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OF SOUTHERN AFRICA

CONCRETEBETON

Umgeni Road Interchange
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COVER: The upgrading of the Umgeni Road Interchange, winner of the Fulton Award in the Civil Engineering Structure >R100 million category, was a technically challenging project requiring meticulous attention to detail during design and construction. The project has been successfully designed and constructed despite challenging site constraints. The project includes seven concrete bridges and a number of other concrete structures making it a showcase for the use of concrete in civil engineering projects. These bridges, together with the 20-metre high, elevated casting yard, were unique and special features of this civil engineering project. The Umgeni Road Interchange is now a local landmark and is having a major positive impact on the travelling public.

In the face of an ever increasing population, greater expectations, demands from society and budgetary constraints, our government is facing an increasing amount of pressure to deliver new and improved infrastructure projects.

Are PPP's the answer?

In the face of an ever increasing population, greater expectations, demands from society and budgetary constraints, our government is facing an increasing amount of pressure to deliver new and improved infrastructure projects from transport (roads, railways, bridges); education (schools and universities); healthcare (hospitals, clinics and treatment centres); waste management (collection, disposal, waste to energy plants); water (collection, treatment, distribution), government accommodation and defence.

However, the technical requirements of current and prospective infrastructure needs, far outstrip resources available. This was highlighted during a keynote address and a CEOs' 'fireside chat' at the Totally Concrete Conference held recently in Midrand.

Meeting these needs is critical to ensure continued process, development and economic growth. Skills constraints and an acknowledgement of private sector efficiencies and know-how, are two of the principal reasons why our government should be taking the economic and political decision to accelerate the use of private sector, and adopt Public Private Partnership (PPP) models in order to deliver infrastructure projects which would have been previously built by the public sector using public sector finance.

Exponents of PPP's are adamant that these arrangements can be very successful – but what are the benefits? Research tells us the following:

- Infrastructure created through PPP's can improve the quality and quantity of basic infrastructure such as the provision of water and its treatment, energy supply and transportation. In addition, the process can be widely applied to a variety of public services such as hospitals, schools, prisons and government accommodation.
- Construction is being completed to plan and to budget. Early delivery of good quality premises and services is delivering wide social benefits.
- PPPs are helping the public sector develop a more disciplined and commercial approach to infrastructure development, whilst allowing them to retain strategic control of the overall project and service.
- In PPP structures the risk of performance is transferred to the private sector. The private sector only realises its investment if the asset performs according to the contractual obligations. As the private sector will not receive payment until the facility is available for use, the PPP structure encourages efficient completion, on budget without defects.
- There is evidence of better quality in design and construction than under traditional procurement. PPP focuses on the whole life cost of the project not simply on its initial construction cost. It identifies the long term cost and assesses the sustainability of the project.
- The use of private finance enables the public to have access to improved services now, not years away when a government's spending programme permits.
- The expertise and experience of the private sector encourages innovation, resulting in shorter delivery times and improvements in the construction and facility management processes. Developing these processes leads to best practice and adds value.
- The process helps to reduce government debt and to free up public capital to spend on other government services.
- The tax payer benefits by avoiding paying higher taxes to finance infrastructure investment development.
- The PPP process requires a full analysis of projects risks at the outset. This fuller examination of risks by both the government and lenders means that cost estimates are robust and investment decisions are based on better information.

So overall it can be said that PPP's build trust and therefore, create efficient and productive working relationships between the public and private sector. It's what we need.

For the love (and growth) of concrete!

John Sheath
Editor
CEO, Concrete Society of Southern Africa

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A sense of belonging

Man has an inherent need to belong.

We mostly belong to social structures and groups by default (e.g. our families, the suburbs we live in). At times we join other social groups because of shared interests such as religious denominations and sports clubs. We also belong to functional groups as a result of where we are at a given time such as the groups shared with work colleagues.

Professional groups offer the opportunity to interact with like-minded professionals, usually within clearly stated parameters. The mission and the vision of these groups are openly communicated and the members expect affiliation with the group to satisfy a need.

We join professional groups as a matter of choice and because we have a passion for a specific topic. We remain in groups where we feel valued, appreciated and nurtured and where we feel that there is purpose.

I have chosen to put energy and commitment into the Concrete Society of Southern Africa, not only as a body representing the most used construction material in the world, but as a prime example of what a well-functioning professional group should be all about.

The benefits derived from affiliation to a professional body are numerous and multi-layered. In the case of the CSSA some of the benefits include:

- **Instrumental Benefits:** technical seminars, site visits, business contacts, listing in the Source Book
- **Unity benefits:** Networking with like-minded people, sharing of expertise, best concrete practices and latest research
- **Material benefits:** free copies of CSSA publications, discounted rates on ACI publications

Whlie membership of the CSSA is the first step, your personal level of involvement with the Society will determine the value you will be able to add to your job, your personal and professional development, and the strategic insights you could gather. I urge everyone to leverage your membership of the Concrete Society at all these levels.

I am excited about my tenure as President of the CSSA. With the support of a truly professional and efficient head office team, the technical guidance of my fellow Board members and the enthusiasm and commitment of the Branch Chairs and committees, I know that the Society will remain relevant in its value offering to individual and company members alike.

Accepting the presidential chain of office and the responsibility that goes with it, was a huge honour for me and it is a task I do not take lightly, as I cherish what the Concrete Society stands for and that sense of belonging.

For the love of concrete,

Hanlie
President – Concrete Society of Southern Africa

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

OUR MISSION
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.

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Upgrading of 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 (N2), in Durban, KwaZulu-Natal. The interchange was a signalised split level diamond interchange at the intersection of Umgeni Road/M19 and the N2 and experienced unacceptably high levels of congestion before the project was initiated in 2009.

This was characterised by 14 000 vehicles per hour (VPH) and 16 000 VPH during the morning and afternoon peak periods respectively. Figure 1 shows the interchange before the upgrades were implemented.

Hatch Goba was appointed by the South African National Roads Agency SOC Limited to undertake the design and contract administration for the upgrades to the Umgeni Road Interchange. The Construction Contract was awarded to the Rumdel, EXR, Mazcon Joint Venture in October 2010. Construction started on 22 March 2011 with a construction value of R350 million (incl. VAT and CPA). The project was co-funded by the eThekwini Municipality. The final design for the upgrade of the interchange was a four level interchange which includes eleven new ramps and seven concrete bridges. Figure 2 shows the final layout of the interchange.

LOCALIITY

The Umgeni Road Interchange is located between km20.8 and km22.0, Section 25, on the National Route 2 (N2). This is south of the Umgeni River and 4.5km north of the EB Cloete Interchange. The project is situated within the municipal boundary of the eThekwini Municipality (Durban), KwaZulu-Natal, South Africa.

MOTIVATION FOR CIVIL ENGINEERING PROJECT

There are very few projects which will come close to matching the complexity of the Umgeni Road Interchange project. 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 project is a showcase for the use of concrete in civil engineering projects. There are two incremental launch bridges, three precast beam and slab bridges, two sections of cast in-situ pre-stressed box girder deck bridges, a voided deck slab bridge, and a conventionally reinforced concrete deck included in this multifaceted project. 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 800m^2 of rock anchored sprayed concrete wall. A total of approximately 25 000 m^3 of concrete was used for this project.

Figure 1: Umgeni Road Interchange Pre-Upgrade.

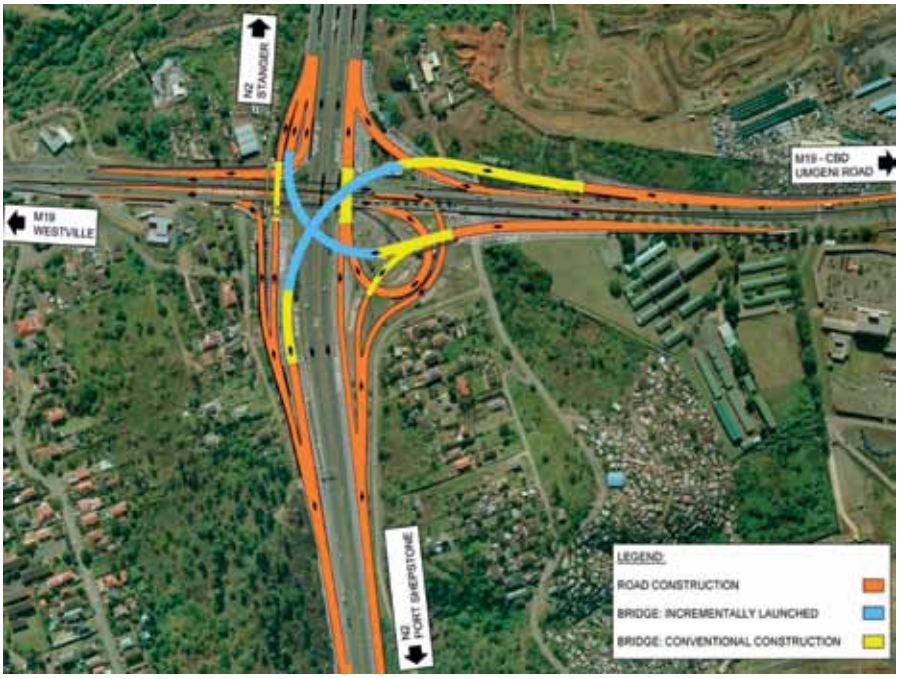

Figure 2: Upgrades to Umgeni Road Interchange Final Layout

The construction of two incremental launch bridges was a special feature of this project. The incremental launching method of bridge construction was chosen to prevent disruptions to the heavy traffic volumes on the N2 Freeway and Umgeni Road. The two incrementally launched bridges being constructed at the same time and crossing each other was a unique sight and a first in South Africa. The very limited space on the site meant that these bridges had to be constructed and launched on a path of an inclined circle in space. This was a technically challenging part of the design but importantly allowed the necessary vertical and horizontal changes to be achieved on this restricted site.

The elevated casting yard was a unique feature of the design of the Ramp A1 Incremental Launch Bridge. Due to the road geometrics of Ramp A1, the casting yard had to be constructed on a 20 m high elevated platform. The construction of the bridge deck as well as the launching operations was carried out from this elevated casting yard.

Precast pre-stressed beams were used to construct the bridges over Umgeni Road. This allowed for these bridge decks to be constructed with very minor disruptions to the traffic on Umgeni Road. The twelve 30 m long beams and twenty-three 20 m long precast beams were constructed off-site and erected during overnight road closures.

Unique and elegantly shaped bridge piers were designed to enhance the aesthetics of the bridges. The Ramp A1 and Ramp D1 bridge pier heads resemble a fish tail and the Ramp D2 Bridge piers resemble a shaved golf tee. Special formwork was manufactured to cast these unique shapes. The quality of the concrete finishes produced on this project was excellent and has also enhanced the durability and appearance of the concrete structures.

The Umgeni Road Interchange is now a significant landmark in Durban and will have a major positive impact on the travelling public. The improvements to this interchange will make it safer for both motorists and pedestrians as well as significantly reduce travel times for commuters.

CONCRETE

Concrete was the construction material of choice due to its resistance to the harsh coastal environment, versatility, cost effectiveness, low maintenance, and the characteristic of being able to create aesthetically pleasant shapes.

Concrete for the project was supplied by Lafarge Readymix from their Riverside batching plant in Durban. A total of 13 concrete mix designs were used for this project. This was due to the large number of different structures and their respective concrete requirements. A number of mix designs were also used for pumped concrete and high early strength concrete.

In order to facilitate high speed construction of the incremental launch bridge decks high early strength concrete was used. Concrete was required to have reached a compressive strength of 35 MPa before the stressing operation could be done. The use of high early strength concrete allowed the pre-stressing operation to take place within 72 hours of casting the top slab of the bridge.

Self-compacting concrete was used for the construction of the launch bridge deck diaphragms which were only cast after the deck was launched into its final position. The use of self-compacting concrete helped ensure that there was no honeycombing in this element which was very difficult to vibrate.

Significant attention was given to concrete quality and concrete durability due to the large number of concrete structures on the relatively small interchange site. Regular durability testing of the concrete was carried out through the project. Concrete was tested for oxygen permeability and water sorptivity and chloride conductivity. The results of these tests were very good. Attention was given to placement, compaction and the curing methods for the concrete to ensure that the concrete produce met SANRAL's strict durability specifications. The aesthetics of the concrete structures was critical to the appearance of the interchange. The Contractor has produced excellent concrete finishes which has enhanced the appearance.

DESCRIPTION OF THE PROJECT

For ease of reference the site was divided into 4 quadrants during the design phase of the project viz. Quadrant A, B, C and D. Refer to Figure 4. The upgrade to the interchange consists of eleven new ramps and seven concrete bridges. The Ramps have been named in accordance to the Quadrant in which they start. The new ramps have been named Ramp A1, A2, A3, B1, C1, C2, D1, D2, D3, D4 and D5. The bridges have been named in accordance with the ramp on which it is located.

Table 1 gives a summary of the traffic movement on each ramp as well as a description of the bridge associated with each ramp.

The two incremental launch bridges are special and unique features of this project. The following section will describe the details of the design and construction of these bridges. The remaining bridges as well as the other concrete structures which are part of this project will also be described in the following sections.

