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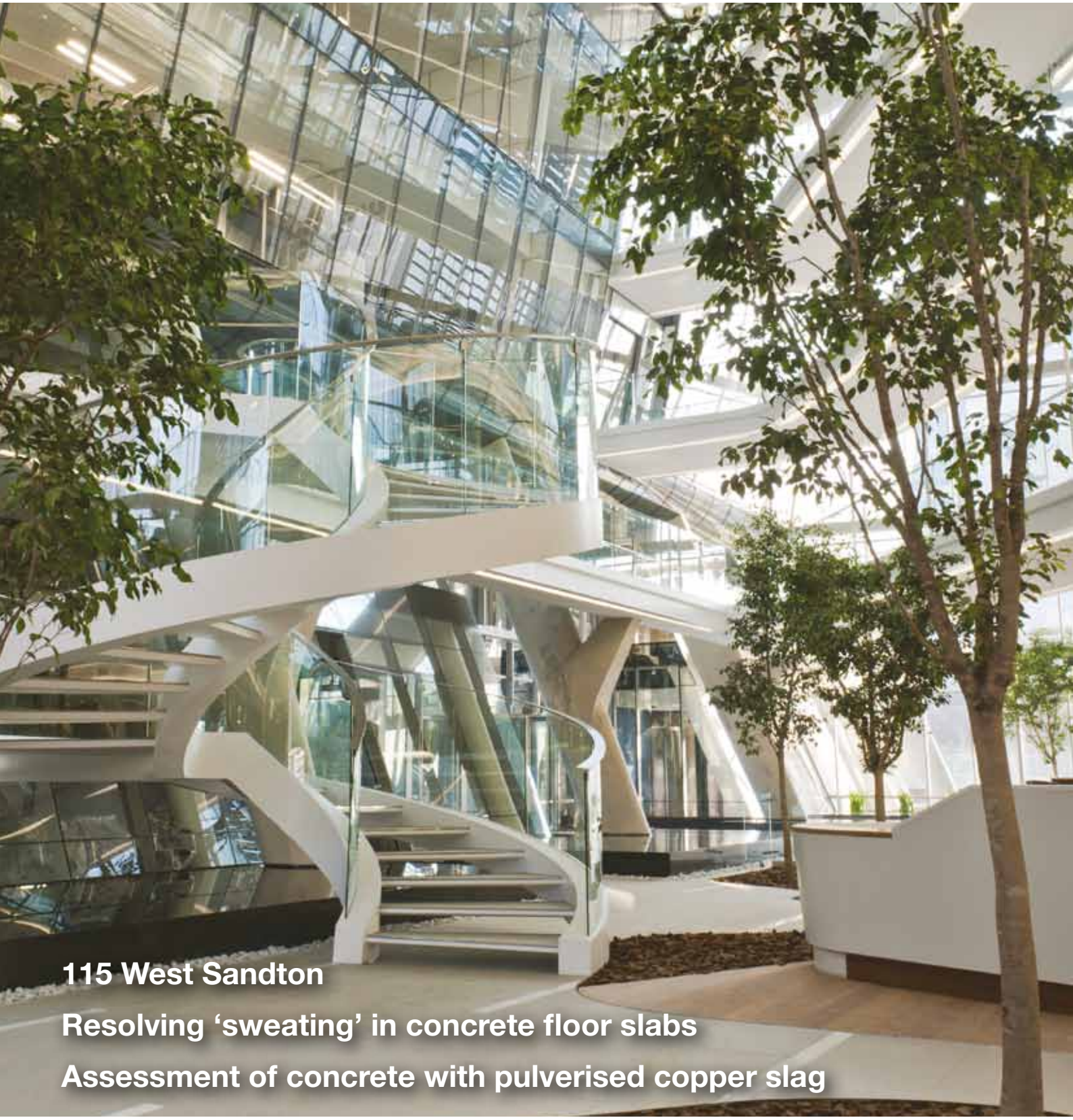
CONCRETE SOCIETY OF SOUTHERN AFRICA

CONCRETEBETON



115 West Sandton

Resolving 'sweating' in concrete floor slabs

Assessment of concrete with pulverised copper slag

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Cover: The Alexander Forbes Head office building in Sandton is one of the largest and most innovative buildings to be constructed in recent times. The project was awarded the Fulton Award for excellence in Architectural Concrete, and also received a commendation in the Building Structures category. The complex architecture was iconic and technically difficult, incorporating elements such as concrete double-storey raked columns and curves scallop walls.

Editor's comment

Our final, and bumper edition of Concrete Beton for this year, and I hope you all enjoy the contents. Thank you to all the members and other readers that have sent positive and constructive comments about our 'new look' magazine, and also to our advertisers for the tremendous support over the past year.

We will continue to strive for improvement, so please continue to send in your comments and suggestions on content and we will take these 'on board' and incorporate them where we can.

In this issue we bring you two accredited technical papers, one local (Part 1 of 2) and one international. Something we plan to feature on a regular basis, to bring you the very best in latest research and technology in concrete.

As we approach the time for members to renew their membership with us, I would like to appeal to the non-member readership of our magazine (on-line) to seriously consider joining the Concrete Society of Southern Africa.

We are a community of individual, like-minded professionals seeking to keep ourselves up to date with the latest technology and thinking in concrete-related matters, and the Society provides the perfect platform for networking and for the sharing of knowledge and information of concrete.

We also create business opportunities for our Company Members through exposure to the built environment and networking with industry decision-makers

Our membership includes engineers, contractors, suppliers, manufacturers and academia, so the spread of interest is wide, but all cement and concrete-related. Joining is easy – simply go to our website at www.concretesociety.co.za and click on 'Membership' where you can either download the application form, or complete and submit it on-line.

It just remains for me to wish everyone a relaxing an enjoyable summer break – and return safely, ready to take on the New Year which will, undoubtedly, bring its own challenges and successes.

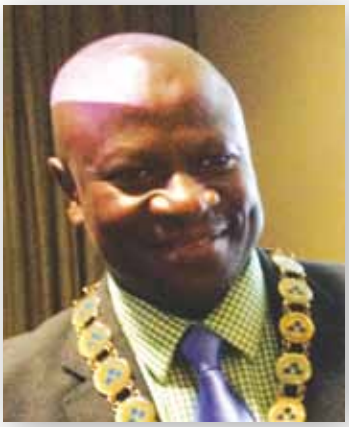
John Sheath
Editor

President's message

The year 2014 has been a very busy year. Fulton Awards nominations are now in and the countdown to the holiday season has begun. Let us reflect on the past year.

This year saw the launch of the Concrete Beton publication "in-house" and it has been a resounding success judging by the continuous feedback we have been receiving and its continued growth. Well done to the team, and if there are any suggestions or ideas to improve the publication, please contact our CEO and Editor, John Sheath.

A record number of nominations for the upcoming 2015 Fulton Awards have been received and by the time this issue reaches the members, most of the full entry packs would have been completed. Judging by the diversity and innovation in the use of concrete reflected in the nominations, we are looking forward to a very competitive, interesting and successful Fulton Awards 2015. This shows the passion and dedication of the owners, professional and construction teams involved in these projects. Thank you for all the nominations!!!!



President, Tseli Maliehe

Two successful roadshow seminars, ConSem 2014 and FloorSem 2014 were held in June and September respectively. The ConSem 2014 seminar covered the constituent materials used in the production of concrete and the latest developments and research in cements, cement extenders, aggregates, admixtures and specifications. In September the FloorSem 2014 seminar dealt with the industry hot topic of concrete floors and slabs on grade, covering aspects such as design, construction and latest developments in flooring systems. These seminars attracted a lot of interest with well over 200 delegates attending each seminar in the four venues around the country. Planning and preparations for the next roadshow seminar, RepSem 2015 that will be held early next year, are in full swing. RepSem 2015 will cover the fundamental principles and causes of deterioration in concrete structures, evaluation and measurements, and the practical strategies for repair and protection. This is yet another critical subject affecting the industry.

Finally, I would like to extend my gratitude to the CSSA board for their continued guidance in the first year of my Presidency, our CEO and Head Office staff for their diligence and hard work in raising and maintaining the profile of the CSSA, and a big thank you to our members for your continued support.

With this being the last publication of the year, I take this opportunity to wish you all a blessed holiday season, enjoy the read and God Bless!!!!

Yours Sincerely
Tseli Maliehe
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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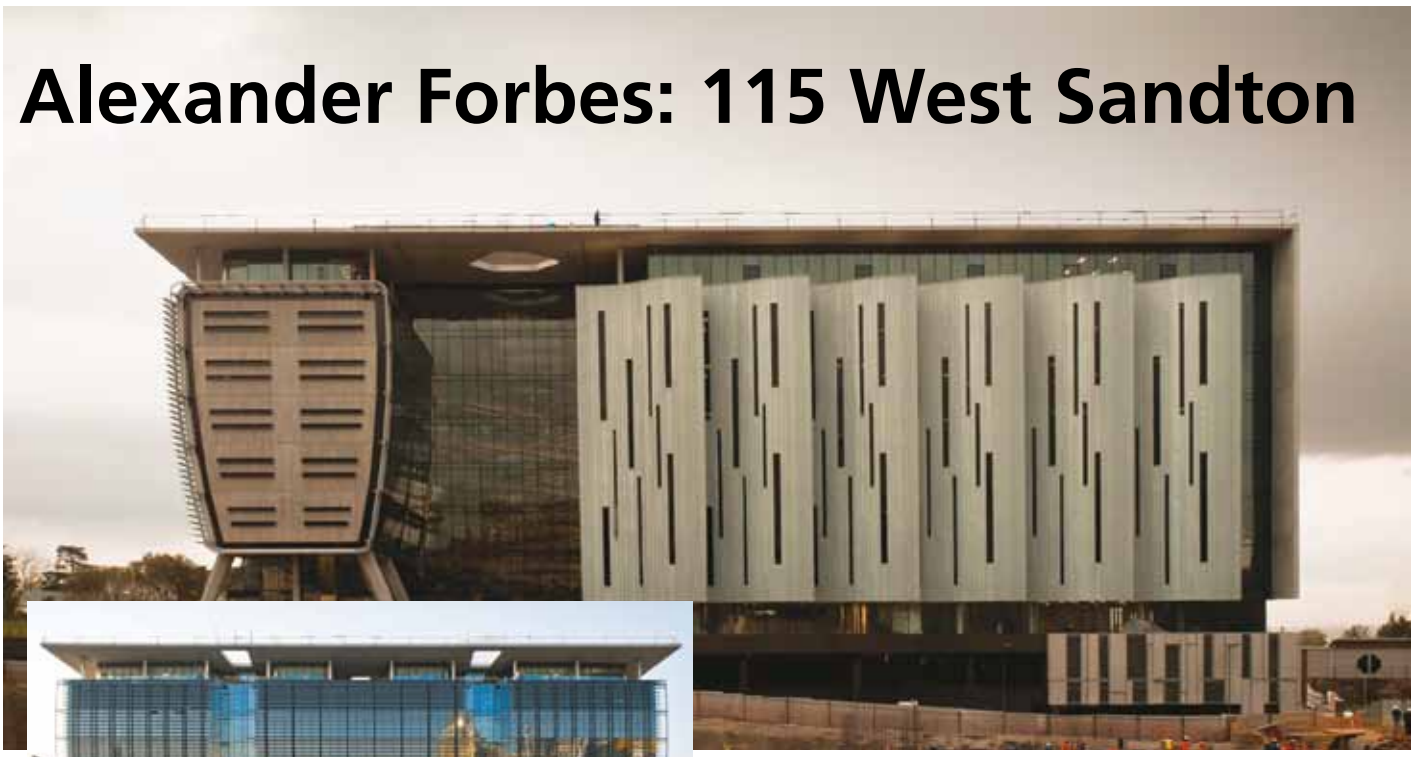
Physical: Suite 301, The Hillside, 318 The Hillside Street, Lynnwood, 0081. **Postal:** P O Box 75364, Lynnwood Ridge, 0040
Tel: +27 12 348 5305 **E-mail:** admin@concretesociety.co.za **Web:** www.concretesociety.co.za

Alexander Forbes: 115 West Sandton



West elevation, top, curved scallop concrete walls clad with Rheinzink and north elevation, above, main entrance with external louvred glass façade.

South façade, concrete walls with timber grained off-shutter textured finish.

The Alexander Forbes building, at 100 000 m^2, is one of the largest buildings to be completed in South Africa during the last few years. It was also one of the first to be accredited with a Four Star Green Star Design V1 rating. On account of these two factors, the role of concrete in the construction was critical, not only in its obvious application and timing in floor plates and building structure, but also the method of construction (Green Star rating) and the use of concrete in specialist architectural elements. These included:

- Raked columns, whose forms were generated through parametric modelling and then constructed using complex formwork
- Smooth off-shutter roof soffits and overhangs
- Textured off-shutter in-situ concrete walls with timber shuttering
- Pre-cast panels used on basement façade
- Pre-cast stair treads to main entrance stairs
- In-situ smooth off-shutter curved walls integrated with landscaping.
- Polished concrete walkways within landscaped areas
- Curved S-shaped concrete walls also known as the “scallop” walls clad, with Rheinzink.

The owner’s needs

This building replaced the existing head office for Alexander Forbes which was spread over two buildings on the corner of Katherine Street and Rivonia Road, Sandton. The client needed to consolidate facilities with an improved use of space for 2 500 people; this involved modernising work operations and upgrading technology services. Considering its status as a renowned financial services company, these needed to be state-of-the-art, with added security. To accommodate this number of people and facilitate a smooth flow, large (4 500 m^2) concrete floor plates were designed. The building also had to be completed in 19 months, which had a major impact on the production of designs and construction.

