 that incorporated a new overpass bridge as part of the interchange but during the preliminary design stage it was ascertained that there was a need for two additional bridges. The first was an overpass 1,5 km east of the new interchange and the second was a pedestrian bridge between the interchange and overpass bridges to provide a safe crossing of the N8 between the residential area of Ratau and the town centre of Thaba Nchu.

As it was the client's preference to have bridges that were essentially maintenance free and highly durable, the decision was taken to construct them using reinforced concrete, either conventional or pre-stressed. The loadings and allowable deflections dictated that the overpass bridges carrying vehicular traffic should be pre-stressed while the pedestrian bridge could be conventionally reinforced.

The two overpass bridges, one for the interchange at km 58,756 and one carrying Hoof Street over the N8 at km 60,253, both comprise four-span structures with fully open side spans; continuous pre-stressed concrete decks voided over the two shorter middle spans; spill-through type abutments with claw and gland expansion joints at each abutment and piers comprising twin, shaped, tapered walls with recessed board finishes. The interchange bridge is orthogonal to the N8 while the overpass bridge at Hoog Street is approximately 19 degrees skew to the highway.

A conventionally reinforced concrete structure that is very slender in elevation, the pedestrian bridge provides safe passage across the N8 from the residential area of Ratau to the south of the national road to the town centre of Thaba Nchu to the north. The use of circular shapes of varying radii on the top and bottom surfaces of the structure has given it an aesthetically pleasing arch-like appearance. Spiral approach ramps with limited, but constant, gradients have made it possible for wheelchair access to the bridge. Integral piers on both bridge and approach ramps have minimised expansion joints and bearings, resulting in reduced long-term maintenance. ▲

TEAM

Location: Bloemfontein, Free State
Categories Entered: Civil Engineering Structure over R100 million
Submitted by: UWP Consulting (Pty) Ltd
Client: South African National Roads Agency SOC Limited
Principal Agent: South African National Roads Agency SOC Limited
Main Contractor: Ruwacon Construction – Bloemfontein

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