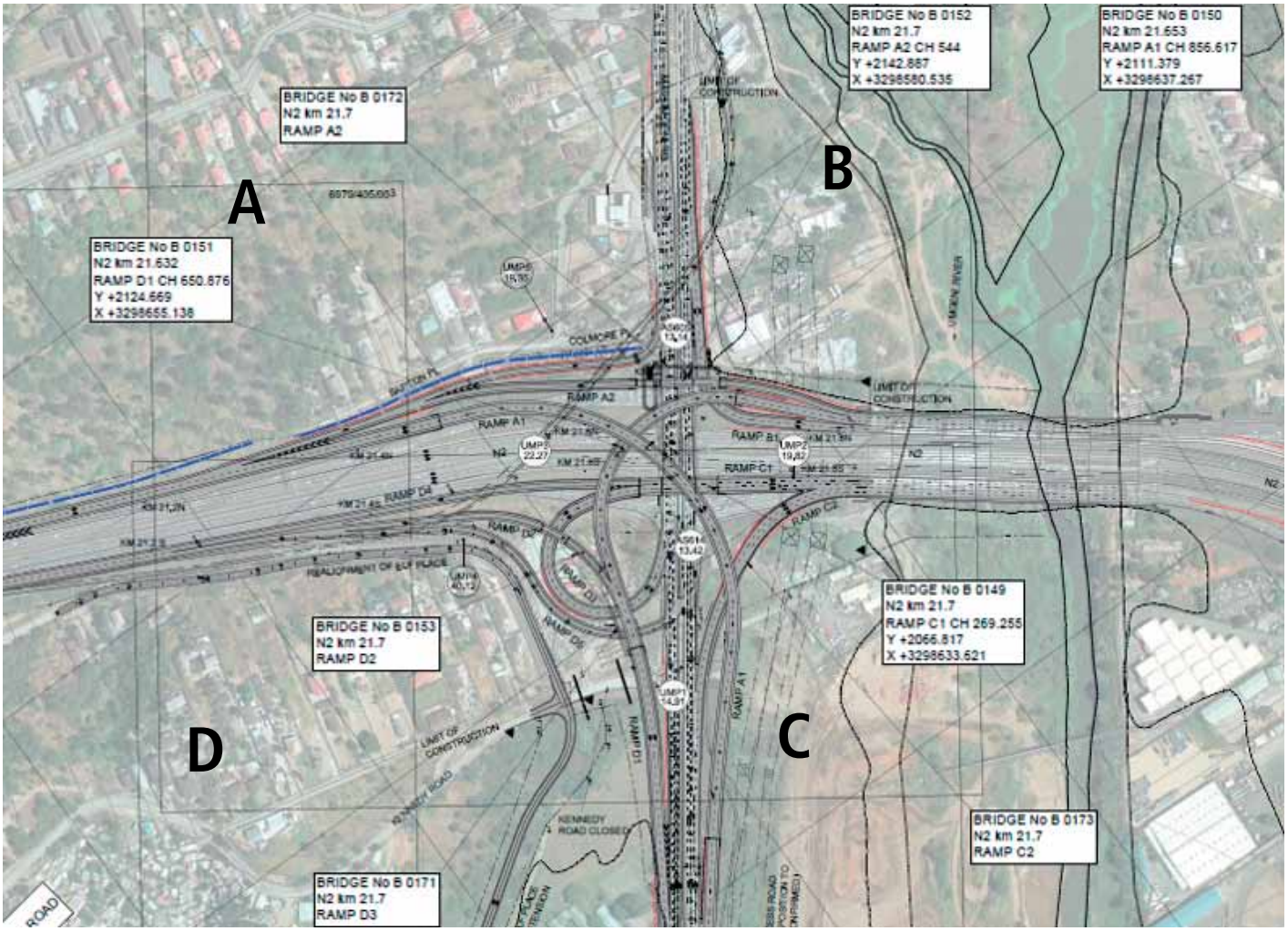

Figure 4: Division of the site into Quadrants A, B, C and D

Table 1: Summary of the traffic movements and the bridges

RAMP	TRAFFIC MOVEMENT	BRIDGES
A1	N2 Northbound to Umgeni Road East incremental launch bridge B0150	2 Cast in-situ pre-stressed double barrel box girder deck sections+
A2	N2 Northbound to Inanda Road Interchange	Precast beam and slab B0152
A3	N2 Northbound to M19 West	None
B1	M19 Eastbound to N2 Northbound	None
C1	N2 Southbound + Inanda Road to Ramp D3 and D4	Precast beam and slab B0149
C2	N2 Southbound to Umgeni Road Eastbound	None
D1	Umgeni Road Westbound to N2 Northbound	Incremental launch bridge B0151-2
D2	Umgeni Road Westbound to N2 Southbound	Voided deck slab B0151-1
D3	Ramp C1 to M19 Westbound	None
D4	Ramp C1 to N2 Southbound	None
D5	Umgeni Road Eastbound to N2 Southbound	None
	East Pedestrian Bridge	Cast In-situ Reinforced Concrete B0171
	West Pedestrian Bridge	Precast beam and cast in-situ concrete B0172

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The Incremental Launch Bridges

The main feature of the Umgeni Road Interchange project was the two incremental launch bridges. The Ramp A1 Bridge, B0150, and Ramp D1 Bridge, B0151-2, were designed to be constructed using the incremental launching method. This incremental launching method facilitates high speed construction without disruption to traffic and the works below the bridge deck. It is also economical since there is no staging required for the construction of the bridge decks.

Both of these incremental launch bridges were designed to be launched on a path of an inclined circle in space with small radii. This was due to the restricted space on the site. This launch path significantly reduced the length of the ramps required to tie-in with existing roads. This was a technically challenging part of the design of the interchange which required meticulous attention to detail. The bridge was first designed on a local coordinate system which then had to be transformed to the global coordinate system. This design allowed the bridge deck to be launched westward, over and across the N2 Freeway and then slope down to the final launch position. An added advantage of the design with this launch path was the super-elevation varied naturally along the horizontal component of the deck curvature. Refer to Figure 5 and 6 for details of the launch path of an inclined circle in space.

The bridge decks were constructed in 15 segments of lengths which varied from 9.00 m to 17.33 m. The length of each segment was dependant on the position of the diaphragm beams and the size of the casting yard. Each of the bridge deck segments was constructed in three concrete pours i.e. the bottom slab, then the webs and then the top slab. High early strength concrete was used for the top slab of the bridge deck so that the concrete would achieve a compressive strength of 35 MPa within 3 days of casting.

The concentric pre-stressing tendons were stressed after the deck concrete had a compressive strength of over 35 MPa. The relevant deck segment would then be launched out of the casting bay thus making the casting bay available for the construction of the next segment. Refer to Figure 7 for the details of the construction cycle of a typical launch bridge deck.

Two 350 ton hydraulic jacks were used for the launching of the bridge decks. The launch path meant that a special seating frame for the hydraulic jacks had to designed and manufactured to accommodate the lateral movement of the pulling bars during the launching process.

The deflections of the piers for the incremental launch bridges had to be carefully monitored during the launching operation. This was done by using inclinometers attached to the top of each pier. The data from these inclinometers was transmitted to a laptop stationed

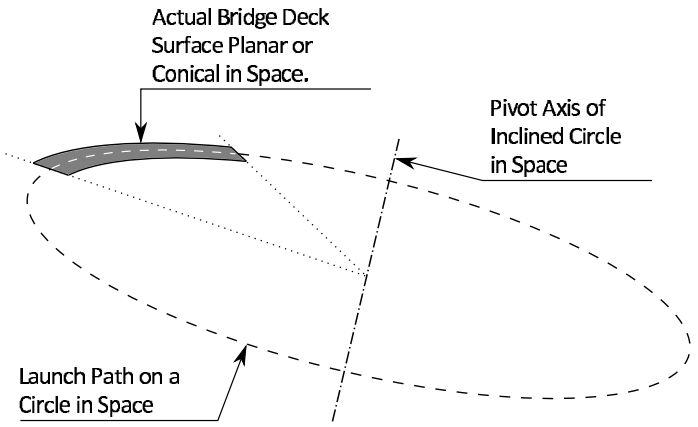

Figure 5: Launch Path of an Inclined Circle in Space (Benade, 2011)

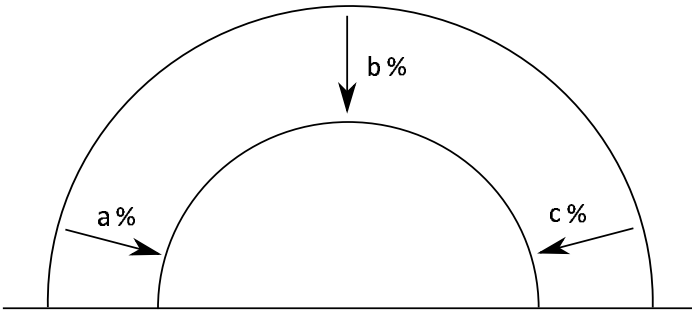

Figure 6: Variation in Super-elevation along Incremental Launch Bridge Decks (Benade, 2011)

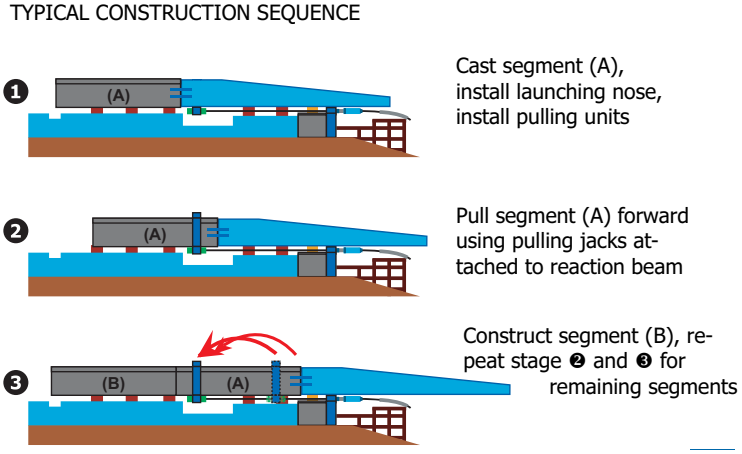

Figure 7: Typical Incremental Launch Bridge Construction Cycle (VSL Systems)

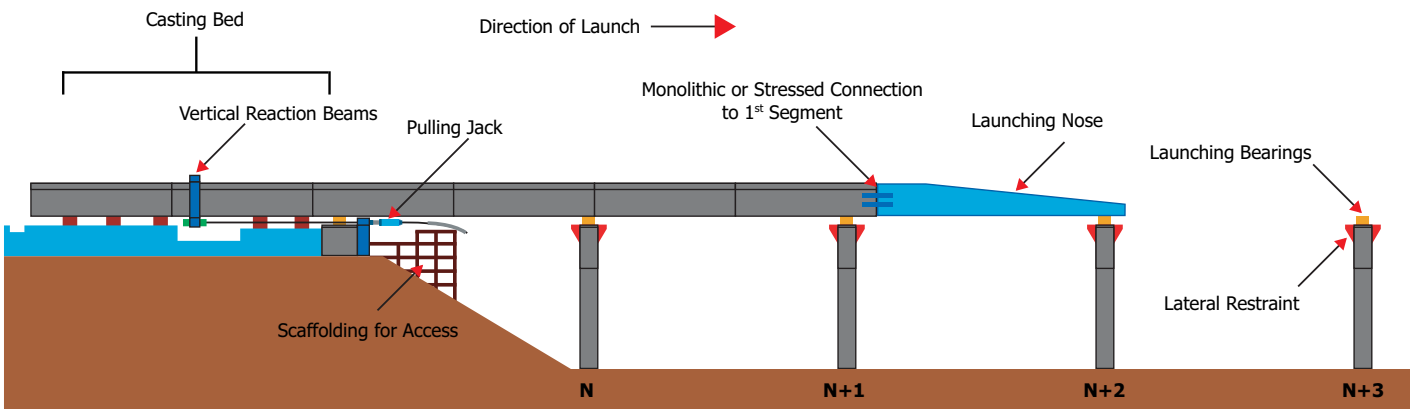

Figure 8: Typical Situational Diagram (VSL Systems)

near the launching hydraulic power pack. Safety cut-off switches were incorporated into the launching system so that power to the launching jacks would be cut off if a pier deflected more than the calculated expected deflections. Figure 8 shows a typical situational diagram for the construction of an incremental launch bridge deck.

Ramp A1 Incremental Launch Bridge B0150

The Ramp A1 Bridge consists of three sections with a total length of 570.5 m. One of these sections is a 232.5 m long and 3.2 m deep incrementally launched section. The radius of the inclined circle of the launch path is 188.65 m. The Ramp A1 Bridge is at the fourth level of the interchange and is approximately 30 m above Umgeni Road at its highest point. This section of the Ramp A1 Bridge has five spans with the two spans over the N2 Freeway being 66 m long. Additional pre-stressing tendons were designed for the bridge deck in these two long spans and temporary piers were required for the launching operation. These temporary piers were demolished after the launching operation was completed to allow for future widening of the N2 Freeway and M19.

Due to the required road geometrics the casting yard for the Ramp A1 Bridge had to be constructed approximately 20 m above ground level as shown in Photo 1. The 20 m high elevated launch yard was a unique feature of this project and a first in South Africa. This temporary structure consisted of 4 No. 1 m x 5 m columns and 2.4 m deep beams. It was designed to resist the loads from the casting of the deck and the loads from the launching operation. Due to the very strict dimensional control required for an incremental launch bridge the skid beams had to be carefully monitored for any settlement. This robust temporary structure was also demolished after the completion of the launching of the bridge deck was complete.