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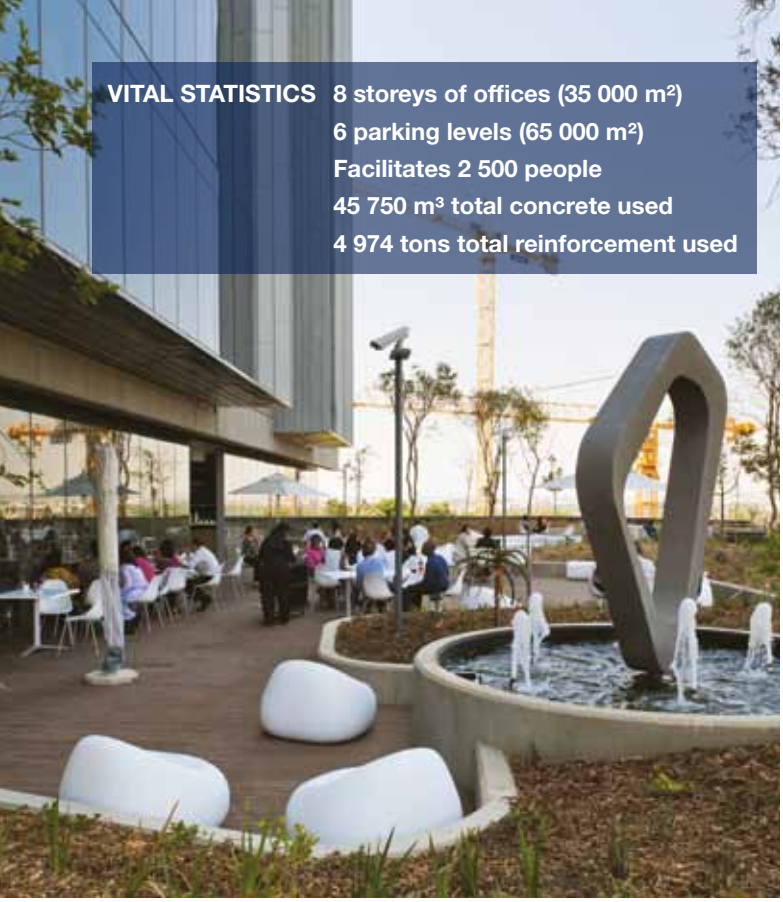

Off-shutter concrete used to create meeting areas in planted areas.

Why concrete was chosen for the project?

At 100 000 m^2 under construction, concrete was always going to be an integral part of the project. It was the expression of concrete which sets the building apart, from the complex raked columns to the in-situ walls, both smooth and textured. Concrete was widely used in elements from floors to walls, roof, columns and landscaping and its detailing became very important throughout the project.

Description of the works and construction procedure

The building programme was 19 months, so documentation and construction often ran concurrently. Given the extent of the project and timeline for completion, the construction was a mammoth task which was undertaken by the WBHO/Tiber joint venture. It also meant that clear and consistent communication remained critical.

The off-shutter concrete columns are one of the architectural features of the project. Raked and vertical columns on the ground floor are 8.5 m tall and moulded in a single cast; the specialised formwork was generated in Revit Design and Revit Structure; exported to AutoCAD in .dwg format to the sub-contractor for construction. Minimum sizes were specified by the engineer and then sculpted by the architects, who pinched the noses of the columns to create a more elegant and sculptural form. There were two types: a Y-shaped branch that supports the cantilevered walkway and one simple type that supports the building structure. Self-compacting concrete was used due to the amount of reinforcement within the column and difficulty to vibrate the concrete for a 8.5 m tall raked column.

S A Pine shutter board, cut into various thickness and widths, were used as a lining in the shutters to create timber grained textured, off-shutter walls for the North gable and South concrete walls. The textured finish also accommodated the varying quality of concrete finish and construction joints could easily be hidden at the board edges. These walls were cast past the floor slabs to minimise horizontal construction joints, which meant that all floors slabs had to be tied to the concrete walls with either pull-out bars or dowel bars. Self-compacting concrete was also used for these off-shutter walls to ensure that a high quality finish was obtained.

Another special architectural feature was the S-shaped walls, also called the "scallop walls", on the east and west façades. The accuracy and finish required would have normally called for highly specialised formwork which would have come at a high cost. Peri used their girder wall formwork system, made up in 10 m long units, with special radius whalers, to construct these curved walls with the same quality and tolerance, but at a much lower cost. A different texture was required by the architect for these walls and it was decided to clad the walls with 'Rheinzink'.

Planter walls are constructed from smooth off-shutter concrete, to create pockets of meeting areas in the planted and xeriscaped areas to the north and south of the building. Polished concrete walkways with exposed aggregates link portions of the different meeting and break away areas. Concrete was chosen for its durability, texture and it's reduced maintenance cost.

Link bridges span over the north and south atriums, which proved to be more difficult to construct than initially anticipated. The long spans, together with the architect's request to keep these bridges as thin as possible, meant suspending them from the roof. Having seven levels of bridges suspended from the roof meant that these bridges had to be lightweight and it was decided that concrete and steel would be used compositely to construct them. Finishes in the atriums were on the critical path and the contractors could not wait for the roof to be completed before the bridges were constructed and suspended from the roof. Construction of these bridges had to occur as each floor plate was being constructed and thus all seven levels of bridges were supported temporarily on the lower level floor slab, using a temporary steel frame.

The complexity of design coupled with intense programme constraints and sheer scale of the project made it a unique health and safety challenge for the contractor. The WBHO/Tiber JV rose to the challenge and won the Gauteng Master Builders Association's top award in their annual Regional Safety awards and received the FEM Super League Trophy for its health and safety achievements on the project. ▲

PROJECT TEAM

Client – Zenprop Property Holdings (Pty) Ltd
Principal Agent – Capital Projects
Main Contactor – WBHO/Tiber Bonvec JV
Consulting Engineers – Sotiralis Consulting Engineers (Pty) Ltd
Architects – Paragon Architects

Resolving "Sweating" in Open Industrial Concrete Floor Slabs

Problems may be linked to using floors as a casting surface.

by Arthur W. McKinney

Although the concrete industry has developed reliable methods for constructing concrete slabs that will carry moisture-sensitive flooring materials,[1] there has been a steady increase in floor moisture problems associated with open industrial floors. In such cases, moisture develops on the exposed surface and produces a persistent wet, slippery condition. This is not a simple transient condensation event. The persistent slippery surface affects foot and vehicular traffic and may also affect moisture-sensitive materials stored directly on the floor.[2] Serviceability and occupant safety are critical concerns.

The floors experiencing these problems share common characteristics: they are in buildings with tilt-up concrete walls constructed within the last 10 years and generally within a relatively well-defined geographic area. This pattern recognition has been useful in trying to understand the underlying causes and developing strategies for avoidance or remediation.

These floors are typically finished by machine troweling; to date, nothing remarkable has been identified in the basic chemistry of the cements or other components of the concrete mixtures.

Common Factors

Certain common factors have been observed where sweating has occurred:

- Sweating can be correlated with specific, predictable changes in ambient humidity; however, in-place measurements indicate that the floor surfaces are typically above the dew point. Geographically, the problem has been concentrated in northern Florida, Georgia, South Carolina, North Carolina, and Texas;
- The projects were built using tilt-up wall construction, and portions of the floor used for casting the wall panels were treated with a liquid-applied, reactive bond breaker to prevent the wall from sticking to the floor when lifted—a requirement unique to tilt-up construction;
- Areas used to cast wall panels sweat, while adjacent floor areas do not;
- In cases where the floor has been cured with a similar reactive product, sweating may be observed over the entire floor, except for secondary areas, such as pourback strips between the erected wall panels and the edge of the slab used as casting surfaces, pourbacks to replace slab sections removed for subsequent utility work, and pourbacks at column blockouts. These secondary areas typically have not been treated after finishing (or they were cured using means other than a reactive product), and they do not exhibit the sweating problem; and
- When drying occurs, white powder, filaments, or crystals may be left on the surface. These have been identified as carbonation products of alkali salts precipitating out of solution. Frequently, such material defines the extent and pattern of tilt-up panels or other components cast on the floor (Fig. 1).

Hypothesis

Reactive bond breakers have been effective in facilitating tilt-up wall construction. Typical reactive compounds contain components to produce a gel or film of crude soap by reacting with calcium hydroxide in the concrete surface. Such products may be applied as a curing compound for the casting surface and possibly to other areas of the floor slab. Multiple coats are applied in the casting area as a bond breaker.

Effects of both the application and the application rate of the reactive compounds are clearly discernible. The residual gel or film and its effect remain persistent over time.

One effect is similar to sealing a concrete surface, causing a redistribution of the moisture profile (from the wetter bottom of the slab to the drier top). This can draw deliquescent materials to the surface, resulting in the powder, filament, or crystal deposits. Observation suggests that the persistence of the problem is exacerbated by the absence of a vapor-retarding sheet under the slab. This allows free movement of water vapor from the subgrade into the slab.

It appears that, unless residual products can be completely removed, their presence and the transport of deliquescent materials to the surface create the persistent wet, slippery surface conditions observed. Adverse chemistry at the floor surface is the root problem.

However, it is also clear that weather does play a role. Floors do not typically exhibit sweating except under specific weather conditions related to relatively rapid changes in relative humidity.

Our analysis suggests that simply cleaning the floor surface could remediate or at least substantially attenuate the problem. This should be coupled with reasonable management of the building ventilation system.

Remedial Approaches

Two remedial approaches have generally been attempted:

- Clean the floor surface to remove any residual or deliquescent materials brought to the surface. The effects of cleaning can be evaluated as a change in the absorption rate at the surface; and
- Manage the building ventilation system to minimize the introduction of outside air (attenuate the rate of change in ambient interior conditions). Ceiling-mounted, high-volume, low-velocity (HVLV) fans can be used to improve air movement. Such fans can move warmer air near the ceiling down to the floor, warming the surface and moving it further off the theoretical dew point.

(a) (b)

Figure 1: In many cases, surface moisture problems are associated with the formation of a powder or crystalline residue in areas where tilt-up wall panels were cast: (a) general view of casting area on floor slab; and (b) close-up of crystals.

Figure 2: Testing for relative absorption using Rilem tubes. In this case, four tubes were used at each test site/cycle.

Normal cleaning procedures have been shown to temporarily resolve the problem. Aggressive cleaning can severely damage the traffic surface, leading to serviceability problems such as tire wear. Numerous protocols have been proposed and field tested over the last several years with limited success. It became clear that a workable deep-cleaning process needed to be developed.

Remediation by deep cleaning

Where the project reflects the conditions described, deep cleaning of the slab surface to effectively remove residual materials may be the best choice. Recent success with this approach has been encouraging, as it directly addressed the root cause. One issue with such cleaning has been to determine the correct materials and protocols for remediating the problem without damaging the slab surface.

A sequence for an effective deep-cleaning protocol is set out in the sidebar on "Cleaning Regime." Experience has shown that both the specific sequence and dwell time within each step are very important.

If deep cleaning does not fully resolve the problem, the weather side of "sweating" may be addressed.

Events can be anticipated and attenuated by managing the building ventilation system.

Remediation by managing ventilation

Managing the building ventilation system to limit or avoid moisture events has become better understood as the problem has affected an ever-larger geographical area and, thus, more projects. This solution is, basically, living with the problem. The strategy is as follows:

1. Identify and track the problematic weather events;
2. Keep the floor clean;
3. Avoid negative air pressure in the building;
4. Under the appropriate conditions, close all exterior doors and shut down ventilation fans and louvers to minimize infiltration; and
5. Supplement air movement from the ceiling area down to the floor using high-volume, low-speed (HVLS) fans. These prevent stratification and warm the slab.

Steps 4 and 5 must be activated prior to the weather change. With proper timing, events can be substantially curtailed. Bad timing can make the problem worse.

Such "air movement only" solutions do not require additional heat energy or mechanical dehumidification. Evaporation, per se, is simply not effective unless the air is dehumidified. The perceptible air movement from HVLS fans reduces occupant stress during problematic events.

General Avoidance and Design Considerations

Current understanding of the moisture problem leads to two approaches that should be considered for new open industrial floors, particularly in those geographic locations subject to sweating events:

- Use reactive bond breakers only in areas used for casting and use them in strict accordance with the manufacturer's printed instructions. Avoid direct contact with the floor surface. In the casting areas, cure the floor with a suitable water-based styrene acrylic compound. Again, follow the manufacturer's instructions. Using the curing compound will help ensure that the reactive component in the bond breaker will interact with the materials in the wall panel—not the materials in the floor. This is an approach that is used in stack casting. After casting operations, completely remove the residual materials from the floor surface; and
- Limit sources of moisture by the design and management of the building ventilation system and by requiring a competent vapor-retarding sheet under the entire floor.

Summary

Sweating floors are the result of a combination of adverse transient weather and adverse floor surface chemistry. The problem can be substantially remediated by deep cleaning of the floor surface.

For open industrial floors, the moisture issue represents a growing concern. The indicated strategies will affect the design and overall methods and materials required for a project. This will impart costs that may push pricing outside local market norms. ▲

References

1. *ACI Committee 302, "Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials (ACI 302.2R-06)," American Concrete Institute, Farmington Hills, MI, 2006, 42 pp.*
2. *ACI Committee 360, "Guide to Design of Slabs-on-Ground (ACI 360R-10)," American Concrete Institute, Farmington Hills, MI, 2010, 72 pp.*

Received and reviewed under Institute publication policies.

Arthur McKinney, FACI, has 45 years of design and construction experience and a successful international practice. He is a member and past Chair of ACI Committee 360. Design of Slabs on Ground, and a member of Committees 117, Tolerances; 301, Specifications for Concrete; and 302, Construction of Concrete Floors.

Cleaning Regime

A small test area should be used to confirm the adequacy of the materials, protocol, and timing. When cleaning large areas, results should be checked against the test area at each step. The general outline for testing the procedure is as follows:

1. Check the floor for water penetration. If water sprayed on the surface beads up, proceed with the following steps.
2. Spray alkaline degreaser (at full strength or at a dilution rate recommended by the supplier) in front of a ride-on floor scrubber. The ride-on unit should be configured to agitate the degreaser with its leading brooms, followed by scrubbing and continuous vacuuming.
3. Rinse using a spray of clean water in front of the scrubber, again agitating, scrubbing, and vacuuming continuously.
4. Spray acidic cleaner in front of the scrubber, agitating with the unit's brooms and scrubbing but without vacuuming. The scrubber should leave a trail of bubbles on the floor.
5. Vacuum the floor
6. Repeat Steps 4 and 5 to increase the absorption of the floor.
7. Fill the clean water tank with neutralizing solution and scrub the floor with neutralizer and without vacuuming. The scrubber should leave a trail of bubbles on the floor.
8. After the complete work area has been treated with the neutralizer, rinse with clean water and vacuum.
9. After each step, test the floor for water penetration and compare the results with the test area. In recent tests, Rilem tubes have been tried to assess relative improvements in surface absorption. The tubes were sealed to the floor and evaluated over a 2-hour period (Fig. 2). Rilem tubes on concrete can produce erratic results, but multiple tests suggest significant improvement after cleaning.
10. Allow to dry or revacuum.

Each agitation and power-scrubbing step may take 15 to 20 minutes based on a 10,000 ft2 (930 m2) effort. Keep the work area uniformly wetted through each step. Dwell time is very important. The cleaning products should likely contain surfactants and chelating components. It may take some trial and error to achieve a process that deeply removes the targeted materials without damaging the floor surface. The developed process can then be applied to larger floor areas.

After deep cleaning, application of a surface densifier might be considered (to date, the presence or absence of a silicate densifier has not been shown to be a factor in either causation or remediation).