Photo 1: Ramp A1 Incremental Launch Bridge Elevated Casting Yard

Ramp D1 Incremental Launch Bridge B0151-2

The Ramp D1 Incremental Launch Bridge deck is 2.65 m deep and 205 m long with six spans of varying lengths. Due to the tie-in with the N2 Freeway on the north end of the deck the radius for the inclined circle launch path for the Ramp D1 Bridge had to be particularly small at only 106.84 m. Refer to photo 2. This presented a number of challenges during the construction as it impacted on design of the launching girder, and the side guides for the deck had to resist large lateral forces

Photo 2: Ramp D1 Incremental Launch Bridge 106m Radius of Inclined Circle Launch Path

during the launching of the bridge deck. This complex launch path also meant that dimensional controls had to be very precise in order for the leading end of the deck to reach its intended position once the launching was completed.

Due to the steep downgrade at the end of the Ramp D1 launch bridge, the launching system for the last two launches had to be designed to restrain the deck from moving due to its own self weight. This was done by adding a hydraulic jack to the back of the launching pier and controlling the pressure in the jack as the deck was launched forward.

Ramp A2 and C2 Pre-stressed Beam B0152 & B0149

The Ramp C1 Bridge, Ramp A2 Bridge and the West Pedestrian Bridge were designed to include precast beams to minimize disruptions to traffic on Umgeni Road during construction. These precast beams were constructed in Olifantsfontein, Gauteng, by Civilcon (Pty) Ltd and then delivered to the site in Durban, KwaZulu-Natal. Given the space limitations on the site it was found to be more feasible for Civilcon to construct these beams in their established precast yard in Olifantsfontein

Photo 3: Placement of the precast beams at night

and then deliver these beams one at a time to the site. A total of twelve 30 m long beams and twenty-three 20 m long beams were constructed. The beams are 1.4 m deep and the width of the soffit is 980 mm. The Ramp C1 and Ramp A2 bridges have 3 spans and a total length of approximately 71 m. The Ramp C1 Bridge has an average width of 16 m with 7 precast beams per span. The Ramp A2 Bridge has a width of 8.9m with 4 precast beams per span.

The precast beams were lifted into position at night so that the road closures had a minimum impact on the travelling public who use the M19/Umgeni Road. Photo 3 shows the placement of one of the 30 m long beams. The beams were erected under the supervision of the experienced Civilcon team. The movement of the beams from their storage areas to the bridge position had to be accurately planned. The 20 m and 30 m beams had to be carefully lifted in the storage area onto the delivery vehicle and then moved to the bridge location where the beams were lifted and placed in position. A 200 ton mobile crane was required to lift and place the beams. The weight of each 30 m beam was approximately 52 tons.

Ramp D2 Bridge Voided Deck Bridge B0151-1

The Ramp D2 Bridge deck is a conventionally reinforced concrete voided deck slab. The deck is 1.5 m deep and the void formers are 1 076 mm in diameter. The total length of the bridge deck is 144 m. The deck was constructed on scaffolding in six stages. In order to meet the programme the deck was constructed from both ends i.e. from the East Abutment and from South Abutment. The piers for this bridge were designed with the shape of a shaved golf tee to enhance the aesthetics of the structure. Photo 4 shows the construction of stages 5 and 6 of the bridge deck and Photo 5 shows the "shaved golf tee shaped piers".

Photo 4: Ramp D2 Bridge Voided Deck

Photo 5: Ramp D2 Bridge "Shaved Golf Tee" Shaped Piers

Ramp A1 Pre-stressed Double Barrel Box Girder Bridge B0150

The total length of the Ramp A1 Bridge is 570.5 m. Two cast in-situ pre-stressed double barrel box sections link the 232.5 m long Ramp A1 incremental launch bridge to the roadworks on the south and east ends of the ramp. The east section has six spans and a total length of 246 m. The south section has three spans and a total length of 92 m. The longest span for this bridge deck is 45 m. The deck is 2.2 m deep and was constructed on scaffolding in six and three stages on the east and south sections respectively. The foundations on the east end of this bridge deck were constructed with precast piles which were 36m deep.

Photo 6: Ramp A1 Cast In-situ Deck

Pedestrian Bridges B0171 & B0172

Pedestrian traffic was a significant consideration for the upgrade of the interchange. Two pedestrian bridges and concrete walkways will accommodate pedestrians in this area. The East Pedestrian Bridge is a cast in-situ conventionally reinforced concrete two span bridge which is 48.5 m long. The deck is 1.2 m deep and 3.1 m wide. The West Pedestrian Bridge is made up of a combination cast in-situ reinforced concrete and precast beam and slab deck with a depth of bridge deck which varies between 0.89 m and 1.68m. The width is 3.1 m and has a total length of approximately 130 m. Refer to photo 7.

Photo 7: East Pedestrian Bridge

Retaining Walls W0069–W0098

Due to the restricted nature of the site a number of retaining walls were required to retain the fill from the ramps. These retaining walls include 1 650 m^2 of reinforced concrete retaining walls, 5 100 m^2 of mechanically stabilised earth walls and 5 800 m^2 of rock anchored sprayed concrete retaining wall. Feature cladding panels were used for the mechanically stabilised earth walls and an architectural rock pattern finish was given


Photo 8: L-R: Mechanically Stabilised Earth Wall and Rock Anchored Sprayed Concrete Wall

to the rock anchored sprayed concrete wall to enhance the aesthetics of these walls. Refer to photo 8.

Cast In-situ Box Culverts C0231, C0247, SC016

Three cast in-situ box culverts were constructed as part of this project. Storm water culverts which run under the N2 Freeway and the M19 had to be extended to accommodate the roadworks for the new ramps. A total of 650 m of cast in-situ storm water box culvert structures was constructed. Refer to photo 9.

Two other cast in-situ box culverts were constructed to protect services. These services include a Transnet gas pipeline, bulk water and wastewater pipelines. The culvert for the Transnet pipeline is approximately 70 m long and has a 3X3 m barrel. The culvert for the bulk water and sewer main was constructed to protect these services from settlement of the ground due to the fill for Ramp C1. This culvert has a 3.8 X 3.2 barrel and is 40 m long.

Foundations

The ground conditions on this site were poor and highly variable. There are three types of foundations for the bridges on this project. Where the shale rock was relatively shallow, spread footings were designed and constructed. In other areas where the tillite bedrock was less than 20 m below ground level, Continuous Flight Auger piles were used, and in areas where the bedrock was greater than 20 m deep Precast Concrete Driven Piles were used. Some of the precast piles had to be driven to a depth of 36 m before reaching the bedrock and achieving the desired set.

Roadworks and Services

The roadworks for this project included 200 000 m^3 of bulk earthworks, 50 000 m^3 layer works, 6 600 m^3 of asphalt base and 67 000 m^2 of Ultra-Thin Friction Course (UTFC) surfacing. Careful traffic accommodation planning was required and a number of traffic deviations had to be implemented to facilitate construction of the new ramps throughout the project.

Approximately R30 million was spent on the relocation of services as part of this project. Bulk water and wastewater pipelines, high and medium voltage powerlines, as well as telecommunication lines had to be relocated to facilitate the construction of the ramps and structures.

CONCLUSION

The Umgeni Road Interchange project was a technically challenging project which required meticulous attention to detail during design and construction. The project has been successfully designed and constructed despite challenging site constraints. The project includes seven concrete bridges and a number of other concrete structures making it a showcase for the use of concrete in civil engineering projects. Two of these bridges are incremental launch bridges which were launched on a path of an inclined circle in space. These two bridges, together with the 20 m high elevated casting yard, were very unique and special features of this civil engineering project. Umgeni Road Interchange is now a landmark and will have a major positive impact on the travelling public. ▲


Photo 9: L-R: Services and Stormwater Culverts

Lessons from the TailorCrete Project

Innovative industrial methods for future digital concrete architecture.

by Thomas Juul Andersen, Wilson Ricardo Leal da Silva, and Lars Nyholm Thrane

One of the major challenges in the future production of non-standardized concrete structures is introducing novel and cost-effective ways to fabricate non-standardized formwork. With this idea in mind, the Danish Technological Institute (DTI) coordinated the TailorCrete project,[1-3] funded by the European Union's 7th Framework Program (FP7) in cooperation with 14 European partners. FP7 was the European Union's research and innovation funding program from 2007 to 2013.[4]

The TailorCrete project addressed the weak link between the possibilities in digital three-dimensional (3-D) modeling using advanced computer-aided design (CAD) software as well as in formwork and reinforcement fabrication to enable the realization of digital architecture. The project introduced new methods and technologies to create concrete structures and surfaces with complex shapes using industrialized, cost-effective, and sustainable approaches based on digital architectural design, robotic fabrication, and concrete technology. This approach opens up the possibility of increasing the architectural value in concrete buildings and enables innovative and advanced architecture in traditional housing. The construction of a full-scale sculptural concrete structure, namely the Demonstrator, located in Aarhus, Denmark, proves the technologies established in the TailorCrete project. This article presents the most relevant developments from the TailorCrete project, as well as details on the Demonstrator construction.

Digital Architectural Design

The Turkish architectural firm SuperPool designed the Demonstrator using the latest digital modeling tools. Figure 1 shows the final design. The Demonstrator structure features an advanced geometry that would be complex and difficult to fabricate with the use of traditional available methods. Hence, the project allowed the demonstration of the highest number of the technologies developed in the TailorCrete research project. The design program called for a structure that would serve as a storage element to protect different materials and equipment from snow and rain. The final design suggested a load-carrying structure with medium to high curvatures in the roof and leg structures, respectively. The dimensions are approximately 21 x 6 x 6 m.

Digital Manufacturing

Cutting strategies

Although their repetitive operations seem unsuitable for creating advanced architectural designs, robots possess an unexploited potential for the fabrication of non-standardized building parts. At present, the potential of using robots in the construction market has come within reach because human-robot interfaces have improved and robots have become less expensive. In this light, the TailorCrete project experts developed a new formwork system based on digital manufacturing to help architects in the creation of complex CAD models. A great share of

Fig. 1: Architectural design of the TailorCrete Demonstrator

Fig. 2: High-Technology Concrete Laboratory at DTI: (a) automatic concrete batch plant; and (b) industrial robot

the project activities were developed at the High-Technology Concrete Laboratory at DTI. This lab is equipped with a fully automatic concrete batch plant and a six-axis FANUC industrial robot (Fig. 2).

The design of the Demonstrator was developed in Rhinoceros, a 3-D modeling software program. When the architectural and structural designs were complete, a Rhinoceros plugin was used to automatically generate the formwork layout. From this layout, the software program PowerMILL was used to generate the robotic programming for each formwork piece.

TailorCrete's digital formwork manufacturing process comprises robotic milling strategies (subtractive manufacturing) and lightweight formwork materials, including coatings and release agents.

Expanded polystyrene (EPS) block is the typical base material used in milled formwork. EPS is easy to machine, its low weight makes it easy to handle, and it has high strength despite its high air content (up to 98%). Also, clean EPS can be recycled, thus minimalizing environmental impacts. A number of architectural projects have used milled EPS formwork. Examples include the Spencer Dock Bridge[5] in Dublin, Ireland, and a concrete pavilion in Glostrup, Denmark (Fig. 3). These projects showed some of the potential of milled formwork, but also pointed out some of its weaknesses. In particular, reusability and recycling were issues because separating EPS and its coating was a time-consuming task. TailorCrete addressed formwork reusability and recycling and other specific challenges, including improvement of costeffectiveness through optimized robotic milling strategies, minimization of the amount of milled material, production of smooth concrete surfaces, and improvements in the formwork release properties.

A key cost factor in robotic machining is the milling time. It's necessary to find the right balance between the milling tool, milling strategy (axial and radial depth-of-cut and the trajectories for the cutting tool), and surface quality. With the use of advanced five-axis strategies (where the milling tool angle is a function of the milled surface curvature), it was possible to reduce the milling time by a factor of 6 when compared to traditional three-axis strategies (where the milling tool angle is fixed). The milling process is displayed in Fig. 4.

Fig. 3: Concrete Pavilion built in connection with the Danish research and development project Unique Concrete Structures (UniKaBeton)

Fig. 4: Manufacturing of formwork blocks using five-axis milling at DTI

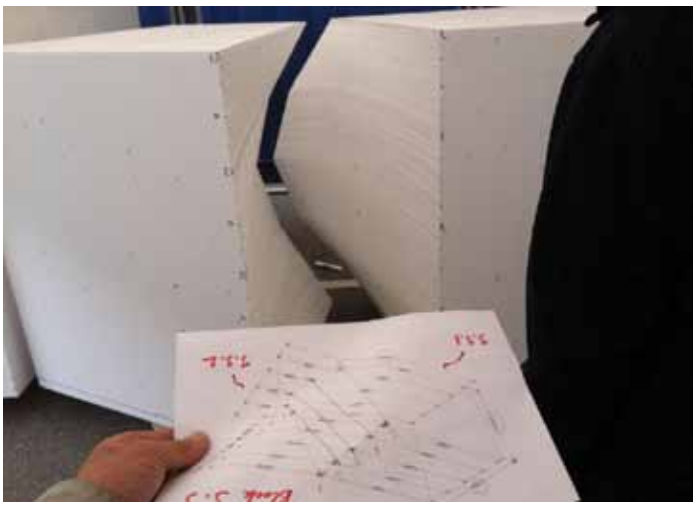

Fig. 5: Gross machining of 1200 x 1400 x 4800 mm. EPS blocks was initiated using a hot-wire cutter to produce smaller blocks that were then cut into two halves representing rough versions of the inner and outer formwork. The formwork surfaces were then robotically milled based on the geometries in the digital model (including drilling of holes for the tie-rods)

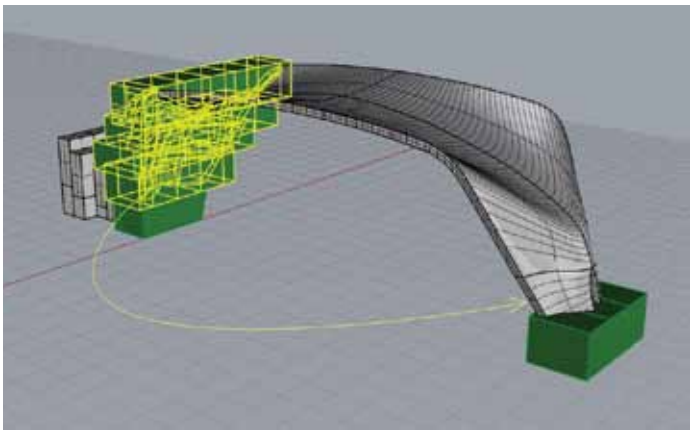

Fig. 6: The Demonstrator was designed with a rotation line along the center of the roof, enabling formwork reuse when combined with the silicone membrane coating system.

Fig. 7: Initial work at the construction site: (a) the assembled first layer of formwork; and (b) steel reinforcement. A complete 3-D model of the reinforcement was developed, and the more complex bars were fabricated using robots. However, most bars were designed to be fabricated conventionally using standard machinery

The use of a formwork substructure in the milled formwork helped save substantial volumes of EPS. In short, the formwork substructure enabled splitting non-standard geometries into a standard grid that simplified control in the design and building process. For the Demonstrator, all EPS blocks were precut using a hot-wire cutter. The front and back formwork surfaces were cut from one piece, at angles corresponding to the concrete structure's cavity, as shown in Fig. 5.

Design for demolding and reuse

Demolding can be cumbersome when concrete is cast against milled EPS formwork, especially when the geometry includes high curvatures. Experiments show that applying a liquid coating to milled surfaces can result in a smooth concrete finish; however, the formwork often breaks during demolding. It therefore, becomes difficult to separate the coating from EPS, hindering EPS recycling. A new flexible membrane coating system was developed as a solution. Optimal results were obtained using a 0.5 mm thick silicone membrane, which was found to be easy to handle and attach to the milled EPS. The silicone-coated milled EPS can be detached easily from hardened concrete, leaving both the membrane and the EPS ready to be reused or recycled. Such technology enabled reusing 90% of the formwork in the Demonstrator. In this case, the structure was designed with a rotation line along the center, as shown in Fig. 6. Hence, the two halves of the structure are equal, except for the lowest part, as it has different endings.

On-Site Processes

Assembling of prefabricated parts

The prefabricated EPS pieces were marked with an identification number referring to their final position in the structure to simplify the on-site formwork assembly. To optimize logistics, the formwork parts were transported in a container and were positioned corresponding to the order of use on-site. Figure 7 displays the first layer of formwork assembled on-site as well as the steel reinforcement. The formwork assemblage was rather easy due to high precision given by digital fabrication. The position of the tie rods was planned in the design phase, so it was possible to predrill the holes needed in the formwork using robot technology. A special cone was used in the connection between formwork and tie rods in curved areas.

Casting

The Demonstrator was cast in four stages, as highlighted in Fig. 8. The first three stages include the casting of the two legs and the tail structure. In these vertical parts, selfconsolidating concrete (SCC), designed with a high plastic viscosity (100 to 150 Pa) but low yield stress (20 to 40 Pa) corresponding to a slump flow of 620 to 710 mm, was used. The high plastic viscosity was specified to avoid dynamic segregation and blocking when SCC had to flow several meters through a dense net of reinforcement. The 4C-Rheometer[6] and the V-funnel were used to measure the rheological properties before and after pumping. Test results for two concrete batches used on the project are listed in Table 1.

The SCC mixture was pumped through a thin hose that was inserted (along with a small camera) in a small hole on top of the formwork. The pump hose was slowly raised at the same rate as the filling rate. The filling rate was low, as results during the project had shown that a low filling rate was key to obtaining smooth surfaces, in particular on upside surfaces. Also, it was known that a low casting rate would be beneficial in terms of the formwork pressure.

The horizontal deck was cast using conventional concrete. This part had no counter-formwork, so the surface finishing was done manually.

Demolding

Formwork demolding turned out to be more challenging than expected. The release properties of the membrane had changed as the result of exposure to the sun and weather, so separating silicone membrane and concrete was not as easy as had been observed in laboratory tests. Also, the attachment points of the membranes were not accessible during demolding because they were located along the sides of the EPS. If the attachment points had been located on the backside of the EPS blocks, the EPS could have been pulled out and the membrane easily removed sideways. Even though 90% of the membranes had to be replaced, all EPS blocks were reused.

Final structure

The Demonstrator's concrete surface exhibited a high-quality finish in terms of smoothness and lack of bugholes (surface voids). In some areas, the formwork was slightly misaligned during assembling and casting. Although this creates noticeable offsets when one is very close to the structure, it does not affect the overall appearance of the Demonstrator. Figure 9 shows the Demonstrator's surface details, revealing the fingerprint left by the formwork milling process, whereas Fig. 10 depicts the overall final result of the TailorCrete project, the Demonstrator.

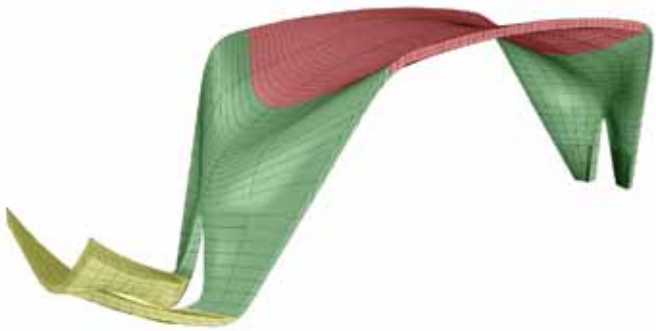

Fig. 8: The Demonstrator casting process: leg structures (green) and tail structure (yellow)—SCC, and horizontal deck (red)—conventional concrete

Table 1: SCC testing results for the Demonstrator project

	Batch 1		Batch 2	
	Before pump	After pump	Before pump	After pump
Yield stress, Pa	31	27	27	24
Plastic viscosity, Pa·s	180	115	139	107
T_{500}, s	6.1	4.7	5.5	4.5
Slump flow, mm	660	680	680	700
V-funnel, s	14	10	11	105

Note: 10 mm = 0.4 in.

Fig. 9: A close view of the surface of the Demonstrator reveals the extra detailing applied in the milling process

Fig. 10: The overall appearance of the Demonstrator proves the success of the TailorCrete project

Experiences

The TailorCrete project developed a new formwork system based on robotic milling technology. In summary, the use of advanced five-axis milling strategies significantly improved the cost-effectiveness of the milling process. The development of a fixed-grid substructure and the use of hot-wire cutting before milling helped minimize the amount of milled material and milling time. The use of a flexible membrane cover over the machined EPS delivered smooth concrete surfaces, while also ensuring formwork reuse and recycling the waste material. In addition, formwork assemblage was easy due to high precision of the digital fabrication. The use of SCC in the legs and tail resulted in concrete surfaces with high quality. The Demonstrator construction validated all technologies developed in the project. Thus, they are ready for application in the construction of architecturally challenging concrete structures. The experiences within digital manufacturing from the TailorCrete project has inspired the team from the High-Tech Concrete Laboratory at DTI to take the next step forward—3-D printing of concrete elements.

Project credits

Client: EU Commission
Project Coordinator: Danish Technological Institute (Denmark)
Partners: Bekaert (Belgium), Chalmers University (Sweden), Czech Technical University (Czech Republic), DesignToProduction (Switzerland), Dragados (Spain), El Caleyo Nuevas Tecnologías (Spain), ETH Zürich (Switzerland), Gibotech A/S (Denmark), Grace (Germany), MT Højgaard (Denmark), Paschal Danmark A/S (Denmark), Superpool (Turkey), University of Southern Denmark (Denmark), Unicon A/S (Denmark). ▲

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Selected for reader interest by the editors.

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WILSON RICARDO LEAL DA SILVA is a Concrete Consultant at DTI's Concrete Centre. His research interests include concrete rheology, mixture design and testing, self-consolidating concrete, nondestructive assessment of concrete structures, and mass concrete. His experience has included research in Brazil, the Czech Republic, Germany, and Switzerland. At present, he is focused on topics such as 3-D concrete printing and mobile software solutions applied to concrete technology. He is a member of RILEM Technical Committee TC 242-CMS, Thermal Cracking of Massive Concrete Structures, and developer of the Mass Concrete App. He received his PhD from Czech Technical University, Prague, Czech Republic.

LARS NYHOLM THRANE is Team Manager of the Product and Material Development group at DTI's Concrete Centre. He has a vast experience in the field of mixture design, material modeling, fresh concrete rheology, and textile reinforcement. Currently, he is heading a large Danish project on development and application of environmentally friendly cements in concrete production. Also, he is the inventor of the 4C-Rheometer, a commercially available rheometer for measuring the rheological properties of self-consolidating concrete. He received his PhD in civil engineering at the Technical University of Denmark.

Bold advances in precast concrete applications

The results of the CMA Awards for Excellence competition, announced at a gala dinner function in Johannesburg in April, suggest that advances in precast concrete technology were significant influencers in this year's judging process.

Bosun Brick's Castle Bottom Kerb

The judges had no hesitation in awarding the concrete cladding of No. 1 Silo at Cape Town's V&A Waterfront the Aesthetics Commercial Trophy. Besides its striking visual appeal, which showcases the beauty of precast concrete construction at its best, the project also involved high levels of skilled precast concrete engineering.

Similarly, the judges were unequivocal in nominating the Gouda Wind Farm concrete tower project for the Technical Excellence Trophy, which again reflects substantial levels of technical engineering input. It is a project with a pronounced innovative bias, being the first time that a South African wind farm used precast concrete segments in the construction of its towers, which in this instance were 100 m high. Not surprisingly, the project was also entered into the Innovation category where it prevailed as a Commendation Winner.

No 1 Silo 3: Precast panelling at No 1 Silo by Concrete Units

Fan cobble paving blocks at Knysna Waterfront by Smartstone

Gouda Farm Wind Tower segments by Concrete Units

Walmer Township Paving project: Pavers in Walmer Township by Shukuma Bricks

Entries closed in October last year and the judging took place in November at the Johannesburg offices of PPC Cement, the main sponsor of this year's event. The five judges, all leading professionals in the field of construction, were:

- **Antoinette de Beer** - Landscape architect and director of Arla Consulting
- **Hugh Fraser** - Architect and media manager of Paragon Architects
- **Malcolm Pautz** - Civil engineer and President of the South African Institution of Civil Engineering (SAICE)
- **Abe Thela** - Civil engineer and a director of Nyeleti Consulting
- **Bert van der Heever** - Quantity surveyor and Managing Director of Bert van der Heever Bourekenaars Ingelyf

Interest in this year's competition was far greater than in 2012 when the CMA was celebrating its 40th anniversary. This was borne out by the number of entries which spiked from 77 in 2012 to 117, this year.

CMA executive director, Frans Minnaar, said that although this year's entries were generally of a very high standard, the judges felt that none of the entries in the Aesthetic Residential category stood out sufficiently to merit a trophy award; a single commendation was all that was awarded.

"The CMA has always advocated the maintenance of high standards in the manufacture and application of precast concrete products and this year's Awards for Excellence competition once again reflects this. Although we would have been happier had all six trophies been awarded, the absence of a trophy winner in the Aesthetics Residential category does have a positive spin-off in that it emphasises that CMA awards are only made when they are merited. As always, the judges were briefed to apply strict appraisal criteria and not to allocate awards where they felt they were not fully justified," continued Minnaar.

"However, I am pleased to note the many other projects, especially those in the Aesthetics Commercial, Technical Excellence and Innovation categories, were certainly good enough to have taken an award," he concluded.

This year's five trophy winners were as follows:

- **Concrete Units** - the Aesthetics Commercial trophy for casting the precast concrete panelling for No. 1 Silo at Cape Town's V&A Waterfront.
- **Shukuma Bricks** – the Community Upliftment trophy for providing concrete pavers for the paving of gravel roads in Walmer Township, Port Elizabeth.
- **Concrete Units** – the Technical Excellence trophy for manufacturing 782 precast concrete wind tower segments for the Gouda Wind Farm project in the Western Cape.
- **Bosun** – the Innovation trophy for introducing the Castle Bottom Kerb.
- **SmartStone** – the Precast for Life trophy for supplying Fan Cobble paving blocks for the Waterfront at Knysna Quays project in Knysna.

Apart from the Aesthetic Residential category all other categories posted two commendation winners each.

The Aesthetic Commercial commendation winners were: SmartStone Midrand and Bosun, the former for supplying pavers and coping for the Thaba Moshate Hotel Casino and Convention resort in Limpopo, and the latter for providing drycast paving blocks for the courtyard of BMW's head office refurbishment project in Midrand.

C.E.L. Paving Products and Hydraform each won a Community Upliftment commendation. C.E.L. produced 6 400 m² of paving for surfacing gravel roads in Kassiesbaai/Arniston in the Western Cape, and Hydraform supplied concrete block making machines for the Radway Green Housing project in the same province.