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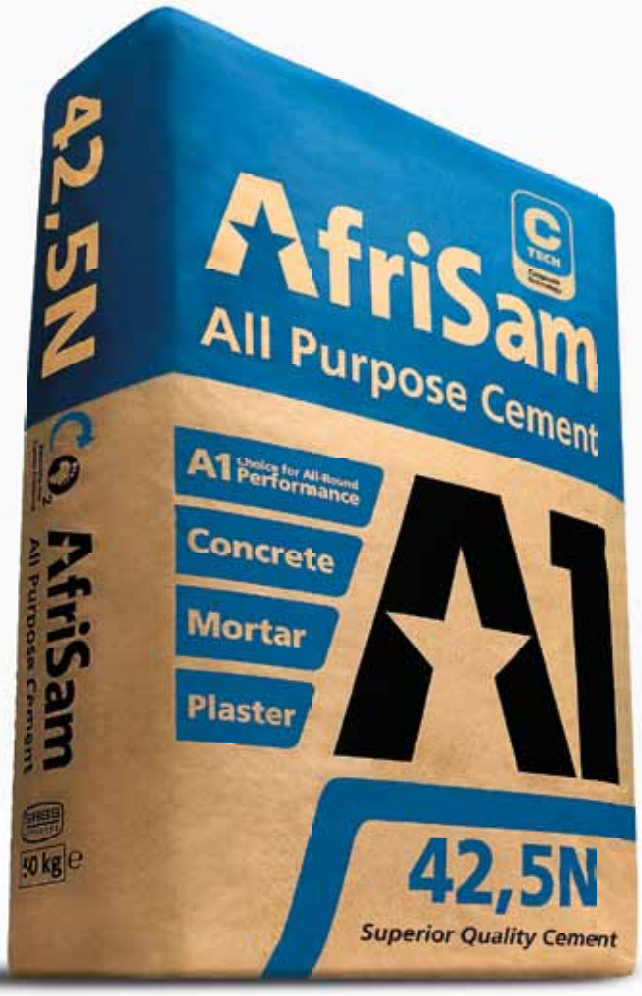

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Assessment of concrete with pulverized copper slag as partial replacement of cement – part one

D M Boakye, H C Uzoegbo

Department of Civil and Environmental Engineering, University of the Witwatersrand

ABSTRACT

This paper presents results of an experimental research project into the effect of using pulverised copper slag (CS) as partial replacement for ordinary Portland cement (OPC). Cement was replaced in the following proportions; 2.5, 5, 10 and 15% compared to the control (0%) specimen. Test performed included X-ray diffraction (XRD) and X-ray Fluorescence (XRF) respectively for mineralogical and chemical oxide composition. The compressive and flexural strength developments of samples concrete were determined for up to 90 days of water curing. Oxygen permeability, water sorptivity and chloride conductivity tests were performed to assess the long term durability performances.

In assessment of the hydraulic properties of slags, the hydraulic activity index of the copper slag was found to be approximately 0.5, less than the requirement for usage as constituent for cement as per SANS 55167-1:2011. The results of the strengths tests of the concrete cubes and beams showed a reduction in strength with increasing copper slag content. However, there was observed an improvement in the durability properties of the concrete samples with increase in copper slag content.

Keywords: Pozzolan, hydraulic index, compressive strength, oxygen permeability, water sorptivity, chloride conductivity index

Figure 1.1: Slag Heap Adjacent To A Farm Plantation in Democratic Republic of Congo

Figure 1.2: A Slag Dumping Site In Likasi, Democratic Republic of Congo

Figure 1.3: Metallic Trace Elements Dispersed into the Katamanda River

Figure 1.4: Slag Mountain Seen In The Background Close To Residential Area in DRC

1. INTRODUCTION

South Africa like many other countries, is witnessing a rapid growth in the construction industry, involving the use of natural resources for the development of infrastructures. This growth is jeopardized by the lack of natural resources that are available. Natural resources are depleting worldwide, while at the same time the generated wastes from the industry are increasing substantially (Al-Jabri, 2009). Slag, the glassy materials left when metals are either hydrometallurgical or pyrometallurgical extracted from their ores, in the metallurgical industries have traditionally been considered a waste product (Gorai et al., 2002). Waste from extractive industries are therefore to be properly managed, in order to ensure in particular the long term stability of disposal facilities and to prevent or minimise any water and soil pollution arising from acid or alkaline drainage, as well as, the leaching of heavy metals (European Commission, 2012). Current management options of slags are recycling and recovering of metal, production of value added products and the disposal in slag dumps, stockpiles or tailing dams.

Over the years, rigorous environmental impacts have been associated with copper tailings dam failure. According to Grimalt et al., (1999) approximately 2 million m^3 of mud containing heavy metals were spread over 4 286 ha of land and surface water during the 1998 Aznalcollar tailings pond failure in Spain. Lungu (2008) also highlighted that, the year 2000 tailings spillage at Nchanga Copper Processing Plant in Zambia released high concentrations of heavy metals into the nearby surface water, thereby contaminating the local source of water supply. Similar contamination of the Katamanda River in Lubumbashi, Democratic Republic of Congo (DRC), was also observed by Mutombo et al., (2011). According to the authors, metallic trace elements such as Cu, Co, Cd, Pb, and Zn shown in Figure 1.3, are frequently dispersed into the Katamanda River due to an adjacent heap of slag tailings produced by Electronic Foundry Panda (FEP) copper plant in Lubumbashi.

A case study of the slags from the copper mining areas of the Democratic Republic of Congo was presented by Mutombo et al., (2011). After about 40 years of mining large quantities of copper, the Authors concluded that, significant amount of slag has been generated. Figure 1.1 shows a slag mountain in the background adjacent to a farm and the Katamanda River used by the locals in DRC.

2. EXPERIMENTAL PROCEDURE

2.1 Materials Used

OPC, CEM 52.5 N procured from PPC Ltd was used for this research study. Coarse aggregates (granite) of nominal sizes between 18-20 mm and fine aggregates (crushed granite) between nominal sizes of 75 µm-4.75 mm were used. The properties of the cement conformed to the requirements of BS EN 197-1:2000, whiles the sampling of the aggregates was done in accordance with BS 812: Part 102. The copper slag (CS) used for this experiment was brought from Katanga, Democratic Republic of Congo. Katanga is a province with several mining companies producing copper and cobalt. The physical appearance of the CS is black, glassy and granular in nature, with particle size range similar to conventional sand used for concrete production.

2.2 Chemical Composition

The mineralogical and glass content of the CS sample were obtained using the Rietveld X-Ray Diffraction (XRD) method. The elemental oxide composition of the CS sample was obtained using the X-Ray fluorescence spectrometer to determine all the major oxides present in the sample. The XRF of both the CS sample and cement were analysed in South Africa by Lafarge's Chemical laboratory, whiles the XRD was performed in Germany by Heidelberg Technology Centre.

2.3 Blaine Air Permeability Test

The fineness of both slag and cement has a significant effect on the physical properties when used in concrete. Generally the finer the slag powder, the more rapid the concrete will set, as there is an increase exposure of the surface area, consequently increasing the rate of micro reaction. The Blaine air permeability apparatus was used to determine the fineness of Portland cement and pulverized CS in terms of the specific surface, expressed as total surface area in square centimetres per gram as per EN196-6. The Blaine apparatus draws a defined volume of air through a prepared bed of compacted cement powder of defined porosity. The resistance to air flow is directly proportional to the fineness of the sample grain, as long as the same testing conditions are observed.

2.4 Setting Time Determination

Cement paste were prepared with pulverized slag replacing cement at percentages 0, 2.5, 5, 10 and 15% under standard laboratory conditions with relative humidity of approximately 50% as per EN 196-3:2005. The water requirements for standard constituency were determined for each percentage replacement, prior to preparing the paste for the setting time test. The penetration depth of the plunger and the base-plate was within the required range of 6 ±2 mm. The initial and final setting time measurement was performed using the manual Vicat apparatus and the penetration depth between the needle and the base-plate was within the distance of 8 ±3mm in accordance with EN 196-3:2005.

2.5 Compressive Strength Determination

A series of concrete mixtures were cast in cubic moulds of nominal size 100 mm for control and with different proportions of pulverised CS ranging from 2.5, 5, 10 and 15% respectively replacing Portland cement. Activation of the pozzolanic reaction of the pulverized CS was done using 1.5% hydrated lime i.e. $Ca(OH)_2$ by weight of OPC. The materials constituents are shown in Table 2.

The slump of the fresh concrete mixes was determined to study the effect of different percentages of CS used on the workability of the concrete mixture as per SANS 5862-1. The mixes were compacted using a vibrating table and afterwards, the specimens were covered with polyethylene sheet, cured under ambient laboratory conditions of temperature 23 ±2ºC and demoulded after 24 hours. The demoulded cubes were moist-cured in a water tank at temperature of 21 ±2ºC and tested at the required curing age. All specimens were cured for 3, 7, 14, 21, 28 & 90 days before compressive strength tests were conducted. The maximum load at failure of three specimens at a loading rate of 1.0 kN/sec was recorded and the average value computed in accordance with SANS 5863 for compressive strength determination.

Copper slag replacement (%)	0	2.5	5	10	15
Cement (kg/m^3)	352	343	334	317	299
Fine aggregate (kg/m^3)	758	758	758	758	758
Coarse aggregate (kg/m^3)	995	995	995	995	995
Copper slag (kg/m^3)	0.0	8.8	17.6	35.2	52.8
Ca(OH)2 kg	5.3	5.3	5.3	5.3	5.3
Water (kg/m3)	170	170	170	170	170
Water to binder ratio	0.5	0.5	0.5	0.5	0.5

Table 2: Concrete Mix Design

2.6 Flexural Strength Determination

For flexural strength determination, concrete beam specimens of cross sectional length 300 mm, breadth 100 mm and width 100 mm were cured in water for 3, 7, 14, 21, 28, 60 and 90 days. The dimensions of the beams were determined to the nearest mm and the mass of each specimen were determined before testing. The rollers of the compression testing machine were wiped cleaned and the concrete beams were placed centrally on the supporting rollers, with orientation of the casted face perpendicular to the loading face. The axis of the beams were aligned with the centre of thrust of the spherically seated top roller holder(s), whiles ensuring that the axes of both the top and the supporting rollers were normal to the longitudinal axis of the specimen in accordance with SANS 5864:2006.

Demoulded prism specimens were water cured and tested at the required curing age at a loading rate of 0.6 kN/s until failure. For both the control samples and for each percentage replacement of the Portland cement with CS, three beams were tested at the required curing age for flexural strength under two loads at third point conditions in accordance with SANS 5864:2006. The average modulus of rupture (flexural strength) was determined using the expression for a third-point loading method as per SANS 5864:2006. The results of the modulus of rupture of all mixtures showed similar trend to the compressive strength results as the replacement level of copper slag increased.

2.7 Concrete Durability Test

Three standard test methods were used to investigate the durability properties of CS admixed concrete cored samples, namely: oxygen permeability, water sorptivity and chloride permeability tests.

For the oxygen permeability index (OPI), cored disc samples of average diameter 70 ±2 mm and depth 30 ±2 mm were placed unto the compressible collar within a rigid sleeve, with the test face at the bottom and resting against the lip of the collar. The thickness and diameter of each disc specimen was measured with a vernier calliper at 4 points equally spaced around the perimeter of the disc specimen and

Figure 2.1: OPI Measuring Setup

Figure 2.2: A Computer Data Logger

recorded. The samples, collar and rigid sleeve were placed on top of the permeability cell so that it covers the hole in accordance with SANS 516-2. Afterwards, the cover plate was partially tightened with the top screw to ensure that it was centred. The time and pressure readings in the permeability cell were then recorded in 15 minutes time steps by a computer data logger shown in Figure 2.2, connected to the oxygen permeability index setup for about 3 hours.

For the water sorptivity test, the vertical curved sides of the cored disc specimen were sealed with a packing tape which extends to the extreme edges of the sides towards the test face. 10 layers of paper towel were then placed on a tray and a solution of $Ca(OH)_2$ poured into the tray, the paper towel was saturated with water visible at the top surface. The specimens were weighed at 3, 5, 7, 9, 20 and 25 minutes, after patting it once on the damp piece of absorbent paper not longer than 15 seconds and replaced each time after weighing until the maximum time of 25 minutes as per SANS 516-4. The concrete discs were vacuum saturated in water to determine the effective porosity.

The chloride permeability test was conducted to assess the concrete quality as per SANS 516-3. 2.93 kg of NaCl was added to 10L of water to form a brine solution in a container. The connecting points of the conduction cells were unscrewed and the lugging capillaries of the chloride cell connected to both chambers of the cell were filled with NaCl solution. With the flexible collar in the central ring portion of the cells, the concrete disc samples were placed within the collar with one face against the plastic lip of the rigid ring. The central portion of the cathode section of the cell was screwed ensuring that the solid plastic lip pressed against and compressed the flexible collar. Both parts sealing the sample were tightened to ensure that there were no signs of leakage. Both the ammeter and voltmeter were connected and the DC power supply was adjusted until the voltage applied across the specimen was approximately 10V. The current and voltage readings were simultaneously recorded. Testing was completed within 15 minutes of removing the specimen from the suspended NaCl solution. All other concrete discs waiting testing were stored in the NaCl solution in accordance to SANS 516-3. ▲

Figure 2.3: Cored Discs Samples Stored in a Desiccator

Figure 2.4: Cored Discs Samples Being Tested For Water Sorptivity

PART TWO of this technical paper covering 'results, discussion and conclusions', together with all references, will be featured in the March 2015 edition of Concrete Beton.

Innovative thinking generates new retaining wall concept

A new concept in retaining wall systems, Echo Gravity Retaining Walling (EGRW), which utilises precast concrete hollow-core slabs in combination with geotextile membrane, has been introduced by South Africa's leading hollow-core slab producer, the Echo Group.

The first EGRW system was built at the recently constructed Green Cross Medical Centre, one of the first property developments to have been completed at the newly proclaimed Lords View Industrial Park, situated in Chloorkop, Kempton Park.

The idea behind the Green Cross EGRW wall, which is 135 m long and varies between 2,5 m to 5,7 m high, was the brainchild of Echo's engineering team.

"The original intention had been to construct an in-situ retaining wall. Echo's engineers, however, believed that a precast concrete wall would offer a more cost-effective option and submitted an alternative design proposal based on the use of prestressed hollow-core slabs in combination with geotextile membrane. The design offered substantial savings in reinforced concrete and formwork, not to mention considerably faster construction times," said Echo technical director, Daniel Petrov.