The two Technical Excellence commendation winners were Concrete Units and Aveng Infraset. Concrete Units won the award for manufacturing precast concrete rock print panels for the Mouille Point Sea wall Project in Cape Town and Aveng Infraset for providing non-standard portal culverts for the Tweefontein Optimisation project in Mphumalanga.

Concrete Units' precast concrete expertise was rewarded a fourth time - in this instance an Innovation commendation award for the Gouda Wind farm towers for which it also won the Technical Excellence trophy. The other Innovation commendation award was won by Rocla for casting 128 precast concrete cabins for housing photovoltaic equipment in the Free State and Northern Cape. ▲

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Sustainability and infrastructure development: finding commonality to ensure collective success

Africa's ambitious development goals require the construction of infrastructure and related mega-projects as a priority. With the IMF forecasting that 11 of the world's 20 fastest growing economies will be in Africa by 2017, and cities across the continent needing to collectively accommodate an additional 900 million new urban dwellers in the next 35 years, how can African governments and private sector investors meet such high demand for growth in a way that is both realistic and sustainable?

Can rapid infrastructure development in itself be sustainable given the type of materials used and the approach usually adopted in these projects? And, if so, what is the likelihood of project custodians insisting on sustainability as a starting point for urban development and expansion?

If the predictions of various leading world bodies and associations including the Mo Ibrahim Foundation are anything to go by, our continent will witness urban development of the scale and intensity seen collectively in the USA, Europe and Japan over the past 265 years, before 2056.

"As Africa starts gearing to become the home of nearly a quarter of the world's urban population by the middle of this century, governments, investors and players in the greater construction value chain are beginning to recognise the significant role each of them will have to play in making this a sustainable reality," notes Kevin Odendaal, PPC Executive: Business Development. "For cities to accommodate growth of this scale, partners will need to take a different approach to infrastructure development from planning right through to design, construction and building management. As such, a lot of this sustainable innovation will centre around the use of concrete as a building material."

This is especially the case given that cement, a key constituent of concrete (approximately 10 – 15% by volume) has a significant environmental cost due to the energy required to achieve the high kiln temperature involved in its production.

"This has to be viewed in context however," explains Odendaal. "In order to maximise the sustainability of concrete structures – including infrastructure megaprojects – we have to understand the interdependencies from 'cradle to grave' in the design phase, during construction and at end-of-life. We additionally need to unpack how these impact the levels of energy savings achievable during a structure's life cycle and use."

While the industry has worked to quantify "embodied" impact of materials used in infrastructure development, effectively measuring the "whole-life" impact and full effects of the infrastructure's existence during its usage phase continue to challenge the industry.

"This type of measurement is however critical if we're to meet future targets of 'zero net-energy' buildings and infrastructure for Africa. Understanding the full impact versus benefit of concrete is therefore central to this equation."

With the recent Concrete Manufacturers Association (CMA) Awards – of which PPC was a sponsor – showcasing effective and inspired use of concrete as a medium, Odendaal emphasises the importance of user groups working together to leverage efficiencies in order to ensure collective sustainable use. "This year's CMA Award winners once again demonstrated the benefits of concrete per user group, and how greater interdependence between these can facilitate meaningful sustainability.

"In the case of architects as a group for example, concrete offers a dramatic range of colours, finishes and unlimited design possibilities, difficult to match in other materials. At the same time, it allows structures to be created that provide superior environmental and energy performance," he notes.

Developers are similarly able to benefit from their use of concrete based on its first cost, long term economic benefits, energy efficiency, lower maintenance, and overall operating costs, as well as opportunities for future reuse should the occupancy of the building change.

"Again here, if various players in the collective value chain work together from planning through design and into development, it's relatively easy to ensure that the strength, durability and natural thermal mass of concrete can be harnessed to create structures that require little maintenance, offer high durability and have high operating energy efficiency."

Odendaal argues that value-adding partnerships will prove critical in order for this level of sustainability – and sustainable infrastructure development – to be realised however.

"For Africa to meet her collective development goals and needs, players will need to work as a collective. They will need to take a long-term view of projects in order to unlock economies of scale and sustainability at all levels – ensuring that the infrastructure they create puts society on the road to a sustainable future," he concludes. ▲

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ABOUT PPC LTD A leading supplier of cement and related products in southern Africa, PPC Ltd has four milling depots, nine ready mix batching plants and nine cement factories in South Africa, Botswana, Zimbabwe and most recently Rwanda with a current capacity to produce around eight and half million ton
s of cement products each year. As part of its strategy and long-term plan to more than double its business every 10 years, PPC is expanding its operations in existing markets and extending its footprint into the DRC and Ethiopia. The recent acquisitions of Safika Cement and Pronto Readymix (including Ulula Ash) form part of the company's channel management strategy for South Africa. PPC also produces aggregates, metallurgical-grade lime, burnt dolomite and limestone, with PPC's Mooiplaas aggregates quarry in Gauteng having the largest aggregate production capacity in South Africa.

A place to gather – Souk Waqif, Doha

Revived in the last decade as the social heart of Doha, Qatar, Souq Waqif, a historic shopping hub, is a must-see highlight of the city. There has been a souq on this site for centuries; the Bedu would bring their sheep, goats and wool here to trade, and the entire market area has been skillfully redeveloped to look like a 19th-century souq, with mud-rendered shops, exposed timber beams and some beautifully restored original Qatari buildings.

To provide parking for large numbers of visitors, an underground parking facility, located opposite the Msheireb, Downtown Doha, Qatar, became necessary. The design of the car park offered architects some extra space aboveground to facilitate place making - a collaborative process that shapes the public realm in order to maximise shared value. With this is mind, Dragana Lutic Djokic, Landscape Architect at Parsons Qatar, contacted Consent LLC (Terraforce Licensees in the UAE) in 2012, requesting an Amphitheatre design. Specifically, the engineers at Parsons were in search of a product that can be used both for retaining and seating purposes.

Consent subsequently proposed an arena design with the Terraforce 4x4 Multi Step Block, a light, dry-stack concrete unit, generally used for constructing low terrace walls, stairs and seating arrangements. Aimed at providing efficient and economical steps in conjunction with the original Terraforce retaining blocks, in this case the L16, they have become very popular (in South Africa and abroad) not only for stairway access, but comfortable, practical stair and seating arrangements at leisure amenities and school sports facilities.

Initially, Djokic specified another pre-cast system for the proposed Amphitheatre design, but after a presentation by Consent on the Terraforce 4x4 Multi Step Block and L16 retaining block and their colour options, the design was re-rendered with Terraforce blocks.

The final design, completed by Fred Laker of Terrasafe, Terraforce's international retaining wall design service, was approved by Parsons, and in October 2013. Approximately 5 100 no. 4 x 4 Multi Step blocks and 4 757 no. L16 blocks were used, and LED lighting installed at intervals for night time ambiance. ▲

PROJECT TEAM

Client:	Private Engineering Office (PEO)
Project Consultant:	JAIN Sustainable Engineering Solutions
Design Consultant:	Parsons, Qatar
Main Contractor:	UrbaCon trading and contracting
Sub-contractor:	Palmera Agriculture Business LLC
Wall design:	Terrasafe
Block Supplier:	Consent LLC

Concrete excellence abounds at Lafarge's Artevia™ awards

Lafarge South Africa awarded applicators and architects for outstanding use of the company's Artevia™ product at the 2016 Artevia™ Awards held in Sandton.

Artevia™ by Lafarge is a collection of decorative concretes for indoor and outdoor applications that combine freedom of design with low maintenance and durability. The product offers great aesthetics and outstanding performance, ideal for home owners, architects and landscapers alike. Artevia™ is more than just concrete. A beautiful design material with all the advantages on concrete, it is not only hard wearing but also long lasting. Available in an array of colours, patterns & textures, it brings any location to life with vibrant colour and realistic texture.

Architecture and design firm, Urbain McGee and grinding and polishing contractor, World of Decorative Concrete were the overall winners in the architect and applicator categories respectively. They each won R40 000 in travel vouchers.

Both companies won the awards for their involvement in the Smith Studio Project in Cape Town, a refurbishment of a 250-year-old neglected building. They used polished Artevia™ concrete to make the floor robust enough to handle ground water and achieve a high-gloss finish.

Nadine Engelbrecht Architects were awarded as the highly commended architect and Oceanside Trading were the highly commended applicators. All category winners were presented with R20 000 in travel vouchers.

General Manager of Readymix for Lafarge South Africa, Alta Theron, said the quality of entries "was truly exceptional, pushing boundaries, and made the job of our judges almost impossible."

"The Artevia™ Awards celebrate the finalists, semi-finalists and winners as a critical component of Lafarge South Africa's investment in people and in research and development. Without their brilliance, our determination to build better cities would remain nothing but an unfulfilled vision," said Theron.

Launched in 2009, the Artevia™ Awards take place every two years, and were sponsored by Lafarge South Africa in partnership with Chryso Southern Africa. ▲

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The other winners were:

Winner	Artevia™ product	Category
SAOTA	Exposed	Architect
Horticare	Exposed	Applicator
Nico van der Meulen Architects	Polished	Architect
Ocean Trading 49	Polished	Applicator
Alternative Concrete	Print/Colour	Applicator

Reanne Urbain of Urbain McGee (L) and Johan Coetzee of World of Decorative Concrete (R) receiving award from Alta Theron, Lafarge and Norman Seymore, Chryso Southern Africa.

Smith Street Studio, Cape Town: winner in the Architect and Applicator categories.

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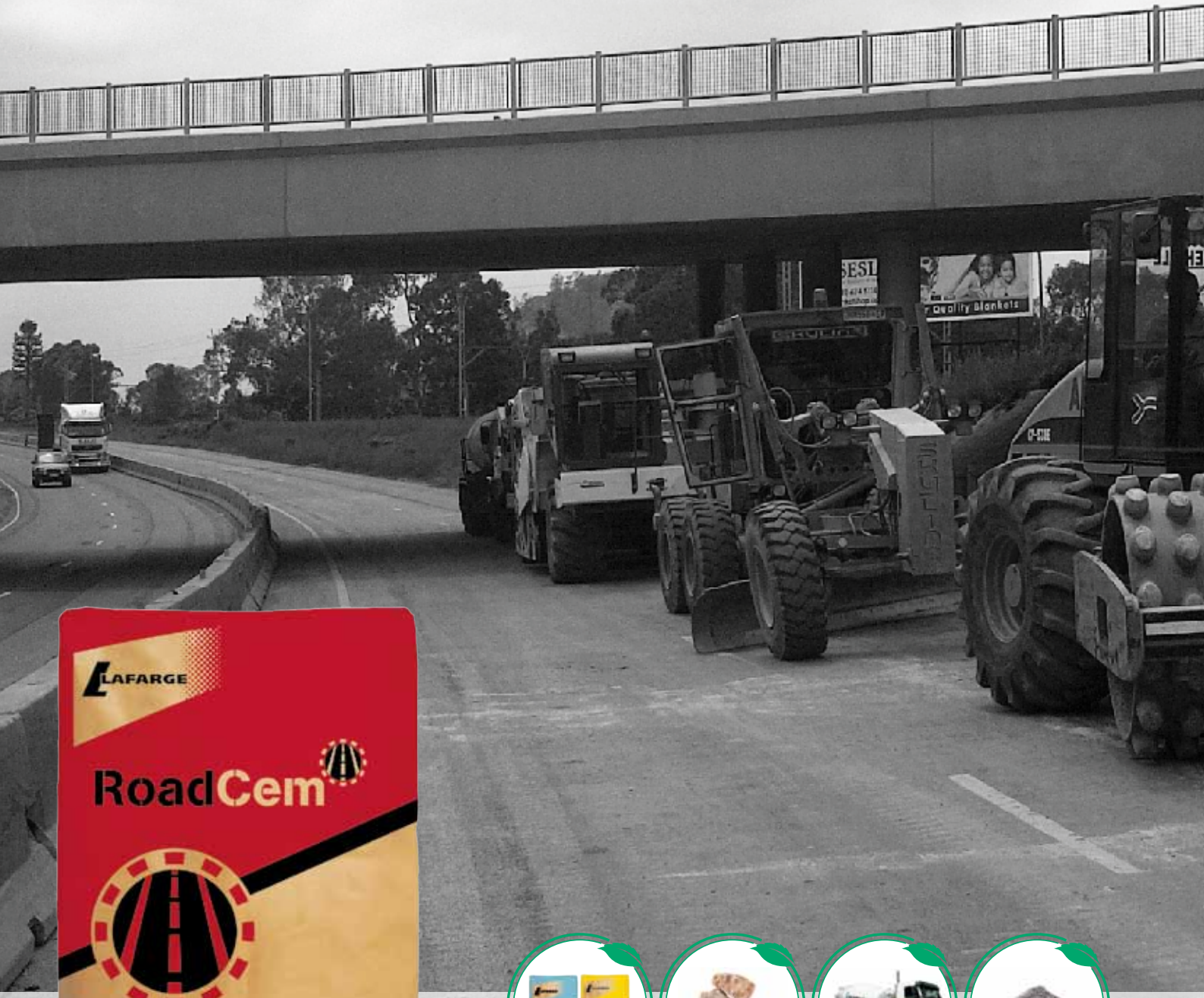

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Pulling out all the stops on road build

While quality of materials is a prerequisite for any construction project, it is also the ability to guarantee an interrupted supply of cement that has proved to be a major competitive edge for AfriSam on recent road overhaul projects in the Free State.

The largest building materials producer in South Africa has supplied cement for stabilisation activities on three South African National Roads Agency Limited (SANRAL) projects in the province.

This includes the more recent order for 20 000 ton of cement by Raubex Construction which is upgrading the National Route 1 from Sydenham (km 28.8) to Glen Lyon (km 62.4) in Bloemfontein.

Raubex is working with Roadmac Surfacing on this heavy upgrade, which will prolong the life of the road by up to 20 years. Raubex is building the pavement, while Roadmac Surfacing is handling the bitumen-treated-base (BTB) course as well as the surfacing components of the works.

As such, the sub-base component of the project is absolutely critical to Raubex. And Johan Acron, the company's contracts manager on this project, is impressed by the consistent supply of quality cement the

Raubex is stabilising the sub-base to a depth of 350 mm with AfriSam's Roadstab 32.5N CEM ii B-L cement.

Raubex Construction is upgrading the National Route 1 from Sydenham (km 28.8) to Glen Lyon (km 62.4) in Bloemfontein.

Affordable houses built with precast products

With affordable housing backlogs growing, developers are increasingly turning to precast concrete products to speed-up construction times while improving build quality of houses.

Affordable houses today can be built almost entirely from easy-to-use precast materials from hollow-core floor slabs, to walls and roof tiles. Depending on requirements many peripherals such as stairs, window sills, basins, counters and other precast units are adding value to the houses and lending a quality touch.

Frans Minnaar, director of the Concrete Manufacturers Association NPC (CMA), also points to precast concrete products as a means of ensuring quality materials and preventing costly repairs and rebuilds. Due to skills shortages on the ground, contractors realise that the best way of ensuring quality construction is to have units precast in a factory under controlled conditions and more easily assembled on site.

Material of choice

"Whether it be hollow-core floors mated to tilt-up walls, or large masonry units that reduce brick-laying requirements tenfold, there are solutions that work. Then there are age-old traditional building products such as concrete bricks (masonry units), wall tiles, lintels, beams and a myriad of other concrete products that are commonly used throughout the construction phase.

"When one looks at adjoining infrastructure and service it is also clear to see how precast concrete simplifies construction from pipes, drains, paving and kerbs, to lamp posts, fences and retaining walls. There is hardly a single area of construction that does not benefit from factory, mass-produced concrete products".

"Imagine a contractor sitting on the side of the road trying to in-situ cast kerb stones? It will take days and then the mixes have to be thoroughly controlled and flow of traffic and pedestrians will have to be stopped. Thanks to precast kerbs the unit is simply lifted into

Hollow-core floor slabs

construction team is receiving from AfriSam. He says this has definitely helped Raubex forge well ahead of schedule on the works programme.

The supply of cement on all three of Raubex's recent projects in the province has been managed by AfriSam's Stefan Roos who ensures that two loads of cement, each comprising 1 440 bags, are delivered to the site every day.

This cement is delivered from AfriSam's depot in Bloemfontein. It is located a mere five kilometres from the construction site, and receives a regular supply of the material by rail from the company's Ulco clinkering and grinding operation in the Northern Cape.

As Roos notes, should an emergency arise, the cement producer can guarantee that it will have cement on site within an hour.

The first loads arrive at 04h00 in the morning, and sub-contractors start unpacking and spreading the cement, ahead of the stabilisation operations.

The sub-base is an essential component of the high specification road infrastructure, which also comprises a 120 mm thick BTB layer. Work starts with the measurement of the natural ground levels, followed by the milling of 50 mm of the base of the existing pavement. Raubex is stabilising the sub-base to a depth of 350 mm with AfriSam's Roadstab 32.5N CEM ii B-L cement. Some 20 000 tons will be used on this project.

On two of these contracts, Raubex used mechanical spreading, a service that is also supplied by AfriSam. However, on this contract, it has opted for manual spreading practices to meet SANRAL's objective of developing small, medium and micro enterprises on all of its builds.

While building activity may have slowed down in Bloemfontein, Roos remains optimistic about the future. He definitely has reason to be, considering the growth the city has enjoyed over the past few years, and the infrastructure needed to support this. ▲

place, grouted and is ready to use in a matter of hours. The same applies to houses now, and progressive developers and contractors have already adopted precast products and are using them widely on their construction sites," says Frans.

Built right

He adds that buyers also prefer houses built from precast concrete products because they are straight, structurally sound and can be made to be virtually maintenance-free, requiring no plastering or even painting, if units are coloured with pigments during the casting process. Shorter delivery times also mean that buyers have shorter waiting times which can dramatically improve their satisfaction level.

The CMA is actively involved with all sectors of the construction industry, as well as Government, developers and contractors. To facilitate better quality housing, the association publishes pre-approved housing plans, which can be downloaded and adapted to meet developer's or buyer's requirements. The plans meticulously document all the materials required to build the house, as well as highlighting applicable SANS specifications and make allowance for local by-laws to be incorporated into the final build.

Various technical publications are available from the association. To find out more about precast concrete building solutions or precast products visit the association's website www.cma.org.za ▲

Contact: Concrete Manufacturers Association, Frans Minnaar, Executive Director Tel: (011) 805 6742, Email: director@cma.org.za, Web: www.cma.org.za

A novel chute system has allowed the contractor to do away with a mobile crane and boost productivity.

Bolstering resources on the site has seen the contractor exceed its initial production requirements.

Easy going between a rock and hard place

Working next to the main haul road of a well-known iron ore mine and sequencing construction activity around its blasting programme are just two of challenges Murray & Roberts Infrastructure has to overcome on one of its current contracts.

However, this leading South African construction company, which forms part of Murray & Roberts Construction, has ample experience working in mines' "red zones" in the Northern Cape, South Africa. Since 2005, it has earned itself an enviable reputation for being able to deliver quality infrastructure in these demanding environments. This includes at Kumba Sishen iron ore mine, where it has been involved on a number of projects.

The latest contract at this mine is the relocation of a section of the G80 canal and its related infrastructure. It forms part of Kumba's environmental management plan for Sishen, with the canal used to collect run-off surface water to be reused elsewhere in the operation.

Tiaan Krugel, contracts manager of Murray & Roberts Infrastructure, says the concrete-lined canal is 4,6 km long, with the width of its base varying between 2 metres to 3 metres. Connected to the build is a gravel road running alongside the canal over three newly-constructed cast in-situ culverts. A steel water pipeline is also being laid along the length of the canal.

Blasting at the mine takes place twice a week. When this happens, the contractor has to evacuate the site before 12h00, denting its production scheduling. "We initially planned to achieve a production target of 150 metres a week. Although we were aware of the blasting scheduling when we tendered, it took us a bit longer to achieve the desired level of production," says Krugel.

An additional 32 workers were introduced to the existing team to make up for lost time when blasting was done - a very effective strategy with production peaking at about 183 metres a day.

Working next to the primary haul road means that there is a lot of interfacing with the mine on this project, calling for careful planning. While processes such as these can be managed, the Murray & Roberts Infrastructure team also had to be prepared to think on its feet to cope with unforeseen events.

Such an event occurred, when a crack formed in the pit high wall alongside the canal and prevented further construction of the canal for approximately 950 metres. The contractor only regained access to this portion six months later.

Its ability to think outside of the box came to the fore again when it introduced a novel chute system to place concrete in sections of the drain that are deeper than 2 metres and beyond the reach of a readymix truck. The polyvinyl chloride chute allows teams to dispense concrete directly from the truck, doing away with the need for a mobile crane and therefore boosting productivity.

Jerome Govender, executive chairman of Murray & Roberts Construction, says work is expected to be completed in May 2016, when the entire team will mobilise to another project to commence work on a new road construction project. He adds that given the position of the work in a mining environment, he is extremely pleased that the project's safety performance has been excellent with zero lost time injuries experienced. ▲

Spalled Concrete falling from Motorway Bridge

In this regular section of Concrete Beton, we feature concrete-related, confidential reports emanating from the Structural Safety organisation* in the UK, represented in South Africa by the joint Structural Division of SAICE.

It has been reported that an incident occurred at a motorway overbridge resulting in a piece of spalling concrete falling onto the carriageway and striking a vehicle. This resulted in minor injuries to the driver. It is understood that the concrete which fell was no greater than 50 - 60 mm in size.

It had spalled from an area of previously repaired concrete on the cantilevered deck soffit located over the carriageway and resulted in closure of the motorway for 3 hours. During closure an initial Special Inspection of the structure was undertaken and other areas of potentially loose concrete were removed.

Subsequently a full review of all the structures on both carriageways of this section of the motorway was carried out and a risk mitigation plan established based on a programme of special inspections to identify areas of concrete with potential to spall. This was developed into a programme of ongoing inspections and concrete removal to manage the risk of further such incidents.

Risks will be managed further when planned substantial concrete repair works are undertaken over the next two years as part of an upgrade scheme.

The following have been identified as contributory to the concrete spalling incident:

- Corroding reinforcement as a likely consequence of poor design detailing and quality of construction (reinforcement with low concrete cover in close proximity to a drip detail and relating to the date of original construction in 1962).
- The poor quality of the concrete repair carried out around 2008 (likely poor detailing with feathered edges to the repair, poor adhesion combined with repair material not being anchored around adjacent reinforcement). In addition, there was a lack of as-built information relating to the repair.
- A recent Principal Bridge Inspection had not included a close examination of the elements of the structure above the relevant lane.

The following lessons learned have been identified:

- The need for a good quality of design and construction to provide a safe and durable structure.
- The need for quality concrete repairs to be undertaken in accordance with current good practice and as-built details recorded.
- The need to undertake Principal Bridge Inspections strictly in accordance with current standards and with particular emphasis on a close examination of the elements of the structure. ▲

** If you found value in this material, please consider submitting issues that you have come across, such that others may, in turn, benefit from your experience. This is done through Confidential Reporting on Safety (CROSS) at www.structural-safety.co.za*

COMMENTS

This is an important report from a major infrastructure owner and is most welcome as the lessons learned from a potentially serious incident are being shared. It highlights the importance of design in its widest sense and not just numerical code compliance. It is also a reminder that all structures deteriorate in use and inspections are required to look at how degradation is progressing and to be alert for the likely implications. However, the remedial works were carried out only seven years ago which is not a long life span for safety critical repairs.

Report Back: Recon 2016

ReCon 2016 was the first national seminar of the year and attracted a wide range of delegates from the built environment sector including engineers, contractors, concrete product manufacturers, material suppliers and more.

The event was held in Somerset West, Port Elizabeth, Durban and Kempton Park.

The seminar focused on re-using, reducing and recycling concrete and looked at the topic holistically, covering the status quo in South Africa, a view of the European situation as far as recycling concrete aggregate was concerned, demolition waste; machinery used for recycling, what the local readymix industry is doing on recycling wet concrete, hardened concrete and waste water; current research initiatives and some case studies.

From comments made by delegates and the speakers, it is believed that the content was relevant, useful and up-to-date. The presentations given were:

- **Myths and truths around concrete recycling** – Bryan Perrie/John Roxburgh, The Concrete Institute
  This covered an overview of the reasons why recycling is becoming so necessary, what prognosis might be if the industry does not adopt recycling and some of the myths and truths that prevail. These were quoted as being:

  Myths
  - Concrete cannot be recycled
  - Recycled concrete cannot be used in structural concrete
  - It is not possible to recycle high rates
  - Recycling will reduce carbon footprint
  - Recycled aggregate is more expensive

  Truths
  - Cement cannot be recycled
  - Demolished concrete is inert
  - Recycled concrete can be better than virgin aggregate
  - Using recycled concrete reduces land-use impact
  - Recycling will not meet aggregate needs

  Following a description of the some of the many applications to which recycled concrete can be put, the speaker concluded by stating that:
  - There are significant benefits to recycling concrete
  - For high volume usage, there is a need for good controls and site sorting
  - The industry needs legislation regarding construction and demolition waste in landfills
  - There is a need for the design of new buildings to consider reuse and recycling

- **A secondary materials economy in construction and demolition waste - opportunities and challenges in concrete** – Kirsten Barnes, GreenCape
  The speaker began by describing who GreenCape were and their role in the industry. GreenCape is a sector development agency of the Western Cape government – their mandate being to stimulate the green economy in the Western Cape, with all activities externally funded (at no cost to industry). They also explore the national context, and assist with networking in other provinces where possible.

  The presentation described the main drivers of a secondary materials economy:
  - Increasing cost of virgin materials
  - Siting new quarries
  - Regulation of waste flows through national, provincial and local legislation
  - Landfill space – heading for a crisis

  A brief look at matching the quality of secondary materials with applications, such as backfill, which can just be highly mixed rubble, to re-concreting.

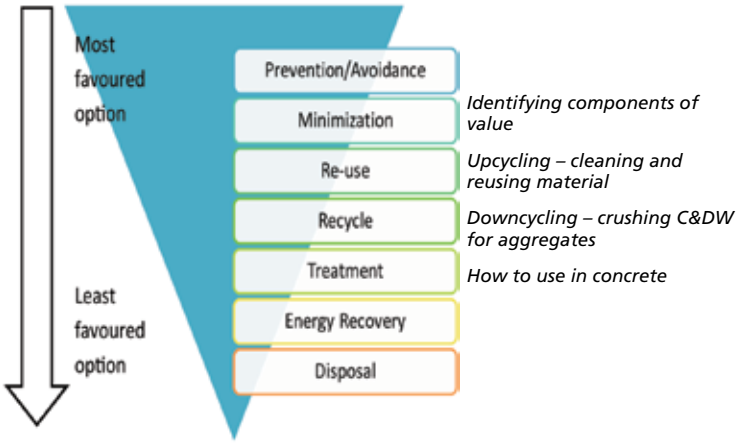
  Re-concreting is the highest value application, but is the lower volume opportunity and seems to have more barriers to uptake than aggregate for construction foundations and roads. The trend is the same globally, with re-concreting a relatively late developer in the growth of a secondary material economy.