"When the decision to opt for the EGRW route was taken an in-situ wall foundation and steel starter bars were already in place and to minimise costs, we incorporated these elements into the EGRW design," said Petrov.

The top of the wall was finished with precast concrete coping to add further aesthetic appeal.

Petrov says that precast retaining walls are generally built considerably faster than in-situ walling. "Moreover, because our hollow-core slabs are manufactured in a factory environment in compliance with Echo's stringent quality control measures, we are able to provide a top-quality end product on a consistent basis." ▲

Upat and fischer – a chemical match

Chemical Anchors were invented in 1963 by Upat GmbH & Co of Germany, in response to the need for fixing technology that could withstand exceptional loads with minimal anchor-to-anchor spacing and smaller edge distances. In 1983, Upat S.A. (Pty) Ltd commenced trading as the sole southern African Distributor and Agent of the Upat range of construction fasteners and fixings. In 1992 the world famous fischer Group of Companies (also of Germany) purchased Upat GmbH and Co. and commenced with the integration of the fischer and Upat product ranges. This full and final integration was realised here in South Africa in 2003. Since then Upat S.A. (Pty) Ltd has been supplying the fischer range of products to southern African countries, along with several other internationally acclaimed brands within the construction, building, mining and DIY markets.

To add to its diverse product range of existing chemical anchors, Upat SA is pleased to announce the arrival of 2 new chemical 'superstars'. Firstly, the 'fischer Powerbond' system which, when used in conjunction with the stainless steel Power Sleeve and a styrene-free vinyl ester-based injection mortar, is claimed to be the strongest, fastest and most economical way to fix critical loads into cracked and non-cracked concrete. It is approved for both hammer-drilled, diamond-drilled and water-filled drill holes.

Secondly, 'fischer Superbond', a bonded anchor system based on a vinyl ester hybrid with silane technology. It is a concrete all-rounder and a combined system (should one wish) of resin capsule and injection systems which perform the same as each other at the same anchor depth and allowing the installers maximum flexibility. The product is approved for very cold conditions of down to -30 degrees C. ▲

More information go to www.upat.co.za or contact alison.kuhlmann@upat.co.za

Revelstone launches off-shutter cladding

Concrete Manufacturers Association NPC (CMA) member, Revelstone, has expanded its range of engineered precast concrete products by launching Off Shutter, a wall cladding (25mm) which can be used for enhancing unplastered brick and other types of wall surfaces or finishes.

Available in four sizes, it has been designed to simulate the look of in-situ off-shutter concrete. Different sizes can be combined to create realistic and attractive wall finishes for internal and external applications and, using Tylon WB114, Off Shutter is very easy and cost-effective to apply.

Revelstone director, Alex Cyprianos, says Off Shutter has a more refined texture than in-situ concrete and being a wetcast product, it can be manufactured in almost any colour, consistently and in any quantity, large or small.

"Off Shutter cladding is extremely durable and hard wearing which makes it a great option for both commercial and residential structures. It is currently available in our standard concrete and weighs approximately 56 kg per square metre. However, we are also launching a light-weight version which will reduce its weight by more than 50% and make it even easier to apply.

"We launched the product at the Cape Homemakers Expo in September and were overwhelmed with the interest and positive feedback. The market has been waiting for an alternative to in-situ off-shutter concrete for some time now and Off Shutter provides the answer, especially when one considers its refined appearance and multi-colour options.

The four Off Shutter sizes are:

- 1000mm x 500mm x 25mm
- 500mm x 500mm x 25mm
- 1000mm x 300mm x 25mm
- 500mm x 300mm x 25mm.

Off Shutter is currently available in any of Revelstone's standard 16 colour range, making it a very versatile and attractive alternative for designers looking for a clean-cut, modern finish. ▲

AfriSam delivers on one of its biggest supply contracts in recent times

On any given day, AfriSam delivers an average of 3 000 tons of material to the project site, and this is in addition to on-time deliveries to many other customers in the Western Cape.

SANRAL's project to improve National Route 7 between the Melkbos and the Atlantis intersections is one of the largest roads projects currently underway in Cape Town. It also represents one the biggest contracts awarded to AfriSam in recent times, involving the supply of about 650 000 tons of layer works material and 750 000 tons of overburden over the 30-month project period, as well as some 15 000 m^3 of readymix concrete for bridge construction at the two new interchanges.

The N7 connects the Western Cape to Namibia via the Vioolsdrif border post carrying large amounts of traffic in volumes that are steadily increasing. The section between the Melkbos and Atlantis intersections had become a notoriously high accident zone and one of SANRAL's primary objectives in initiating this upgrade is to improve road safety by replacing dangerous intersections with grade-separated interchanges and closing all other access to the freeway.

The project, scheduled for completion in November 2014, will also increase road capacity by creating a divided freeway with a 120 km/hour design speed. The dual carriageways are 10,9 metres wide with a lane width of 3,7 metres. The road reserve is 60 metres wide.

Prior to commencement of the project, AfriSam worked alongside Haw & Inglis to develop durable readymix designs that complied with the specifications for construction of the interchange bridges.

From left : Robert Van Zyl, Haw & Inglis concrete foreman; Bevin Cornelius; AfriSam territory manager; Willem Odendal, Haw & Inglis trainee site foreman and Lucien Singh, AfriSam pump operator.

On any given day, AfriSam delivers an average of 3 000 tons of material to the project site, and this is in addition to on-time deliveries to many other customers in the Western Cape. AfriSam's contract with main contractor Haw & Inglis also requires it to maintain stock levels up to 10 000 tons of each type of layer works material to ensure that, in the event of a breakdown, these critical supplies will not be interrupted. AfriSam has also needed to factor in often lengthy delays en route to the project site caused by logjams at the N7 weighbridge.

"The Western Cape is a highly competitive market for us and to secure a contract of this size is a gratifying indication of the confidence Haw & Inglis has placed in AfriSam to support this project," Bevan Cornelius, AfriSam territory manager for building construction material in the Western Cape, says. "We have a sound longstanding relationship with Haw & Inglis that has proved the extent of our services, infrastructure and value-added capabilities. Past contracts for this construction company include the N2 Settlers Way hospital bend upgrade and the N7 widening of Piekenierskloof Pass, both of which were major projects.

"Having secured this latest contract, we're well-positioned in the Western Cape to field future projects on the N7, having fully demonstrated that we have the knowledge and experience to manage such strategic developments."

Prior to commencement of the project, AfriSam worked alongside Haw & Inglis to develop durable readymix designs that complied with the specifications for construction of the interchange bridges. Mix testing was carried out by AfriSam's technical laboratories in Cape Town, and test beams were cast using various mixes and sent for independent verification by the Engineering Department at the University of Cape Town to achieve durability criteria as specified. Test beam verification was initiated three months before the project began because the compressive strength characteristics of the concrete had to be validated over 28 days.

Since construction began in May 2012, AfriSam continues to provide regular back-to-back testing with Haw & Inglis' on-site laboratory to ensure the specifications are maintained through this highly specialised project.

AfriSam operates a fleet of 40 readymix trucks in Cape Town, transporting this material from its five readymix plants in the area, including a newly established plant in the Saldanha Bay Industrial Development Zone, to customers across the Western Cape. Its aggregates are supplied from quarries in Durbanville and Malmesbury. ▲

35 Years of going green

Terraforce turned 35 this year, and Holger Rust, founder and owner of the company wishes to thank clients, licensees and recommended installers for joining them on this journey of building outstanding (some big, some small) retaining walls. Says Holger: "The future looks very encouraging and we are excited to continue to grow our product presence in Africa and abroad."

Rust designed the original interlocking and reversible hollow core earth retaining blocks 35 years ago. They are incredibly versatile, but the most significant aspect of the blocks is that, by being fully permeable, reversible and plantable, they offer a sustainable solution to anyone who needs to consider landscaping or erosion control on site, as an alternative to impermeable (and often unsightly) solid concrete or brick methods .

"Not only has this been part of Terraforce's marketing approach from the beginning, but it goes beyond strategy for them," says Karin Johns, marketing manager for Terraforce:

"Holger has always been passionate about green living and green products and it is this passion that steered him into the direction of creating a product that allows a concrete retaining wall to blend back into the surrounding, be it an environmental or aesthetic consideration. This is an often ignored aspect of maintaining a native balance in urban or rural environments, where profit commonly outweighs sustainable choices"

Holger Rust is satisfied with his decision of pursuing a sustainable business model, through extensive, and sometimes expensive, product testing and research in laboratories, here and overseas:

"I was warned that making too much information freely available on our website would encourage the "reverse engineers", the free riders of our times, to jump on the band wagon. This has happened to some extent, with even a "leading corporate citizen" among the suspects, but on the whole, their activities have not been able to hamper our sustained growth, even in the current recession. For me, that is the most rewarding confirmation, that a combination of innovation, quality and commitment, is the most powerful driver of a long lasting business."

"Our bottom line is to 'go green and clean' wherever you can. In life and in business, it is the only truly sustainable option for the future."

CMA initiates precast concrete standards review

The Concrete Manufacturers Association's NPC (CMA) technical committee under the chairmanship of technical director, Taco Voogt, has formed a working group to revise four precast concrete standards: SANS 1058 (concrete paving blocks) SANS 1215 (concrete masonry units) SANS 677 (interlocking concrete pipes) and SANS 542 (concrete roof tiles). SANS 1215 needs major revision whereas the other three require only minor changes. Once completed and agreed to by various interested parties, the revised standards will be published by the South African Bureau of Standards (SABS).

SANS 1215 was first introduced in 1984 and there have been six subsequent amendments. The last two were drafted in 2013 and are currently being circulated for comment. The masonry standard includes testing procedures for dimensions, squareness, compressive strength, drying shrinkage, expansion, rewetting and soundness/consistency.

CMA technical director, Taco Voogt.

The CMA's SANS 1215 working group is faced with two options, the first being to revise and update the existing standard which was historically based on the British masonry standard, (which no longer applies in the UK) or to adopt the European standard BS EN 771-3 which is a supporting standard for Eurocode 6 – Design of Masonry Structures. At this stage it appears likely the European standard will be adopted under the auspices of the South African Bureau of Standards (SABS) with a South African annex to reflect local requirements. This is not only a simpler option which saves time and money, but the South African masonry fraternity can draw on the experience and research of its European counterparts.

"There is a complication, however, and that is the revision of the National Building Regulations through the addition of SANS 10400XA, which deals with energy efficiency and sustainability. Its introduction means that concrete masonry manufacturers must now comply with stringent energy requirements and right now there is no concrete masonry manufacturer which meets the standard especially in single-skin walls. The proposed regulations will make South African buildings among the most thermally efficient in the world, but at what cost? New buildings, especially in the affordable and low-cost housing sectors will become anything but affordable and double-skin cavity walls will become the norm," says Voogt.

South Africa's paving standard SANS 1058 was extensively revised in 2010 when a test based on compressive strength was replaced with tensile splitting, abrasion resistance and water absorption. Many CMA paving manufacturers found the standard unnecessarily high and it was revised in 2012 when the criteria for tensile splitting and abrasion testing were lowered, albeit marginally, and the water absorption test was placed on a voluntary footing. The current initiative seeks to remove all reference to compressive strength as it is deemed irrelevant to paver performance and to place the water absorption requirement into an annex.

Some concrete pipe manufacturers have requested an annex on jacked pipes to be inserted in SANS 677 and a working group has been convened by Rocla's Gerhard Rossouw for that purpose. No changes are proposed for the roof tile standard, SANS 542, apart from rectifying a minor omission for on-site testing which simply entails the insertion of a missing zero on one of the test schedules. The CMA is monitoring the effect that the revision of the National Building Regulations through SANS 10400L-Roofs may have on the application of concrete roof tiles. ▲

Eastern Cape seminar throws fresh light on precast concrete

The Concrete Manufacturers Association NPC (CMA), staged a two-day seminar in East London on August 27th and 28th on current trends in the precast concrete industry. The seminar was presented by some of the country's leading precast concrete experts and was sponsored by cement producer, AfriSam.

Wally Armstrong, CMA executive director, opens the CMA's Eastern Cape precast concrete seminar.

Fred Crofts of FSC Consulting Engineers.

Delegates, who numbered approximately 30, qualified for CPD points, and subject matter included recent developments in precast concrete raw materials and finished products, as well as some recent initiatives in the overhaul of industry standards.

Day one covered: the extensive roll that precast concrete plays in modern road construction; an overview of modern cement production; concrete release agents and admixtures; the design of concrete retaining blocks; Eurocode 6 in relation to the revision of SA's masonry standards; and product and construction standards for concrete block paving (CBP).

Day two included: practical aspects of concrete retaining blocks: the causes and prevention of failures in CBP and special CBP applications; basic masonry units and the construction of multi-storey buildings using load-bearing masonry.

The seminars were chaired by CMA executive director, Wally Armstrong, who opened the event with an overview of the CMA. Precast concrete roads and all paving-related subject matter were covered by independent paving consultant, John Cairns. Masonry matters and multi-storey buildings were presented by consulting engineer and masonry expert, Fred Crofts of FSC Consulting Engineers.

Structural engineer, Dennis Walters of Walters and Associates, lectured on some of the applications and advantages of concrete retaining blocks, and the two presentations on modern cement production and application were made by Mike McDonald, manager of AfriSam's centre of product excellence, and Amit Dawneerangen, AfriSam's national multi-products solution manager. The presentation on release agents and concrete additives was delivered by Chryso Eastern Cape sales manager, Patrick Flannigan. ▲

Ash Resources appoints new MD

Tshepiso Dumasi appointed as Ash Resources' MD.

Tshepiso Dumasi was appointed Managing Director of Ash Resources, South Africa's leading manufacturer and supplier of fly ash products, on 1 March 2014. South African born and educated, Dumasi was previously the Commercial Director of Lafarge Chilanga Cement in Zambia, a position he had held since 2011.

Dumasi has extensive experience in sales and marketing and joined Lafarge South Africa's cement business line in 2008 as a Key Accounts Manager, later to be promoted to Regional Sales Manager before his move to Zambia.

"Ash Resources has a proud track record of achievement in technical innovation and has a wide range of interesting new innovations in the pipeline," adds Dumasi. "I see an immensely exciting time ahead, building on our traditional business areas and expanding into new markets." ▲

Improving concrete laboratories

Better, more accurate laboratory equipment is required in South Africa's concrete laboratories in order to meet the construction industry's requirement for consistent quality concrete that meets the required specifications.

Marius Grassman, of Concrete Testing Equipment said that the use of an accurate laboratory service (on-site or outsourced) is possibly the most important part of any readymix plant, as it enables concrete suppliers to offer a truly quality product that is able to meet any specification required.