- **Sustainable concrete, the European experience** – Mark Tomlinson, LafargeHolcim Group
  This guest speaker from overseas presented some insight into the recycling activities by some European countries. It was reported that recycling rates in the EU range from around 10% in Spain, whilst the Netherlands is achieving more than 90% recovery rate.
  In the opinion of the presenter the concrete industry needs to improve its sustainability credentials, and the development of recycled concrete is a viable way of achieving this. Recycling can lead to higher profitability through additional revenue and logistics cost savings. It improves resource efficiency and generally improves the competitiveness of concrete (competing materials such as timber, steel and asphalt claim 100% recyclability).
  The speaker then went on to report on two research projects currently under way in France. Firstly - Recybéton, with the objective of reusing all the materials obtained from demolished concrete, even the fines, as components of new concretes, and to recycle the fine grain size part of demolished concrete as raw material for the manufacture of cements (either to produce clinker or as an addition into a blended cement). The research programme is scheduled to be complete by mid-2016.
  Secondly - the HISER project (Holistic Innovative Solutions for an Efficient Recycling and Recovery of Valuable Raw Materials from Complex Construction and Demolition Waste). The main objective here is to develop and demonstrate novel, cost-effective holistic

solutions (technological and non-technological) to increase the recovery rates from increasingly complex Construction and Demolition Wastes (C&DW), according to the principles of circular economy approach throughout the whole value chain in the construction sector.
The proposed solutions will be demonstrated in 5 case studies across Europe (Belgium, The Netherlands, Spain, France and Finland) in demolition and recycling projects. Moreover, economic and environmental impact of HISER solutions will be quantified from a viewpoint of lifecycle (LCA / LCCA), and recommendations for European standardization policies and standards for the implementation of the best solutions, will be proposed.

- **Using Recycled construction waste in concrete – a sustainable approach to conserving aggregates through the use of excavated sand, recycled bricks and recycled concrete** – Vernon Collis/Kyle Wickins, Collis & Associates
The speaker outlined the various types and status of construction and demolition waste (C&DW) material, particularly in the Western Cape. Landfills were reaching capacity and moving further from the city in the Cape, and there were dwindling pit sand sources in the region.
Results of extensive testing carried out by a Masters student at UCT on site-derived sands were described, and turning this material into a valuable resource was discussed. Several case studies were portrayed utilising these materials and emphasising the need for a different approach to design – i.e. materials first, design second.

A very interesting graph was then shown explaining recycling C&DW in the waste hierarchy – see below:



- **Manufacturing quality green, environmentally friendly concrete products: a case study** – Anthony Gracie, Cape Brick
This was a fascinating look at recycling in practice by this company which started processing and using their first recycled aggregate in 2000. In 2001 they ran out of waste and then partnered with a demolition company to import demolition material.
Up until the present they have used almost 1 million tons of recycled concrete aggregates in their products, processing around 400 tons per day in the manufacturing process.

GALLERY

Dr Kirsten Barnes

Mark Tomlinson

Bryan Perrie

Shane Clark

Anthony Gracie

Vernon Collis

Johan van Wyk

The concrete and rubble from the demolished Athlone Cooling Towers in Cape Town were used as material for Cape Brick's green products.

Delegates were exposed to the challenges, in some detail, that were faced when sourcing external material, such as:

- The make-up of the material
- Varying types of materials
- Contamination
- Cost versus benefit
- Constant availability
- Material size
- Space to store material
- Local authority issues (waste licences, etc.)

Following a comprehensive description of the block-making manufacturing process, the speaker summarized his presentation with the following checklist:

- Make sure you get the right material
- Crush it properly
- Separate the fractions
- Wet the raw material
- Batch it accurately
- Cut down the variables in the manufacturing
- Employ good "in process" quality controls
- Cure the product properly
- Learn from your mistakes

- **Equipment for recycling: an overview** – Shane Clark, Infinite Group

This presentation comprised a holistic study of the various processes used to create demolition waste – i.e. through explosive, chemical, hydro, cutting or mechanical (everything from a swinging ball to a 'Mega Muncher') methods.

Details of the various items of equipment were shared together with the features and benefits of each machine. Various pros and cons of using each method were discussed, depending upon the important things to consider such as location, time, cost, penalties, etc.

The Mega Muncher

Moving on to the recycling of concrete the speaker provided an insight into a specialised mobile crusher that is currently available for producing a very high classification material. It features a small single stage jaw crusher, a magnet for removing steel, a spray nozzle to reduce dust and an on-board weighing machine. It is hydraulically adjustable, lighter and easier to transport and does not require abnormal load permits. The presentation concluded with a case study demonstrating the features of this unique machine.

- **Recycling opportunities in the ready-mixed concrete industry** – Johan van Wyk, Southern Africa Readymix Association
The focus here was on current practice within the southern African readymix industry when it comes to recycling water, fresh concrete and hardened concrete.
The speaker explained how typically a readymix plant would recover its 'grey' water and citing South African specification SANS 51008:2004 Clause A3, which states the limitations on the use of water recovered from processes in the concrete industry. He then described the various tests that are carried on the recovered water, to ensure that good concrete is produced from its use.
Recycled fresh concrete is used for either moulding (into concrete products), paving, redirecting or recovering aggregates. Recycled hardened concrete is used for recovering aggregates through chemical addition. The chemical is added to the truck, agitated and then the mix spread open. The concrete is turned in 24 hours, and can then be used in new concrete.
This type of recovered aggregate can increase strengths, due to the improved inter-facial zone. Recovery can also be achieved by washing out the aggregates. The aggregates can be screened into fractions for use in new concrete batches.
In producing new concrete using recycled materials careful attention has to be paid to grading of the aggregates, replacement rates, mix design and quality/consistency.

Question times in most venues were very vigorous and interactive which clearly illustrated the interest in the subject matter.

Thanks were expressed to Lafarge South Africa as the main sponsor for the national seminar, and to others sponsors at the various venues around the country, namely:

BASF, Chryso-abe, The Concrete Institute, Mapei, PPC, SIKA

Thanks were also expressed at each venue to Natasha Pols and Marike van Wyk from Head Office for organizing such a professional and smooth-running event. ▲

Fulton Awards 2017: Celebrating Excellence and Innovation

The Concrete Society of Southern Africa NPC is calling for nominations for its prestigious biennial Fulton Awards which recognise and honour excellence and innovation in the design and use of concrete.

The awards continue to celebrate the legacy of scientific and technological advances in concrete within the built environment, and the late Dr. 'Sandy' Fulton's life and achievements in the industry.

The 2017 awards take on a new look with brand new categories, and a new approach to judging, and the Society is proud to announce that PPC are, once again, the Anchor Sponsor for the Awards.

According to the John Sheath, CEO and Director of the Concrete Society, after more than 30 years of the Awards' existence, some serious updating was required in terms of both the criteria for adjudication of the entries and the entry categories themselves, many of which had been in existence for the lifetime of the awards.

"We had drifted away from identifying all that was special and exceptional in the concrete, Sheath said, "and in the opinion of the Fulton Awards Committee, we were focusing too much on the total project on hand, considering aspects that had little to do with the material".

So, irrespective of category, the criteria for adjudication that the judges will be using are:

- Quality of concrete – focusing on finish
- Sustainability – green building initiatives
- Inventiveness/innovation in the application of concrete technology
- Innovation in concrete construction methods
- Innovative geotechnical use of concrete
- Overall aesthetic impact of the concrete aspects of the structure
- Rationale behind the chosen concrete finish
- Standard of workmanship of the concrete
- Effect of the concrete on the architectural landscape and environment

Some unique criteria will apply to the Innovation in Concrete category:

- Significance of the use/application of the innovation
- Industry need for the innovation
- Does it address or contribute to sustainability issues?
- Will it make concrete more competitive and therefore, grow the market?

Fairscape Precinct, Botswana – a 2015 Fulton Award winner

The procedure for nominations has also changed. These can be made on-line through the Society's website and will require a short motivation as to why it is felt that the nomination is worthy of an award. The judges will assess these nominations and a short-list of entries will be drawn up for subsequent adjudication on site.

The deadline for nominations to be made is 31st August 2016, while the completed Entry Packs have to be submitted by the end of November 2016. The Award winners will be announced at a special gala weekend to be held in Drakensburg from 2nd to 4th June 2017.

Full details of the 2017 awards are available on the Concrete Society website at www.concretesociety.co.za ▲

Contact: John Sheath, Tel: 012 348 5305 Cell: 083 309 4254
E-mail: ceo@concretesociety.co.za

The new categories for 2017 are:

CATEGORY TITLE	TYPICAL EXAMPLES
Buildings up to 3-storey	Residential, schools, commercial, factories, warehousing, industrial, etc.
Buildings more than 3-storey	Office building, multi-family housing, etc.
Flatwork	Slabs, paving, hardscape, etc.
Infrastructure	Bridges, roads, water resources, marine structures, power, transportation, etc.
Innovation in Concrete	Initiatives where totally new materials, techniques, technologies, applications, designs, and/or concepts, using concrete as the principal material have been developed or utilized.
Architectural Concrete	Use of concrete as the principal construction material, demonstrating a unique and exceptional structure, surface finishes or particular detail, in an aesthetic manner
Mining	Special or unusual concrete applications within the mining sector, both above and below ground

Tribute to Jim Horton

Jim Horton, an active member of the KwaZulu-Natal Branch of the Concrete Society and stalwart in the concrete industry, sadly passed away on the 15th April, 2016 following a struggle with leukaemia. He is survived by his wife Anne, his son Chris, daughter Jenny and three grandchildren.

Jim was born in Wellington, Shropshire, England in 1947. At the age of 7 the family emigrated to the then Rhodesia where he was educated at Cecil Rhodes and Chaplin Schools in Gwelo. After his parents divorced in 1963, he and his mother returned to England where Jim continued his education at Rugby.

He met Anne in 1966 and they were married in August 1968. Their son Chris was born in 1971 followed shortly thereafter by Jenny in 1972.

Jim worked at the Rugby Portland Cement Company as assistant works chemist, R M Douglas in Birmingham as Senior Materials Engineer and then Steetley Dennif, a construction company as Regional Technical Manager.

In 1974 the family decided to emigrate to South Africa travelling by sea aboard the Union Castle Line vessel – Windsor Castle. Jim joined Roberts Construction Natal as an Engineer in its Specialist Services Department. He took over the department in 1980, when all forms of concrete technology were handled, as well as specialised contracts in repair works, stressing, pre-casting, joint cutting and sealing, coring and research.

In 1984 Jim left what was then Murray & Roberts and started his own business, Tricee, with Richard Robinson. This was a highly successful move. In 1994 he was honoured by the Institute of Concrete Technology in the UK by being made a Fellow of the organisation. At the time there were only 28 such Fellows in the world, and he was the first person in South Africa to have achieved this status.

Out of this business was born Concrete Technology Services, now called Contest, which has become a leading service provider in the field of concrete technology and testing - a fitting legacy from this great man.

Jim was the epitome of a true concrete man – passionate, dedicated, knowledgeable and thoroughly professional. We salute you Jim – may you rest in peace! ▲

New Office Bearers for the Concrete Society

The Concrete Society of Southern Africa's Annual General Meeting was held recently and new Office Bearers were announced for the 2016/17 term.

Incoming President Hanlie Turner was presented with the official chain of office by outgoing President Retselisitsoe Maliehe. In making the presentation he told members that he was confident that the Society was being placed in good hands under Hanlie's leadership, guidance and enthusiasm for all things concrete.

Outgoing President with the new President

Hanlie who is a Technical Information Specialist with cement company PPC, has been a member of the Concrete Society for many years. She has held several voluntary positions in the organisation, including Committee Member and Chairperson of the Inland Branch and, more recently as National Vice-President.

In accepting the chain of office, Hanlie said that she was honoured to accept the responsibilities that went with it and, at the same time, thrilled that in some small way she is a part of the industry that shapes our skylines and in many aspects defines our civilization.

Francois Le Roux – new Vice-President of the Society

Vice-President

The newly-elected Vice-President of the Concrete Society is Francois Le Roux, Technical Director with Nyeleti Consulting, Pretoria. To be part of the Society follows naturally for him as concrete and materials are the areas of engineering he is very passionate about. He sees the Concrete Society growing in the future as innovation and technology in the field of concrete is ever-growing to meet the needs of our industry.

Board of directors

Also announced at the AGM were the members of the Board for the next 12 months (bearing in mind that as non-profit organisation, one-third of directors have to step down each year):

Office Bearers: Hanlie Turner, Francois Le Roux, Retselisitsoe Maliehe

Non-Executive (elected): Mark Alexander (Prof) – University of Cape Town; Billy Boshoff (Prof) – Stellenbosch University; Roelof Jacobs – Lafarge South Africa; Peter Flower – City of Cape Town; Bryan Perrie – The Concrete Institute

Executive Director: John Sheath – Chief Executive Officer

The Society is in good hands! ▲

Launch of the Unit for Construction Materials

"We are like concrete," said Prof Billy Boshoff at the official launch of the Unit for Construction Materials in the Department of Civil Engineering, Stellenbosch University. "Concrete consists of different materials, some more expensive, some unpredictable, but together they make concrete. No ingredient is more important than the other one, because if you take one ingredient out, the concrete will not work." Hereafter he acknowledged all present - individuals, institutes and industry - for their important roles in the Unit.