Addressing members at the Southern Africa Readymix Association's annual conference, he said quality concrete requires all elements to be performed right and this should start and end in the laboratory. Only if all parameters are checked and verified on a regular basis can consistency be assured.

"Companies also need to know what they are testing and how it influences the requirements of the customer. For example, grading needs to be done on course aggregates, sand, etc. Surprisingly few people test this and simply take the supplier's word.

"Water, cement and additives should also be tested to ensure compatibility with requirements and, where necessary, compatibility with the type of application and even the environment in which it will be used.

Marius Grassman of Concrete Testing Equipment

"Even simple things like slump tests need to be done correctly and thoroughly to avoid trucks being sent back unnecessarily. Seemingly straightforward aspects like cube tests must also be procedurally correct and must be carried out according to required procedures and specifications and cured in a proper curing tank," said Grassman.

He continued that equipment within the laboratory should also be regularly calibrated and staff should be well trained to use such equipment and be aware of what they are testing for, and what the required parameters are.

"If all of this is done properly, records are kept and calibrations are up to date, then concrete suppliers should have no problem showing that their concrete is up to standard, and even proving it in a court of law if the need ever arises," Grassman concluded. ▲

Energy saving initiatives reduce AfriSam's energy intensity by 12%

AfriSam's campaign to achieve exponential energy savings has led to the implementation of a series of focused initiatives that have resulted in the company reducing its energy intensity by 12%, well in advance of the National Energy Efficiency Strategy's 2015 deadline to achieve this target as part of a countrywide initiative.

The main success factor behind this achievement has been the introduction of the company's Advanced Composite Cements, which harness by-products from the steel manufacturing and coal-fired power station industries, together with chemical activators, to improve the characteristics and performance of traditional Portland cement. Besides lowering the clinker factor, Advanced Composite Cements only utilise half the amount of thermal energy of conventional cements.

AfriSam's "Project Green Cement" was launched in 2000, primarily aimed at reducing carbon dioxide emissions, and since then the company has moved away from the pure Cem 1 Portland cements to embrace Advanced Composite Cements.

In 2008, AfriSam received the National Business Initiative (NBI) award for 'Top Performing Energy Efficiency Accord Signatory' in the Industrial Category.

At the Tanga Cement plant in Tanzania, in which AfriSam has a 62.5% shareholding, the company is currently installing a new state-of-the-art five-stage precalciner kiln, which will achieve the lowest thermal energy in the Group and play a role in reducing its average thermal energy consumption.

Today energy is AfriSam's number one cost reduction initiative and the company has adopted a holistic approach to energy savings to ensure steady improvements in the four primary focus areas of thermal, electrical, transport and explosives. Coal and electrical energy are by far the company's biggest costs in cement production, with the fuel costs associated with transport logistics a not-too-distant third.

"To reduce our electricity usage, we've adopted a philosophy that all our future mills will incorporate electrically efficient vertical roller mill technology," Gavin Venter, manager of AfriSam's Strategic Projects, says. "A notable success in this area was the installation of a vertical roller mill at our Roodepoort operation in 2008. Although this mill was commissioned at a 20% higher cost than conventional technology, it has since achieved a 24% reduction in electrical energy consumption. Vertical roller mills are also being earmarked for installation at our new Saldanha and Coega facilities.

"Some time ago we tasked a team of engineers with obtaining maximum energy efficiency out of each plant component and one of the outcomes has been the replacement of old drives with variable speed drives wherever possible, across all our operations. This initiative has certainly contributed to improved energy efficiencies. Where possible high energy utilisation material transport equipment, i.e. pneumatic conveying systems, were changed to mechanical conveying systems. These initiatives required significant Capex expenditure, but could be justified based on the improvement on energy intensity."

In November 2012, AfriSam became the first construction materials company to sign the 49M pledge, signifying the company's commitment to the global agenda for energy efficiency and to playing a proactive role in contributing to energy saving across South Africa.

The vertical roller mill at AfriSam's Roodepoort cement operation has contributed to a 20% reduction in energy consumption since its installation in 2008.

Another more recent initiative has seen the implementation of a production and maintenance tool at AfriSam's Ulco facility in the Northern Cape and Dudfield facility in the North-West to assist with electrical load shifting, predominantly during peak demand periods. This tool has contributed significantly to energy saving and will be implemented at the company's other operations. At the Tanga Cement plant in Tanzania, in which AfriSam has a 62.5% shareholding, it is installing a state-of-the-art five-stage precalciner kiln, which will achieve the lowest thermal energy in the Group and play a role in reducing its average thermal energy consumption.

In terms of fuel energy associated with transport, AfriSam uses as a selection criteria for subcontracted transporters a requirement that the trucks should be made out of lightweight aluminium to assist with fuel consumption. It also ensures that that the shortest haul routes are selected and that these trucks are loaded to capacity to reduce the number of truck loads. Wherever possible, use of rail transport is maximised to cut down on fuel costs.

To address the company's blasting energy consumption at the quarry faces, AfriSam implemented ongoing efforts at all its aggregate and cement operations to optimise these costs.

Included in the ongoing drive to achieve real energy savings is an energy efficiency initiative at all operations that is seeing the installation of motion sensors, energy efficient lighting, solar geysers and solar panels.

"Various behaviour change initiatives have been implemented to empower employees with knowledge on how they can play a role in energy efficiency," Venter says. "These include switching off lights and air-conditioners, utilisation of natural lighting, utilisation of energy efficient lighting and the awareness to ensure that equipment is not kept operational if not required. Our employees are also encouraged to become energy efficient in their own homes by receiving assistance to apply for Eskom-funded energy efficient lighting, showerheads, solar geysers and timers. ▲

PROALL Reimer gets to mix with the best

History was made at this year's SARMA Readymix Conference by ProAll and Reimer SA when the first continuous concrete production plant was officially accredited by SARMA. This unit owned by SSBR (joint venture Stefanutti Stocks and Basil Read) is currently working for Eskom at the Kusile Power Station project.

PROALL Reimer's dry readymix system has been certified by the Southern Africa Readymix Association

Shortly after the announcement was made that ProAll Reimer Mixers have been accepted and accredited by the Southern Africa Readymix Association (SARMA), a similar unit was purchased by 3Q Mahuma Concrete. Although the ProAll Reimer Mixers have been available in the market for some time now, a thorough certification process had to be followed to ensure the trucks could produce concrete of a consistent standard to meet the association's strict requirements.

Reimer SA markets and supports a unique readymix system that allows dry cement, aggregates and other ingredients of concrete to be transported to site and mixed to specification. The system therefore is able to overcome the challenge of ensuring concrete is fresh when being transported over long distances and can metre-out small amounts at many different sites in a day without the risk of the concrete losing slump.

Ready-to-go

With sophisticated metering systems aboard the ProAll Reimer Mixers, exact quantities of raw materials are fed into the screw auger and can be batched to meet each individual customer's requirements along the way – i.e. strength, consistency, workability etc. An immediate printout

Riding in the fast lane

Ash Resources' new Commercial Manager

Ash Resources, South Africa's leading manufacturer and supplier of fly ash products, has appointed Nicola Viljoen as its new Commercial Manager with effect from 1 September 2014. In her previous role as Senior Purchasing Manager for Lafarge Gypsum, she is credited with transforming the company's complex purchasing and contracting function, which handles the multiplicity of specialised products and systems in the building interior fitting business.

Change management is her forte and Viljoen is excited about her move back to a general management function, dealing with a totally different product and sector of the construction industry. "The aspect that the two companies have in common is that they each value and foster their team spirit and unique identity, while benefiting enormously from the technical and financial strength of the international Lafarge Group. It is an interesting challenge to strike the optimum balance," she observes.

Viljoen is strongly people and strategy focused, saying: "It is the people in a company that make it work rather than systems and products. My strength is being able to identify how everyone and everything in departments can mesh together to function better in a company. People should not be afraid of constructive change but they often need the self-confidence to enjoy and embrace change energetically, both for their personal fulfilment and to ensure their company stays ahead of the competition."

Born in Zimbabwe, Viljoen grew up on the East Rand. As a child she says she dreamt of being a racing car driver because it sounded exciting and fun. She doesn't race but loves her motorbike and she is certainly moving in the fast lane, making her mark in industry!

Viljoen holds an MBA from the highly regarded Henley Management College in the UK and has studied Advanced Contract Management. In addition to the three years spent with Lafarge Gypsum, Viljoen's extensive work experience includes Management and Financial Consultancy, National Operations Manager for Hulamin Engineering Solutions, and Group Procurement Manager for Kulungile Metals.

Asked the inevitable question about being a woman in what is still typically perceived as a male industry, Viljoen says it is not an issue if it is approached properly and you have earned the position through skill and hard work. "It is important to avoid trying to be one of the boys," she says. "Handling diversity well, whether gender, race or culture, is an immense strength for any company and is particularly so in the case of Lafarge. Women in general are more caring and often show more

acts as certification of the mix for onsite record-keeping purposes and is recorded for purposes of proof of delivery of supplier. The unmixed product remains usable.

"For our members the advantages of having a ProAll Reimer Mixer of this sort in their fleets are many and the accreditation of the system means that they can rest assured that it is able to produce the same consistent quality as their existing batching plants," said Johan van Wyk, General Manager of SARMA

"Certification follows a lengthy verification process in which Go Consult train the operator, do the mix designs, determine the settings and maintain quality control. SARMA officials audited the manufacturer's systems for accreditation. They also measured the performance and quality of the system against stated outputs. Only then, once they were satisfied that the PROALL Reimer Mixer units met performance criteria were they able to certify South Africa's first continuous concrete production plant ".

Van Wyk concluded that the new system would provide members with a viable means of extending their reach into remote areas and allows them to measure out smaller quantities to clients who would usually have no other option but to settle for less reliable site mixing options. ▲

Sarma, Johan van Wyk, Tel: (011) 791 3327, Fax: 086 647 8034, Email: johan@sarma.co.za, Web: www.sarma.co.za

empathy when dealing with staff, whereas men deal with other workplace aspects better. It is a case of forging a strong, mixed team that benefits from the inherent synergy."

Women's reputation for being natural multitaskers is epitomised by the dynamic, positive thinking Viljoen. A mother of three children, Viljoen is able to excel in her corporate life, while enjoying after-hours interaction with her family and still making time for her biking and her passion for community work. As an ardent superbike rider, she has helped raise money for children's homes and cancer sufferers by taking part in events such as the Teddy Bear Run. A facet of Lafarge that she respects and enjoys is the group's active support and encouragement for employees to do volunteer work to help uplift disadvantaged communities. In this regard, she has recently headed up a team that has arranged ongoing partnership support for the Jes Foord Foundation that is addressing the social evil of rape.

Astonishingly, this versatile corporate department leader fully intends making time next year to renew her studies to qualify as a Chartered Global Management Accountant. Asked whether there was anything she couldn't do or disappointed her in life, Viljoen laughs and says it is not being able to read her Kindle in a relaxing bubble bath! We are sure she will find a way. ▲

Chryso Southern Africa's products travel 2 300 km to reach the Basil Read St Helena Airport Project

Products from Chryso Southern Africa have travelled 2 300 km over the South Atlantic Ocean to St Helena, one of the most remote islands in the world, to be used at the Basil Read St Helena Airport Project (BRSHAP). All of the materials used in the production of the concrete required, apart from the crushed aggregate, were sourced off the island. Dune sand was obtained from Walvis Bay, while the cement came from Ohorongo Cement in Namibia, the fly ash from Ash Resource's Lethabo plant in Vereeniging and admixtures from Chryso's plant in Cape Town.

About 700 litres of Chryso's products have been shipped 2 300 km across the South Atlantic Ocean to St Helena.

Over 700 units of precast Core-loc armour units (7 tonnes per unit) and hollow blocks (27 tonnes per unit before filled with stone) were placed by crawler cranes via GPS around the wharf from the surface bed to just above sea level.

"It was extremely important to keep quantities of materials to a minimum as there was limited space on the Basil Read cargo ship NP Glory 4," Brenton Brouard, Chryso Southern Africa, technical manager, explains. "When designing different concrete mix designs, for example, we could not use vast quantities of dune sand because that still had to be transported to the island."

Concrete was specified for the airport runway, terminal building, air traffic control building, fire department building and permanent wharf. Chryso® Plast Omega 101 was used in all of the general concrete as well as the concrete for the runway and the precast concrete used to construct the 700 precast Core-loc armour units and hollow blocks for the wharf. The 100 m long, 10 m high and 13 m wide wharf has a rock breakwater that had to be protected from any possible damage caused by ships.

"When formulating the concrete mix design for the precast units, it was important to achieve a mix with optimised properties. The concrete had to fill complex mould shapes with limited bleed and settlement. Excessive bleed water would lead to unsightly voids in certain element sections, as well as increasing the risk of both plastic settlement and shrinkage cracking," Brouard says.

Therefore 12 mm Chryso® Fibre Plus polypropylene micro fibres were used to increase the cohesiveness of the mix, while Chryso® Plast Omega 101 assisted in creating an optimised slump. Chryso® Dem Oleo SM was used on all of the moulds to ensure an easy release once the concrete had set, without causing damage to the moulds or concrete.

Concrete also had to be transported over long distances on the island, affecting the slump retention and workability. Chryso® Tard CE retarder was used to retard the concrete setting time. When necessary, Chryso® Rescue Pack slump revival admixture was added to the concrete in a readymix truck immediately before discharge.

"This increases workability and makes it easier to pump or discharge concrete from trucks that may have travelled long distances or been stationary on site for extended periods," Brouard says. Chryso's biodegradable, environmental-friendly cleaning agents Barracuda, Fusion and Truck Wash were used to clean and line the readymix trucks and keep them in good condition.

Concrete was specified for the airport runway, terminal building, air traffic control building, fire department building and permanent wharf.

All of the materials used in the production of the concrete required, apart from the crushed aggregate, were sourced off the island.

In order to reduce the need for future maintenance, it was decided to build the runway with concrete instead of asphalt. Manufactured from 27 000 m³ of concrete, the runway is 1 950 m in length, 45 m wide and has a maximum thickness of 350 mm in parts, with reduced thickness to the 'off-keel' sections. The runway is mostly unreinforced.

Commenting on the complexity and size of the project, Jimmy Johnston, project director, BRSHAP, says: "The long logistical chain made planning vital, and BRSHAP needed reliable suppliers such as Chryso that can provide the correct product at the required amount on an agreed date and time." ▲

Report Back on FloorSem National Seminar

Another successful seminar roadshow was organised by the Concrete Society of Southern Africa recently, focusing on the many aspects of concrete floors and slabs on grade. The seminar, chaired by the CEO of the Society, John Sheath, was held on 4 consecutive days in Durban, Port Elizabeth, Cape Town and Johannesburg, where both local and overseas industry experts in concrete flooring, presented the latest developments in systems, design, measurement, materials, construction and trouble-shooting.

First to speak was Ian Buchanan, Royal Consulting Services who, in his own inimitable style, described the current approaches used to measure both level and flatness of concrete floors. The use of a 'straightedge' for example, he suggested is an inappropriate and unenforceable specification, still inflicted on the construction industry today, because it is impractical; it has no fixed application method; it has no definition of number of tests and is open to a variety of interpretations.

How exactly, would you assess level and flatness characteristics of this floor with a straight-edge?

Worked examples were illustrated to assist delegates in understanding the need for level and flat floors in industrial applications. Also discussed was the method by which a floor constructed to a Free Movement (FM) flatness and level specification, could be converted to accommodate a Very Narrow Aisle (VNA) retrieval and storage system.

He concluded by stating that of all the materials used in an industrial building, the only "living" element which is shaped, is the concrete used in the construction of the surface bed. We get one chance to get it right, so USE THAT CHANCE WISELY!

Next, delegates had the privilege of listening to Darryl Eddy, Regional Managing Director of Twintec, based in the UK and responsible for all technical, commercial, sales and marketing activities for sub-Saharan Africa, and for all Twintec Group's Research and Development activity.

Darryl's presentation focused on 'jointless' steel-fibre reinforced concrete (SFRC) floors, and covered a comprehensive range of issues such as the demands of a modern warehouse, design and engineering considerations, current and potential applications and how 'jointless' SFRC floors are constructed. This was well supported by numerous successful case studies from many parts of the world, including South Africa.

The solutions to many of the challenges facing warehouse operators currently, he felt are to:

- Reduce the number of formed joints
- Increase reinforcement level
- Minimise shrinkage
- Armour the formed joints
- Eliminate sawn contraction joints
- Select appropriate flatness specification
- Increase surface hardness
- Provide detailing that is 'industrial floor slab' specific

Darryl concluded that SFRC suits the demands of a modern warehouse and it can be used in any industrial application, anywhere. SFRC floors offer many benefits such as the elimination of sawn induced joints; a reduction in overall life cost; improved efficiency and operator comfort; greater flexibility; reduced maintenance costs; reduced programme times and improved tolerances.

Good design guidance exists to validate SFRC, but, Darryl emphasised that it must be delivered by experienced contractors working to the requirements of TR34 specification.

Successful SFRC floor in South Africa

The next topic to be presented was the 'jointless' shrinkage-compensated concrete system by Peter Norton, Concrete Laser Flooring. Peter began his presentation by describing some of the many problems that property owners and operators experience with curled joints in conventional jointed floors. For example – damaged hyster wheels, load spillage, slower traffic, repair costs, etc.

The 'jointless' shrinkage-compensated system has three pillars:

- Anti-shrinkage concrete
- High steel fibre reinforcement throughout
- Total Quality Management

Peter explained that the use of an anti-shrinkage admixture in the concrete mix provided a force greater than the force of normal drying shrinkage, and therefore, no cracking develops and no joints are needed. This was illustrated in graphical form.

Special steel fibres were used and the concrete is fully saturated with fibres occurring in the mix every 15 mm. This provides much better tensile strength and strain-hardening

Special machine for blowing and dispensing steel fibres into the mixer

performance. During the mixing process, the steel fibres are literally 'blown' into the mixer, thus giving a consistently even spread and avoiding any balling of the fibres in the mix.

The fibres are all aligned when originally packed, and this also helps to achieve even fibre distribution in the concrete mix

In terms of Total Quality Management, improved quality control techniques are adopted using checklist-based procedures. A fully-owned laboratory tests the cement, aggregate and admixture cocktail, whilst concrete testing includes flexural, shrinkage and compression. In addition, computerized measuring of the floor is carried out with 'Rack Track' after the pouring, and printed daily reports are produced showing achieved surface tolerances.

Benefits of this system are claimed to be: no shrinkage = less joints; less joints = better customer satisfaction; better concrete = more durable floor; durable floor = better life-cycle costs.

Paul Heymans, Amsteele Systems introduced a newly-formed company, PT-Pave, which he explained was a joint venture between Chris Howes Construction and Amsteele Systems, formed to offer the industry a complete package in post-tensioned concrete pavements.

He defined post-tensioning as the "counteraction of concrete's natural weakness in tension by strengthening and reinforcing the concrete with the use of high tensile steel

External slab prior to pour with bonded PT

cables, which exert a compressive force onto the concrete member and providing an uplift force between supports". Paul went on to describe the material requirements for the bonded slab post-tensioning, which included the multi-strand steel cables, anchors, ducts and grout, followed by the materials for unbonded slab post-tensioning – single strand steel cable, polyethylene coating, anchors and wedges.

Some of the many applications that Paul described were floors for distribution centres, warehouses, refrigerated stores, bulk storage facilities, bulk container facilities, raft slabs, reservoir floors and even tennis courts.

Full coverage of the design aspects, installation, concrete placement and post-concreting activities (e.g. stripping curing, and tensioning) were presented. Some cost comparisons were made with other forms of concrete floor construction, and whilst PT floors will never compete with an unreinforced slab situation, they are very economical compared with conventional reinforced concrete floors and in some cases with fibre-reinforced concrete.

Paul stated that post-tensioning optimizes the cost of subgrade preparation due to the PT pavement's strength and stiffness. The system uses an optimum combination of post-tensioning, slab thickness and concrete tensile strength to produce a cost-effective slab on grade solution, and is one of the most durable and robust methods of pavement construction in general, and on poor ground.

Delegates were promised something completely different by the next presenter, Johan Coetzee, World of Decorative Concrete and he certainly fulfilled his promise. Focusing on polished concrete (which, by the way is not the same as ground and sealed concrete), Johan took delegates through the grinding and polishing process in quite some detail, highlighting the pitfalls that many inexperienced contractors face, due mainly to a lack of knowledge of the process.

Some of these included leaving straight edge marks and footprints; bad and inconsistent mixing; bad placing; bad infill work; insufficient rebar cover and general bad workmanship. All these defects he attributed in one way or another, to unskilled applicators, sub-standard

Concrete before polishing

Concrete after polishing

Polished walkway at Moses Mabhida Stadium, Durban

Remarkable finishes can be achieved with polished concrete

materials and/or a lack of knowledge of the product by the Applicator, Specifier and even the supplier.

It did not help either, he suggested, not having a formal Code of Conduct in place for decorative concrete.

Johan had clear messages for the engineers, the architects and quantity surveyors, setting out design and specification requirements that would ensure successful polished concrete and decorative concrete in general. He concluded his presentation by showing images of successful, completed projects that highlighted that dull, grey floors can be transformed into beautiful, easy-clean, environmentally-friendly and durable surfaces.

Final presenter of the day was Bryan Perrie, Managing Director of The Concrete Institute who described the common failures in concrete floors and how to specify to prevent them. He began by citing the results of some research that the Institute had carried out on the level and types of enquiries that the organisation had handled over the past 40 years.

During this time, he stated problems with concrete floors failing represented the highest incidence of enquiries, site visits and reports, and despite numerous interventions, not much has changed – there is still a strong need for education.

Bryan covered typical defects that are experienced with concrete floors and slabs, the three main categories being surface, joint and structural. Each one was dealt with in some detail:

SURFACE

- Scaling
- Crazing
- Dusting
- Pop-outs
- Surface irregularities
- Plastic shrinkage cracking
- Tolerances

JOINT

- Curling
- Edge failures
- Freezing of dowels
- Faulting
- Excessive opening
- Sealant loss and failure
- Pumping

STRUCTURAL

- Transverse, longitudinal and diagonal cracking
- Corner breaks
- Restrained shrinkage cracking
- Vertical slab movement

He also went into a lot of detail describing the various design-related and construction-related causes of these defects. Research had shown, he confirmed, that 40% of problems were caused by design/detailing issues, whilst 60% were construction-related.

Bryan continued with an overview of how specifying could be improved in order to mitigate a lot of the problems experienced. Aspects mentioned were factors affecting performance, subgrade support, concrete quality and thickness, designing for joints, workmanship and finishes.

A golden rule that Bryan put forward was “do not specify anything that cannot, or will not, be measured”. ▲

ACKNOWLEDGEMENTS

Our sincere gratitude goes to **Lafarge South Africa** who were our National Sponsors for this whole event.

Thank you also the many companies who displayed their products and services at the seminar. These were:

- BASF
- Chryso
- Twintec
- Samson Technologies
- CLF Flooring
- PPC
- SIKA
- Royal Consulting
- Amsteele Systems

Concrete repair specialists celebrate their 20th birthday

SPEC-CON (Pty) Limited, a concrete repair specialist company, was formed 20 years ago by a group of professionals working in the construction industry who identified the need for a committed specialist in the field of concrete repair and structural rehabilitation.

The company, with its headquarters in Midrand, Johannesburg, South Africa, has two regional offices in Newcastle, Kwa-Zulu Natal and Vanderbijlpark. Spec-con recently opened a branch in Kolwezi, in the Democratic Republic of Congo, and hopes to extend its services into sub-Saharan Africa with a particular view of increasing its footprint in the mining industry.

Spec-con operates throughout the African continent and is also actively involved with projects in Botswana, DRC, Mozambique, and Namibia. The company has worked in Southern Russia, East and West Africa and the Indian Ocean islands.

Its client base includes companies such as, AcelorMittal, Anglogold Ashanti, Natref, Kinross Mining, Barrick Mining, IAMGold, FL Smidth, Sappi, Sasol and Fipag.

Project Management

The company is also currently involved in a project and technical management capacity, looking after the civils and structural steel reparation component of the R2 billion reline of AcelorMittal's N5 Blast Furnace in Newcastle, KZN. The four year project involves structural design, tender administration, measurement and supervision of the implementation phases.

Spec-con employs 40 people, comprising 10 qualified engineers, technicians and project managers, and 30 artisan repair specialist. It sees skills transfer as a very useful tool in promoting its services, and provides on-site and class-room training, which includes proper use of the equipment, understanding of the material chemistry, safety and environmental considerations, as well as record-keeping and quality control.

Concrete Repair

Structures the world over, built in the previous five decades, are failing to meet service life expectations due to three factors: the environment, durability and the lack of quality control during the construction phase. Spec-con saw the need for a dedicated specialist in this field whose primary aim is to add value by extending the service life of strategic structures in the mining and industrial environment. The founders of Spec-con, having worked in similar environments in northern Europe, were familiar with specialized products and techniques required to repair deteriorating concrete structures.

Spec-con offers specialized services in the areas of Concrete Repair, Structural Grouting, Structural Investigation, Concrete Crack Injection, Gunite & Shotcreting Work, Core Drilling as well as preparing budgets and formulating structural maintenance strategies.

Diagnostic Survey

Spec-con's diagnostic survey division assists engineers and consultants in ascertaining the health of a structure before any structural repair strategy is decided upon. The survey establishes the cause and severity of the deterioration, by encompassing detailed inspections and the use of ultra sound and GRP technology. These techniques assess the severity and quantify the extent of the defects, in order to accurately estimate the potential costs.

The information gleaned from the diagnostic survey allows the client to make informed decisions regarding his assets.

Repair Techniques

Some of the techniques that Spec-con applies to different projects include:

- Patch repair that entails partial depth repair and full depth repair.
- Shutter and cast methods – where formwork is erected prior to casting of specialized grouts and repair products.
- Grouting and crack injection.

Systematic Approach

After deciding on the repair technique to be used, the implementation phase follows. A systematic approach to concrete repair includes identifying, testing, preparing, repairing, protecting, as well as cataloging and keeping accurate records as the work proceeds. As part of the quality control procedures - a checklist is drawn up where each phase of the repair is completed and checked before proceeding.

The actual repair involves the removal of all corrosion from the reinforcing steel and the use of premixed concrete repair mortars applied in multiple layers to the level of the adjacent undisturbed concrete. Protection of the repaired structure is crucial, and protective coatings are selected to provide anti-carbonation protection, effective cover, crack bridging properties and a uniform appearance and color.

Economic Climate

As the economic climate continues to be harsh, every organization strives to cut cost - and it is here that concrete repair and rehabilitation provides a solution, as it makes sound economic sense to upgrade buildings and structures, rather than to knock them down.

As attention returns to repairing and upgrading of our infrastructure, there is a need for professionally applied, cost-effective solutions that will meet rigorous specification criteria for quality and durability.

Spec-con prides itself on being able to respond quickly to the client's needs anywhere on the African continent.

The directors and staff of Spec-con are proud to have reached their 20 year milestone and they look forward to a successful future in the specialized field of concert rehabilitation. ▲

Safety concerns with twin wall system

In this regular section of Concrete Beton, we will 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.

The product is used by standing it vertically over starter bars, then filling the void between the leaves with structural concrete. Panels are typically 3 m high, up to 8 m long and the leaves are in the range 65-80 mm thick with a 50-100 mm void. A panel can weigh 10T or more.

Some failures have been observed on civil engineering projects by a reporter. He says that starter bars must be coordinated with the lattices which hold the two leaves together. Any damage to the lattices will radically reduce the ability of the panel to resist the pressure of the wet concrete tending to push the two leaves apart. Raking props are used to give lateral restraint to the head of the panels. Properly engineered equipment is needed to meet the minimum 2.5% lateral restraint load, or the calculated wind load, whichever greater. A particular risk is that the fixings at the bottom of the props lack strength, because they are connected to an immature concrete slab. Then, for the props to form a rigid triangulated structure with the panel, the base of the panel must be restrained against horizontal movement. Often a panel is shimmed to level, and the shims have very little friction. If there are two props along the length of the panel and one is adjusted in length but the others is not, the panel will rotate in plan adding an over-turning moment to the system.

Concrete twin wall systems are hybrid in-situ/ precast building products used to construct concrete walls quickly. The product comprises of two leaves of reinforced concrete held apart by reinforcement lattices.

Also shims may be kicked out or work loose. A combination of the two effects above was identified as the cause of a panel over-turning on a recent project; fortunately no one was injured. The concrete mix, its temperature and the rate of rise of the pour, all influence the shutter pressure. Because the void is so thin, the rate of pour may need to be very low. The way in which the twin-wall panels are made affects their performance as the ability of the panel to resist the pressure of the site-placed concrete is therefore entirely reliant on the 20 mm, or so, embedment of the lattice into the (interior) cover zone of the panels. It is suggested by the reporter that this capacity is somewhat uncertain.