The UCM strives to be a centre of excellence and a top institute for construction materials in South Africa for teaching, research and consulting. Research and student training are at the core of the UCM. During his speech, Prof Boshoff highlighted the importance of industry collaboration and partnership.

Special emphasis was put on the fact that research must have both academic value and relevance for the industry in the short or long term. Providing a consultation service to the industry, especially where these services are not available at commercial laboratories, is also a high priority for the UCM.

From the left: Dr Riaan Combrinck (UCM), Prof Eugene Cloete (Vice-Rector Research), Prof Billy Boshoff (Head UCM and past president of the Concrete Society), Ms Wibke de Villiers (UCM) and Prof Hansie Knoetze (Dean: Engineering).

The UCM is interested in all aspects of construction materials, but the four main areas of the current focus are:

- Eco-friendly construction materials
- Fibre reinforced concrete
- Fresh and young concrete
- High performance concrete ▲

More information about the UCM can be found at www.sun.ac.za/ucm or bboshoff@sun.ac.za.

Facebook for Western Cape

The Western Cape Branch has recently launched their own Facebook page, their aim being to:

- Provide members with instant access for local events
- Feature photos from events, uploaded live as they happen
- Update event information for their local members
- Obtain more involvement in the branch
- Build brand loyalty

Says Jan Ellis, Branch Manager, "Our primary focus is to gain more exposure of our local events and membership - particularly to the more "IT savvy" generations. This is a key unique selling point for Facebook - it is locking into audiences which would otherwise not tapped into by just using the website".

John Sheath. CEO of the Concrete Society says that the vast majority of Facebook users are accessing the site via their mobile devices – in fact, many of them only with a mobile device.

"As this trend grows," he says, "it becomes more and more important for businesses and associations to have a presence on Facebook. The great thing about a Facebook page is that it does the 'heavy lifting' for you! -- optimizing your page for both desktop and mobile devices.

John maintains that the Society will eventually go national with a Facebook page, building on the projected success of the Western Cape initiative. ▲

Wedgewood Golf Estate, Port Elizabeth

On the 5th May the Eastern Cape Branch of the Concrete Society held its inaugural Golf Day at the Wedgewood Golf Estate, Port Elizabeth. The event was very well attended with 48 players taking part, taking in account that the branch only has a membership of 61.

Our Platinum members had an honorary place at the Golf Day by putting up banners at the Golf Club.

A big thank you and mention must also go to the following companies that sponsored prizes at the golf day:

Afrimat	Concrete 4U
AfriSam	Chryso
Avon	Hatch Goba
BASF	PPC
Billson Trucks	Sika

It was a fun-filled day and looking at the scoring, the Eastern Cape's construction industry definitely seems to spend a lot of time playing golf.

After the competition the players stayed for some very well deserved "light refreshments" followed by prize-giving and a sit-down meal. Patrick Flannigan, local Chairman welcomed everyone at the first golf day and encouraged all present to consider becoming members of the Concrete Society. Every player on the day received a prize.

The team from Afrimat was the well-deserved winner of the day with a four-ball alliance score of 99. They will be receiving a Floating trophy which will give them the bragging rights for a year. They have already committed to defend their title next year.

On the other end of the scoring the team from Chryso came in with the most golf, with a total score of 63. They have committed to do some practicing for next year.

Feedback from everyone involved has been very positive and this will now definitely be an annual event. ▲

New committee member for Inland Branch: Thabiso Maloa

THABISO MALOA was born in Louis Trichardt in Limpopo and matriculated from Eltivillas High School, Louis Trichardt in 2004.

She holds a B Tech in Construction Management (TUT) and a Diploma in Road Engineering (UP). Thabiso is currently completing her MSc in the Built Environment: Construction Project Management. She also holds a Corporate Business Diploma: Talent Management and Leadership from Gordon's Institute of Business Science.

Thabiso is currently a technical consultant at PPC Ltd having been with the company for 3 years. Prior to joining, she was with BKS (Pty) Ltd for five years as an Assistant Project Manager. She is currently busy with her reports for registrations in Engineering and Project Management professions, both to be completed before the end of 2016.

Her View:"...Our deepest fear is not that we are inadequate. Our deepest fear is that we are powerful beyond measure… Be Great". ▲

News from the KZN branch

It goes without saying that the passing on of Jim Horton on the 15th April was a sad moment for KwaZulu-Natal. A well-attended memorial was held on the 21st April hosted by Concrete Society KZN to honour and pay last respects to one of the concrete industry's giants. He is survived by his wife, son, daughter and 3 grandchildren. His legacy lives on through Contest, the company he built.

The Branch was invited by the Department of Works to attend the first meeting concerning the status of the current drought. The forum's main aim is to create awareness concerning the use of potable water and to collaborate amongst the industry's stakeholders to conserve current water resources. Certain short term interventions have been implemented and other long term developments are underway.

On a brighter note, the Concrete Society KZN committee are excited about hosting the "Concrete - Getting it Right" technical meeting on the 14th of June. The new half day format goes to show the innovative forward thinking of Concrete Society head office management and board members. We also heartily welcome Monika Clark who has volunteered to serve on our committee, exciting times lay ahead.

The last word - In today's times life in general may be somewhat overwhelming, but one sometimes has to take a step back and look at the bigger picture; seek opportunities to build relationships in our concrete community, there is wisdom in the counsel of many. ▲

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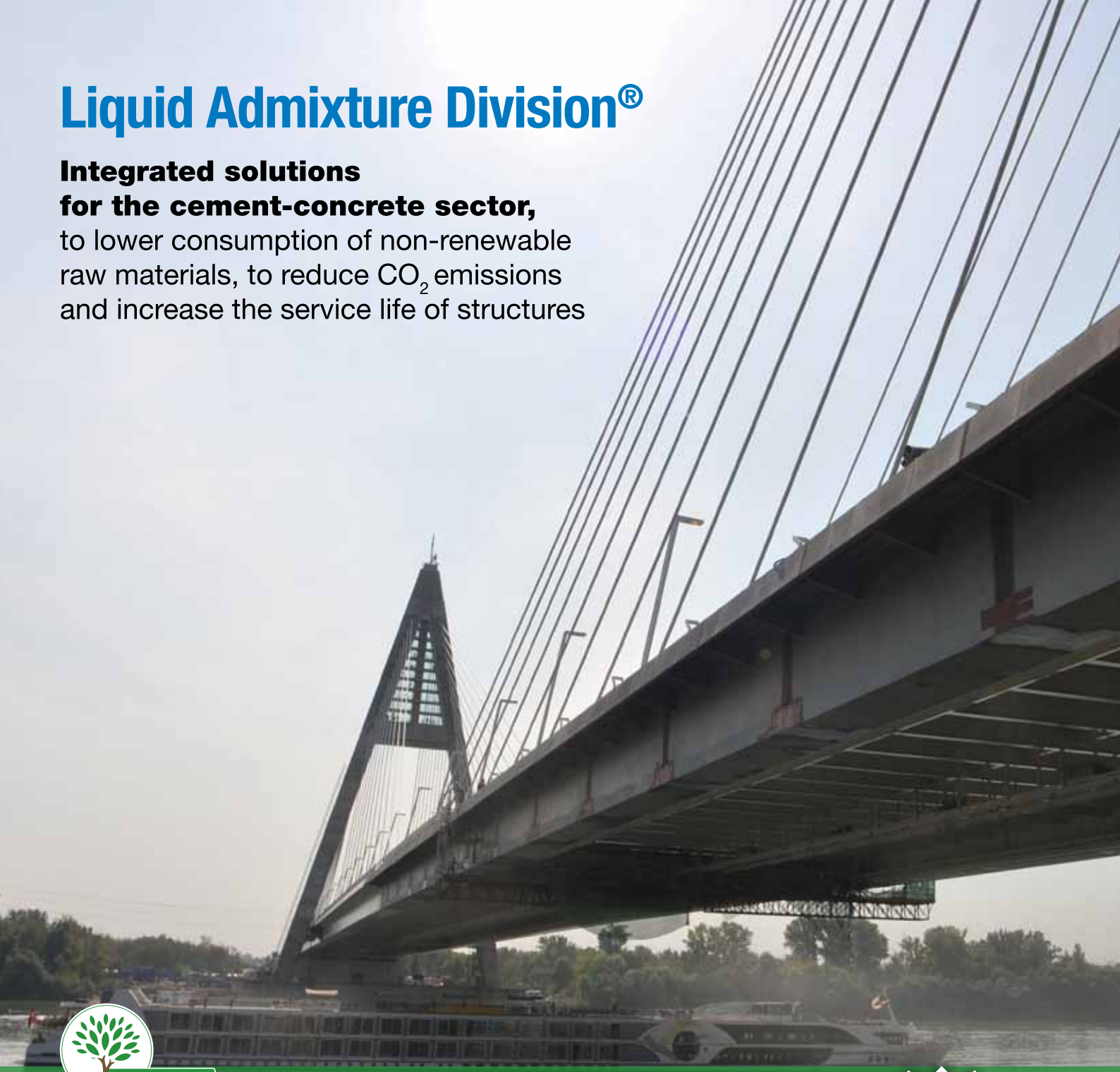

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INLAND BRANCH

DATE	MEETING/EVENT	VENUE	CONVENOR
21 June	Annual Golf Day	TBA	Johan van Wyk/Debbie Harvey
28 July	Technical Meeting	Nelspruit	Debbie Harvey/Kim Twiname/Natalie Johnson
26 August	Egg Protection Device Competition – Cast-In	NA	Jannes Bester/Johan van Wyk/ Kim Twiname
02 September	Egg Protection Device Competition – Cast-In	PPC Jupiter Works	Jannes Bester/Johan van Wyk/ Kim Twiname
08 September	National Seminar	Premier Hotel O R Tambo, Rhodesfield	CSSA Head Office
01 October	Annual Concrete Boat Race Day	Benoni Sailing Club, Homestead Lake, Benoni	Johan van Wyk/Michelle Fick/ Committee
03 November	Undergrad Research Achiever's Award	University of Johannesburg	Roelof Jacobs/Martin Dube/ Kim Twiname
18 November	Chairman's Breakfast and Annual Golf Day	TBA	Natalie/Johnson/Debbie Harvey/ Committee

WESTERN CAPE

DATE	MEETING/EVENT	VENUE	CONVENOR
23 June	MTM	TBA	Adrienne Taylor westerncapecssa@gmail.com
27 June to 1 July	Concrete Academy	UCT	Philemon Arito ARTPHI001@myuct.ac.za
28 July	Site Visit	TBA	Adrienne Taylor westerncapecssa@gmail.com
25 August	Site Visit to MTM	TBA	Adrienne Taylor westerncapecssa@gmail.com
22 September	Site visit	TBA	
October	Cube Crushing	TBA	
November	Annual Cocktail function		
	Committee Meetings are held the first Tuesday of every month	UCT	

EASTERN CAPE

DATE	MEETING/EVENT	VENUE	CONVENOR
June	MTM	To Be Confirmed	Patrick Flannigan/Fanie Smith
07 July	Technical Meeting - Concrete; getting it right	PPC Conference Venue	CSSA Head Office
21 July	Site Visit - Coega Habour	Coega Habour	Fanie Smith
August	Technical Meeting - Concrete Materials	George (Venue to be Confirmed)	Patrick Flannigan/ Fanie Smith/Meredith Jordan
8 September	Committee Meeting	Chryso (cnr Willow & Mimosa Roads, Lorraine)	Patrick Flannigan

NATIONAL OFFICE

DATE	MEETING/EVENT	VENUE	CONVENOR
June	Concrete Beton	Posted to All CSSA Members	CSSA Administration
07 June	Technical Meeting: Concrete: Getting It Right	Cape Town	Organising Committee
14 June	Technical Meeting: Concrete: Getting It Right	Durban	Organising Committee
23 June	2nd Board Meeting	Nkanga Lodge, Kempton Park	CSSA President
07 July	Technical Meeting: Concrete: Getting It Right	Port Elizabeth	Organising Committee
14 July	Technical Meeting: Concrete: Getting It Right	Johannesburg	Organising Committee
September	Concrete Beton	Posted to All CSSA Members	CSSA Administration
September	Technical Meeting: Concrete: Getting It Right	Cape Town, Port Elizabeth, Durban, Johannesburg	Organising Committee
20 October	3rd Board Meeting	Venue to be Confirmed	CSSA President
31 October	2017 Membership Renewals Notices	E-Mailed to All CSSA Members	CSSA Administration
November	Concrete Beton	Posted to All CSSA Members	CSSA Administration
30 November	2017 Fulton Awards: Entries Closing Date		Fulton Awards Committee

INTERNATIONAL

DATE	MEETING/EVENT	VENUE	CONVENOR
13 – 15 June	2nd International Conference on Concrete Sustainability (ICC16)	Madrid, Spain	David Frenández-Ordóñez
28 – 31 August	11th International Conference on Concrete Pavements (ISCP)	San Antonio, Texas	Leif Wathne
29 – 31 August	The 11th fib International PhD Symposium in Civil Engineering	Tokyo, Japan	Koichi Maekawa
12 – 14 September	ConSec 2016 – 8th International Conference on Concrete Under Severe Conditions – Environment & Loading	Lecco, Italy	Laura Losapio
21 – 23 November	Fib 2016 Symposium	Cape Town, South Africa	A/Prof. Hans Beushausen

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BRONZE

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