Comments

The reporter is right that the starters need to be positioned to not clash with the lattice and there may be a temptation to force the panel into place or bend bars to make it fit. Sometimes kickers are used for positioning and to form a shear key. Because this type of construction is inherently quick, the bolts which fix the bottom end of the inclined prop are likely to be into immature concrete. There is a role here for the Temporary Works Coordinator (TWC) who is responsible for ensuring that the contractor's procedures for the control of temporary works are implemented on site. The TWC is responsible for ensuring that a suitable temporary works design is prepared, checked and implemented on site in accordance with the relevant drawings and specification. The principal activities of the TWC are listed in Clause 7.2.5 of BS5975:2008. This, in conjunction with appropriate "Designer" identification of risk (CDM 2007), should reduce the risk. The TWC would be expected to require a base tie to fully triangulate the system and not rely on marginal base connections.

**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 Structural Safety (CROSS) at www.structural-safety.co.za* ▲

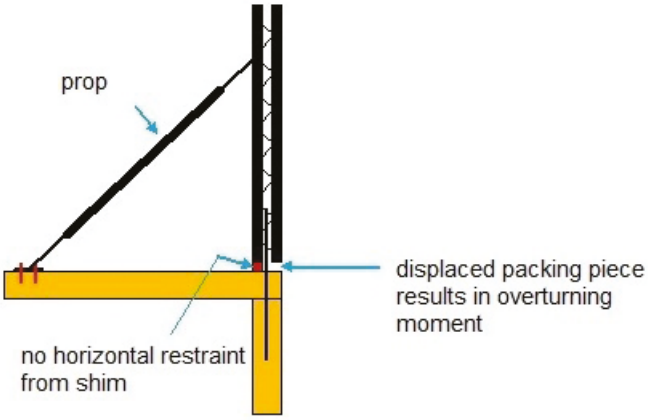


Diagram showing supports

Inland Branch members and students visit the Nizamiye Complex, Midrand

The Inland Branch of the Concrete Society arranged for a site visit to the Nizamiye Complex in Midrand which houses the Nizamiye Mosque, Private School (for 800 pupils), Hostel, Clinic, Restaurant, Conferences Hall and Bazaar. The complex conducts quality education in Islamic and Modern sciences, affordable health services and social and cultural activities.

The visit was focused on the Mosque which was completed in and opened in April 2012 and according to the host, site manager and engineer on the project, Orhan Celik, was the brain child of 77-year old, Ali Katircioglu, a prominent Turkish businessman, who came to South Africa seven years ago. It is now the largest mosque in the southern hemisphere.

The mosque, designed to accommodate up to 6,000 worshippers, is a smaller replica of the Ottoman Selimiye Camii Mosque in Edirne, Turkey, completed in the 1570s and now a World Heritage Site. The Midrand version is some 25% smaller than the Turkish original. The plans for the mosque were designed in Turkey and adapted by a South African architect to South African building standards.

Inside the mosque resonated with serenity; time seemed to stop the moment one entered. Some of the features shown were generously proportioned courtyards, arched stained-glass windows, marble columns, sweeping staircases, fountains, rich mosaics and, one of the most stunning features, the authentic Turkish calligraphy on both the walls and ceiling, and the custom-made 100% wool carpet below, a design echo of the interior décor of the massive dome.

The entire monolithic structure is constructed in concrete and even the exterior walls, which look as if they had been built in original stone, are in reality plastered, in-situ concrete covered with a special quartz-filled coating to simulate actual stone. Total concrete volume use in the whole complex was 3,000 m^3.

Hard to miss, its dome rises 32 metres and is framed on four corners by four towering minarets, each 55 metres high. There are an additional 4 half domes and 21 smaller domes. The main dome, 24 metres in diameter, and cast in 280 m^3 of ready-mixed concrete in one pour lasting approximately 20 hours, is covered with 48 tons of lead. Due to the complexity of the dome, the formwork for the concrete was produced in the traditional Turkish way using timber. The towers (minarets), also cast in concrete, are 5 metres in diameter and one them features 2 spiral staircases, which rise up inside to a three-stage level platform.

The solid cast foundation for the mosque was cast 700 mm thick, whilst the bases for the towers were extended to a thickness of 1,7 metres.

On being asked about the total project cost, Orhan Celik replied that only 4 people in the world know the actual cost of the entire complex. ▲

The Western Cape Branch strengthens networking with local industry associations

In August the Western Cape Branch were proud to host a site visit in conjunction with Concrete Units at their premises where they are currently manufacturing the precast concrete tower segments for the Gouda Windfarm for Spanish Wind Turbine Manufacturer, Acciona Windpower, with quality management by Concrete Growth. Acciona Windpower is an international forerunner with their patented certified concrete tower technology for up to 120 m hub heights supporting their 3 MW turbines. The windf-arm is now being constructed as part of the South African government's REIPPPP which is presently being roled out with 9000 MW earmarked from wind energy in the next 20 years. This is the first wind farm in South Africa using concrete towers as opposed to the conventional steel towers.

Concrete towers for wind turbine generators are particularly important for South Africa due to the advantages they have over steel towers. The most obvious being the impact on local economic development as opposed to steel towers the plate of which is imported. Less obvious, but equally significant, is that taller towers can be constructed at reduced cost of energy, especially since they make up a substantial proportion of the cost of capital (and thus cost of energy) of a windfarm. A significant opportunity therefore presents itself for the South African concrete industry.

Once completed, 46 precast tower structures will be constructed by early 2015. Each tower structure will be 100 m high consisting of 5 times 20 m long tapered cylindrical units, all in all made up of 17 precast tower segments, each weighing in the order of 60 tonnes. The segments are manufactured at Airport Industria Cape Town, and transported to Gouda site (100 + km) where they are assembled and post-tensioned onto in-situ foundations. In the order of 17 000 m^3 of concrete will be used for the towers. High strength self-compacting concrete is used, and the structural and concrete materials design are based on the Eurocode.

The visit was attended by over 70 industry people – and an open invitation was extended to the Master Builders Western Cape branch as well as SAICE Western Cape. Visitors were given the opportunity to share the challenges of working on the project and understanding the lessons learnt, as well as how other projects can benefit.

Aquarium Site Visit

In September, branch members were treated to a unique site visit at the Two Ocean's Aquarium in the V&A Waterfront in Cape Town. Jacques Sowden from Group Five was the host and Mike de Maine from Two Oceans Aquarium explained in detail how the tank operated. The aquarium will be using this new tank as a warmer more tropical and more colorful tank to brighten up the display. It is unique in its design in that everything was incorporated into the tank bio-filters which has not been done before due to budgetary constraints.

The Perspex, which of course looks like glass, is the main viewing panel and is currently being installed. The weight of this will be approximately 12 tons. On completion, there will be a curved view tunnel which will give visitors the impression they are inside the tank. The project will be completed in December 2014 – so if you are on holiday during that time, do make sure you pay a visit!

Special thanks to Group Five, Two Oceans Aquarium and Peri for their support.

The annual cocktail function is to be held at the Grainger Bay Hotel school on the 20th November – we look forward to seeing all our valued members there. ▲

Kwa-Zulu Natal Cube Competition and EPD

Kevin Quayle - General Manager, NPC, sponsor of the event

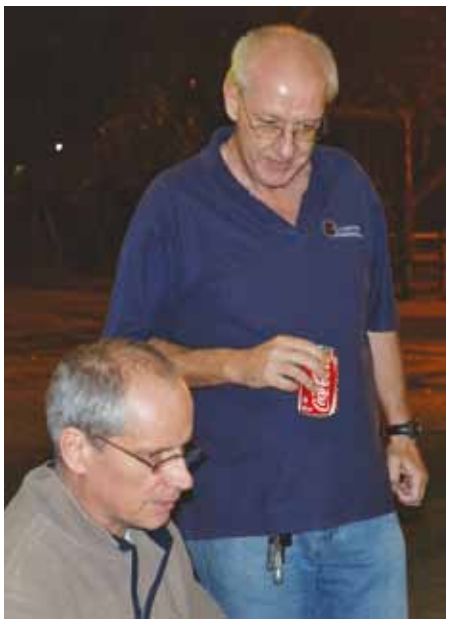
In attendance at this year's event were seven CSSA committee members supported by a good turnout of students and a few guests.

The cube competition comprised an industry and a student category the same as last year, with the EPD show down taking place on the night of the presentations for the cube contest. Twenty five students entered the student cube competition, and twelve people entered the industry cube competition. Thirteen teams of students (3 people per team) entered the EPD competition.

For this year's competition a checklist was developed that could be used in future by anyone delegated or volunteering to run the competition even without prior experience. By the conclusion of the event a few more items were added and this list and it looks like it is now fit for purpose for next year.

Competition between teams was as usual rowdy and very spirited with students seeing first-hand what concrete looks like and how it behaves under duress. The event was well supported and the students really appreciated and enjoyed the evening. The results have been tabulated and formally submitted to the branch chairman.

The evening went off well and many thanks must go to the NPC for their most valued and appreciated sponsorship. ▲



Committee Members - Steve Schulte and Rod Raw

Student - 1st Place

Committee Member - Craig Handler

Student - 2nd Place

Student - 3rd Place

Typical failure after load was applied

Industry - 1st Place

Industry - 2nd Place

Industry - 3rd Place

Annual Concrete Boat Race Day 2014

A new venue greeted the hundreds of students, members and their guests at this year's Annual Concrete Boat Race Day.

Benoni Sailing Club at Homestead Lake, in Benoni was selected because of its prime location, generous size and amenities – all of which easily accommodated this growing event in the Inland Branch calendar of activities.

The day itself started perfectly with the sun rising over the lake with a cool breeze, promising to keep everyone comfortable on a potentially hot spring day. The 40 or so concrete boats were lined up along the lakeside, having been carefully and enthusiastically constructed to new rules by university students and industry companies throughout the region.

First came the judging of the students' construction projects and four judges were on hand to adjudicate. The project required the university students to design and construct cement-based crafts of the '2-person paddle-ski' kind and the judges this year were:

- Jacques Smith – Go Consult
- George Evans – PPC Cement
- Marius Grassman – Concrete Testing Equipment
- Hennie van Heerden – Sephaku Cement

The construction of the boats was carried out to very strict criteria, the most important of which was that they must float! The design was amended this year to a 2-person craft which provided additional challenges to the students in terms of design. The boats had to be made from a freely available, commonly-used cement, mortar or concrete. Lightweight aggregate could be used, and the binding agent had to be predominantly cementitious in composition.

Limited quantities of other materials were allowed, provided that they did not replace the binding action of the cement. The strength and stiffness of the boat had to be entirely due to the cementing action between hardened concrete or mortar and its reinforcement. Non-concrete parts were not allowed to contribute to the strength or structural integrity of the boat and could be removed at the judges' discretion.

Once the judging was over, the racing began, led by Johan van Wyk, Committee Member and MC for the day, who ably steered the various heats to reach the stage where 3 'final' races decided the winners in the Student, Industry and Ladies categories. The racing was very competitive, and different shapes and buoyancies of the boats soon sorted fast-moving craft from the slow. Races took the form of relays where an 8-person relay team paddled 4 legs across a pre-determined course on the lake.

The prize winners in the construction category were as follows:

Position	Boat name	Academic Institution	Sponsors
1st	Mastercrafts	University of Johannesburg	BASF, Go Consult
2nd	The Kraken	University of Johannesburg	Metier Mixed Concrete, SIKA, Stefanutti Stocks
3rd	Torpedo	University of Johannesburg	Lafarge, Ash Resources

After all the heats and the finals had been held, the winners in each category were as follows:

Student Race	Boat Name	Academic Institution
1st	The Kraken	University of Johannesburg
2nd	Glow in the Dark	University of Johannesburg
3rd	Smarties	University of Johannesburg
Industry Race	**Boat Name**	**Organisation**
1st	Herbie	Ash Resources (Pty) Ltd
2nd	Ash Lethabo	Ash Resources (Pty) Ltd
3rd	Lafarge Heavyweights	Lafarge
Ladies Race	**Boat Name**	**Organisation**
1st	AfriSam Ladies	AfriSam
2nd	Smarties	Mapei
Quickest Sinker	**Boat Name**	**Organisation**
5 seconds	The Ankor	Group Five

Winning Team – Construction Category

Runner Up – Construction Category

3rd Place – Construction Category

Monetary prizes for the top 3 students' construction projects, were donated by PPC Cement, and presented to the winners by the Inland Branch Chairperson, Andrew Schmidt.

A special award, donated by the Southern African Readymix Association, was presented to Deon Kruger from the University of Johannesburg for being the lecturer that registered the greatest number of students and boats.

Medals were awarded to the first three teams in the boat race categories.

Winning Boat Construction Category

Runner Up Boat Construction Category

3rd Place Boat Construction Category

The Inland Branch of the Concrete Society would like to thank all the Sponsors for their generous contribution to, and continuing support of, the Annual Boat Race Day!

Thanks also to the Benoni Sailing Club for the use of their facilities; National Paramedics for their usual excellent support on the day; Life Savers; Francois Bain and his Diving team and Quentin Turner, John Sheath and Michelle Fick for the photographs. ▲

1st Place Student race

1st Place Ladies

1st Place Industry

Winning Lecturer

Inland Branch

DATE	MEETING/EVENT	VENUE	CONVENOR
11 February 2015	Committee Meeting	BASF, Midrand	Roelof Jacobs
11 March 2015	Committee Meeting	RHDHV, Pretoria	Roelof Jacobs
19 March 2015	Technical Meeting	TBA	Hanlie Turner
15 April 2015	Committee Meeting	Chryso-abe, Jet Park	Roelof Jacobs
May 2015	Technical Meeting	TBA	Hanlie Turner
20 May 2015	Committee Meeting	Lafarge, Longmeadow	Roelof Jacobs
11 June 2015	Inland Branch Fulton Awards Dinner	TBA	Roelof Jacobs/ Natalie Johnson/Tina Coetzee
17 June 2015	Committee Meeting	PPC, Sandton	Roelof Jacobs
15 July 2015	Committee Meeting	Ash Resources, Longmeadow	Roelof Jacobs
July 2015	Technical Meeting	TBA	Hanlie Turner
12 August 2015	Committee Meeting	Misty Hills, Muldersdrift	Roelof Jacobs
14 August 2015	EPD Casting	Not applicable	Donovan Leach/Jannes Bester/ Johan van Wyk
21 August 2015	EPD Crush-In	PPC Jupiter Works	Donovan Leach/Jannes Bester/ Johan van Wyk
09 September 2015	Boat Race Sub-Committee Meeting	TBA	Roelof Jacobs/ Johan van Wyk/Michelle Fick
12 September 2015	Annual Concrete Boat Race Day	Benoni Sailing Club, Homestead Lake, Benoni	Roelof Jacobs/ Johan van Wyk/Michelle Fick
16 September 2015	Committee/Planning Meeting	Sephaku, Centurion	Roelof Jacobs
14 October 2015	Committee Meeting	AfriSam, Constantia Park	Roelof Jacobs
11 November 2015	Committee Meeting	UJ, Auckland Park Campus	Roelof Jacobs
13 November 2015	Chairman's Breakfast	Blue Valley Golf Estate	Roelof Jacobs/Natalie Johnson

**Excludes Site Visits – to be announced later*

International

DATE	MEETING/EVENT	VENUE	CONVENOR
11 – 13 May 2015	International Concrete Sustainability Conference	Miami, Florida, USA	Lionel Lemay
18 – 20 May 2015	2015 fib Symposium: "Concrete – Innovation and Design	Copenhagen, Denmark	Kaare Dahl
15 – 17 October 2015	International Congress on Polymers in Concrete	Singapore	Lu Jin Ping

KwaZulu-Natal Branch

DATE	MEETING/EVENT	VENUE	CONVENOR
February 2015	Committee Meeting	UKZN	Theresa du Plessis
February 2015	MTM	UKZN	Theresa du Plessis
March 2015	Committee Meeting	UKZN	Theresa du Plessis
March 2015	Event: AGM/ Concrete Achiever Award	UKZN	Theresa du Plessis
April 2015	Committee Meeting	UKZN	Rod Raw
April 2015	Site Visit	TBC	Rod Raw
May 2015	Committee Meeting	UKZN	Rod Raw
May 2015	MTM	UKZN	Rod Raw
June 2015	Fulton Award – KZN Function	TBC	Rod Raw
July 2015	Committee Meeting	UKZN	Rod Raw
July 2015	MTM	UKZN	Rod Raw
August 2015	Event: Golf Day	Beachwood Country Club	Andries Van Rensburg, Sub:
September 2015	Event: EPD and Cube Competition	Berea Rovers Club	Steve Schulte, Sub: Craig Handler
October 2015	Committee Meeting	UKZN	Rod Raw
October 2015	Site Visit	TBC	Rod Raw
November 2015	Committee Meeting	UKZN	Rod Raw
November 2015	MTM	UKZN	Rod Raw

National Office

DATE	MEETING/EVENT	VENUE	CONVENOR
30 November 2014	Closing Date for 2015 Fulton Awards Entries	-	CSSA Administration
12 December 2014	CSSA Head Office Closing for December 2014 Holidays	-	-
February 2015	1st Leg of Fulton Awards Judging	-	Fulton Awards Judges
March 2015	Concrete Beton	Posted to All CSSA Members	CSSA Administration
March 2015	2nd Leg of Fulton Awards Judging	-	Fulton Awards Judges
02 – 05 March 2015	Seminar Road Show: RepSem 2015 THE Concrete Repair & Protection Seminar	Cape Town, Port Elizabeth, Durban, Johannesburg	Seminar Committee
24 March 2015	AGM 2015	Emperor's Palace, Kempton Park	CSSA President
25 March 2015	Board Meeting	Emperor's Palace, Kempton Park	CSSA President
31 March 2015	2015 Fulton Awards Weekend Bookings Open	-	CSSA Administration
April 2015	2014/2015 Source Book	Posted to All CSSA Members	CSSA Administration
05 - 07 June 2015	2015 Fulton Awards Weekend	Champagne Sports Resort, Drakensburg	Fulton Awards Committee
June 2015	2015 Fulton Awards Concrete Beton	Posted to All CSSA Members	CSSA Administration
25 June 2015	Board Meeting	Emperor's Palace, Kempton Park	CSSA President
September 2015	Concrete Beton	Posted to All CSSA Members	CSSA Administration
07- 10 September 2015	Seminar Road Show	Cape Town, Port Elizabeth, Durban, Johannesburg	Seminar Committee
22 October 2015	Board Meeting	Emperor's Palace, Kempton park	CSSA President
31 October 2015	2016 Membership Renewals Notices	E-Mailed to All CSSA Members	CSSA Administration
November 2015	Concrete Beton	Posted to All CSSA Members	CSSA Administration

MEMBERSHIP DETAILS

PLATINUM

COMPANY	CONTACT	TEL	E-MAIL
AfriSam SA (Pty) Ltd	Mr Mike McDonald	011-670-5500	mike.mcdonald@za.afrisam.com
BASF Construction Chemicals SA (Pty) Ltd	Mr Morgan Govender	011-203-2405	morgan.govender@basf.com
Lafarge Industries South Africa (Pty) Ltd	Mrs Alta Theron	011-657-1025	alta.theron@lafarge-za.lafarge.com
PPC Ltd	Mr Donovan Leach	011-386-9000	donovan.leach@ppc.co.za

GOLD

AECOM SA (Pty) Ltd	Mr Philip Ronne	021-950-7500	philip.ronne@aecom.com
Chryso Southern Africa Group	Mr Norman Seymore	011-306-9000	charne@chrysosa-abe.co.za
Hatch Goba (Pty) Ltd	Mr Gary Hooper	031-536-9400	gary.hooper@hatch.co.za
Sephaku Cement	Mr Graeme Smith	012-684-6328	gsmith@sephakucement.co.za
Sika South Africa (Pty) Ltd	Mr Paul Adams	031-792-6500	adams.paul@za.sika.com

SILVER

Ash Resources (Pty) Ltd	Mr David Kanguwe	011-657-2320	david.kanguwe@ashresources.co.za
The Concrete Institute	Mr Bryan Perrie	011-315-0300	bryanp@theconcreteinstitute.org.za
W.R. Grace	Mr Deon Van Den Berg	011-923-4630	deon.vandenberg@grace.com
Stoncor Africa (Pty) Ltd	Mr Ian Hague	011-254-5500	ian.hague@stoncor.com
Mapei SA (Pty) Ltd	Mr Christo Van Der Merwe	011-552-8476	c.vdmerwe@mapei.co.za
NPC Cimpor (Pty) Ltd	Mr Matthew Major	031-450-4412	majorm@intercement.com
SNA Civil & Structural Engineers (Pty) Ltd	Mr Ken Malcomson	012-842-0000	malcomson.k@sna.co.za
Twintec Limited	Mr Darryl Eddy	021-974-6136	d.eddy@twintec.co.za
Royal Haskoning DHV	Mr Alwyn Truter	012-367-5800	alwyn.truter@rhdhv.com
Department of Water and Sanitation	Mr Harry Swart	021-872-0591	swarth@dwa.gov.za

BRONZE

COMPANY	CONTACT	ADDRESS	TEL	E-MAIL
BAMR (Pty) Ltd	Mr Graham Duk	PO Box 23973 CLAREMONT Western Cape 7735	021-683-2100	sales@bamr.co.za
Bapedi Civil and Structural Consultants cc	Mr Tumi Kunutu	PO Box 412689 CRAIGHALL Gauteng 2024	011-326-3227	tumi@bapediconsult.co.za
Baseline Civil Contractors (Pty) Ltd	Mr Petrus Geldenhuys	PO Box 491 SOMERSET WEST Western Cape 7129	021-905-2545	petrus@baseline.co.za
Chris Howes Construction cck	Mr Chris Howes	PO Box 34408 NEWTON PARK Eastern Cape 6055	041-365-2711	chris@chrishowes.co.za
CLF Concrete Laser Flooring (Pty) Ltd	Mr Peter Norton	PO Box 2589 WITKOPPEN Gauteng 2068	011-704-5557	peter@concreteflooring.co.za
Concrete 4 U (Pty) Ltd	Mr Fanie Smith	PO Box 5064 WALMER Eastern Cape 6065	041-501-5400	fanie@readymix.co.za
Concrete Manufacturers Association	Mr Wally Armstong	Postnet Suite 8612 Private Bag X32 KEMPTON PARK Gauteng 1620	011-805-6742	director@cma.org.za
Concrete Testing Equipment	Mr Marius Grassman	PO Box 77110 FONTAINEBLEAU Gauteng 2032	011-708-6141	marius@cte-labsupplies.co.za
Contest	Mr Rod Raw	PO Box 1675 HILLCREST KwaZulu-Natal 3650	031-700-9394	rodr@contest.co.za
Dick King Lab Supplies (Pty) Ltd	Mr Dick King	PO Box 82138 SOUTHDALE Gauteng 2135	011-499-9400	lanserac@iafrica.com
Doka South Africa (Pty) Ltd	Mr David King	PO Box 305 KUILS RIVER Western Cape 7579	021-905-3295	David.King@doka.com
Empa Structures cc	Mr Cameron Bain	PO Box 3846 DURBANVILLE Western Cape 7551	021-979-1129	cameron@empa.co.za
Form-Scaff	Mr Klaas Pouwels	PO Box 669 ISANDO Gauteng 1600	011-842-4000	klaasp@formscaff.com

MEMBERSHIP DETAILS

BRONZE

COMPANY	CONTACT	ADDRESS	TEL	E-MAIL
Group Five Civil Engineering (Pty) Ltd	Mr Nkosana Mhlophe	PO Box 1750 BEDFORDVIEW Gauteng 2008	011-922-3734	njmhlophe@groupfive.co.za
Group Five Coastal (Pty) Ltd	Mr Gareth Chambers	PO Box 201219 DURBAN NORTH KwaZulu-Natal 4016	031-569-0300	gchambers@groupfive.co.za
Hilti South Africa (Pty) Ltd	Mr Schalk Burger	PO Box 5588 HALFWAY HOUSE Gauteng 1685	011-237-3000	schalk.burger@hilti.com
Hindle Mason Projects (Pty) Ltd	Mr Benjamin De Bruyn	PO Box 2051 WITKOPPEN Gauteng 2068	011-875-9987	ben@hindlemason.co.za
IMP Scientific and Precision (Pty) Ltd	Mr Wessel Delport	PO Box 1110 BOKSBURG Gauteng 1460	011-916-5000	wessel.delport@imp.co.za
Independent Concrete Supplies CC	Mr Darren Hoft	PO Box 1765 EAST LONDON Eastern Cape 5200	043-745-1014	dhoft@indepco.co.za
Jeffares & Green (Pty) Ltd	Mr Jacobus Burger	PO Box 794 HILTON KwaZulu-Natal 3245	033-343-6700	burgerk@jgi.co.za
Lambson's Hire	Mr Hannes Senekal	Private Bag x 3 Jeppe Town JOHANNESBURG Gauteng 2043	011-627-7700	hannes@lambsonshire.co.za
Malani Padayachee and Associates (Pty) Ltd	Mrs Malani Padayache-Saman	PO Box 3923 RANDBURG Gauteng 2125	011-781-9710	malani@mpaconsulting.co.za
Metier Mixed Concrete	Mr Kenneth Capes	Postnet Suite 546 Private Bag X4 KLOOF KwaZulu-Natal 3640	031-716-3600	kenneth@metiersa.co.za
Naidu Consulting (Pty) Ltd	Mr Josiah Padayachee	PO Box 2796 West Way Office Park WESTVILLE KwaZulu-Natal 3635	031-265-6007	padayacheej@naiduconsulting.com
Nyeleti Consulting	Mr Stephen Humphries	P.O. Box 35158 Menlopark LYNNWOOD Gauteng 0081	012-361-3629	shumphries@nyeleti.co.za
Pan Mixers South Africa (Pty) Ltd	Mr Quintin Booysen	PO Box 75098 GARDEN VIEW Gauteng 2047	011-578-8600	quintin@panmixers.co.za
Penetron SA	Mr Clive Leader	PO Box 7467 HALFWAY HOUSE Gauteng 1685	011-314-8310	jaco@penetron.co.za
QDS Projects	Mr Quirin Sibuyi	PO Box 2935 NELSPRUIT Mpumalanga 1200	086-722-7089	quirin@qdsprojects.co.za
Rebar, Mesh and Construction Supplies (Pty) Ltd	Mr Louis Aylward	PO Box 2225 BEDFORDVIEW Gauteng 2008	011-310-8660	louis@rmcs.com
Ruwacon	Mr Pieter Ruthven	PO Box 13596 Noordstad BLOEMFONTEIN Free State 9302	051-403-0400	pieterr@ruwacon.co.za
SARMA	Mr Johan van Wyk	PO Box 1983 RUIMSIG Gauteng 1732	011-791-3327	johan@sarma.co.za
Shukuma Flooring Systems (Pty) Ltd	Mr Jacques Bellingan	PO Box 10332 LINTON GRANGE Eastern Cape 6015	041-372-1933	admin@shukumaflooring.co.za
Simpson Strongtie SA	Mr Francois Basson	PO Box 281 Bergvliet CAPE TOWN Western Cape 7864	087-354-0629	fbasson@strongtie.com
Simstone (Pty) Ltd	Mr Amos Masitenyane	PO Box 1113 MEYERTON Gauteng 1960	016-362-2181	amos@simstone.co.za
Spec-Con Engineering (Pty) Ltd	Mr Gordon Mowatt	PO Box 32291 KYALAMI Gauteng 1684	011-468-4265	gordon@spec-con.co.za
Stefanutti Stocks Civils	Mr Werner Jerling	PO Box 12394 ASTON MANOR Gauteng 1630	011-522-4011	werner.jerling@stefstocks.com
Strata Lab cc	Mr Elwyn Hoft	PO Box 1765 EAST LONDON Eastern Cape 5200	043-745-1014	ehoft@indepco.co.za
Structural Solutions cc	Mr Rigo Govoni	PO Box 40295 WALMER Eastern Cape 6065	041-581-3210	rigo@structuralsolutions.co.za
Topfloor Concrete Limited	Mr Peter Lord	PO Box 124 SANLAMHOF Western Cape 7532	021-951-7700	peter@awl.co.za
Uhambiso Consult (Pty) Ltd	Mr Jacques Gerber	P.O. Box 12385 CENTRAHILL Eastern Cape 6006	041-373-0180	jgerber@uhambiso.co.za
UPAT SA (Pty) Ltd	Mr Kevin Owen	PO Box 53059 TROYEVILLE Gauteng 2139	011-624-6700	kevin.owen@upat.co.za
Verni-Speciality Construction Products (Pty) Ltd	Mr Vernon Botha	PO Box 75393 GARDEN VIEW Gauteng 2047	086-118-3764	vernon@verni.co.za
VSL Construction Solutions (Pty) Ltd	Mr Andrew Richmond	PO Box 6596 HOMESTEAD Gauteng 1412	010-591-8211	andrewr@vsl.co.za
Wacker Neuson (Pty) Ltd	Mr Rainer Schmidt	PO Box 2163 FLORIDA Gauteng 1710	011-672-0847	rainer.schmidt@wackerneuson.com
Xypex Chemical Corporation	Mr Lewis Lynch	8 Leeukloof Drive Tamboerskloof CAPE TOWN Western Cape 2001	021-426-0243	llynch@xypex.co.za