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President's Message

This edition marks the end of Concrete Beton published by Crown Publications. Crown Publications has worked together with the Concrete Society for approximately six years making Concrete Beton, a success as well as the Society's other publications, the biennial Fulton Awards and the annual Source Book.

I want to take this opportunity to thank the Publisher, Jenny Warwick, Editor, Carol Dalglish and their staff for their cooperation and support. Every end, however, means a new beginning. I am excited to announce that as from 2014 Concrete Beton will be published in-house by the Society.

The year is nearing an end and the season for year-end functions is fast approaching. We had a busy year here at the Concrete Society. We arranged two successful 'road-show' seminars, one on 'Self Compacting Concrete' and the other about 'Specification and Testing of Concrete'.

In addition, of course, the prestigious Fulton Awards was held in June at Champagne Sports Resort in the Drakensburg. Planning for the 2015 Fulton Awards is already underway, so please start thinking about possible projects that you may wish to enter. The call for entries will open January 2014.

In March 2013, I will be stepping down as President and Tseli Maliehe will be taking over the reins.

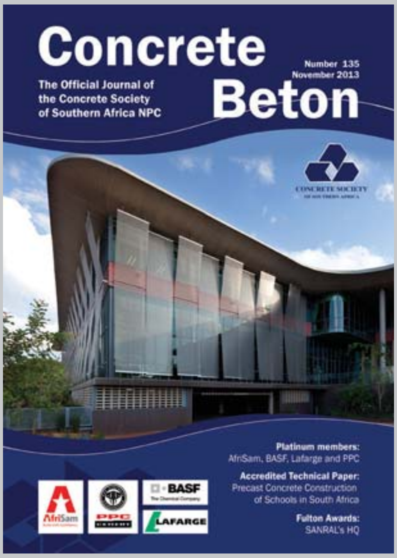
I also wish to congratulate Hanlie Turner from the Inland Branch, who has just been nominated as the new Vice-President. Well done Hanlie!

We also said good-bye to Jeanine Steenkamp, who has served the Concrete Society tirelessly for the past five years at our Head Office. Thank you, Jeanine, for your loyalty and hard work and I hope our paths will cross again in the not so distant future.

Lastly, I wish you all a happy and blessed festive season and all the best for the New Year.

Yours Sincerely,

Billy Boshoff



COVER: The South African National Roads Agency Limited (SOC) project won the Fulton Awards 'Building Structure' category and received a commendation in the 'Architectural Concrete' category. The new Sanral Corporate Head Office uses the architecture to express, in some way, what they do - make and manage the roads and bridges that form the connecting network that make the country networks work.

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

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SANRAL's HQ

The new Sanral Corporate Head Office uses the architecture to express, in some way, what they do - make and manage the roads and bridges that form the connecting network that make the country networks work. The project won the Fulton Awards 'Building Structure' category and received a commendation in the 'Architectural Concrete' category.

The building design makes use of concrete to pay visual reference to the flowing roadways and spanning bridges and its unique green roof helps to integrate the building in its suburban context.

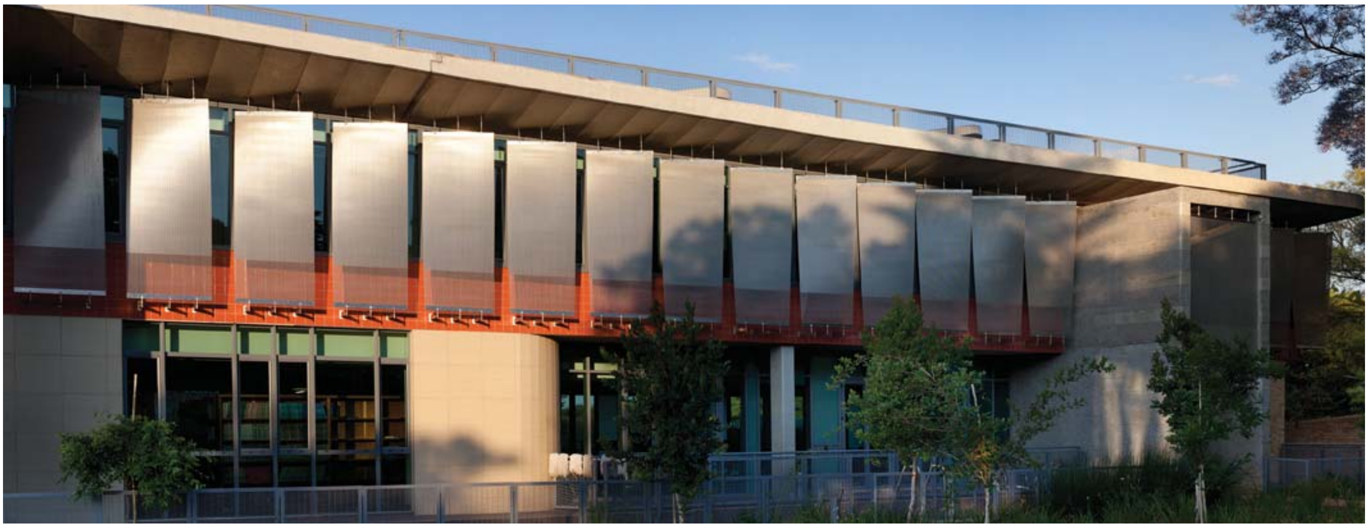
The client's brief included specific spatial requirements, premium grade office space, good indoor environmental qualities as well as aiming for green star design rating and all within the budget.

Apart from the more conventional reasons for using concrete (low maintenance and cost-effective building), the use of a concrete structure and a concrete roof was a very exciting choice for the development for two overarching architectural reasons:

The first reason being that the visual and structural properties of concrete enable a reference to the flowing roads and spanning bridges, that Sanral takes such pride in designing, constructing and maintaining. These roads and bridges are a metaphor for 'connection' between things. The head office is a connector between the regions of the organisation and the country at large.

The second reason for using concrete being that the concrete roof presents an opportunity to make a green planted roof and take advantage of the thermal mass properties of the green roof system, to optimise the energy requirements for the indoor climate control of the building. The concrete green roof also offers the opportunity to make a greener building with its positive connection to the forest-like suburban landscape and make a contribution to biodiversity and the natural environment and has GBCSA 4 star OfficeV1 Design Rating.

The building makes use of a concrete frame structure supporting a concrete roof and suspended floors which were designed using a beam and light weight hollow block system. The structural grid stands at 7,5 m, which needed to accommodate both an optimal basement parking layout and the client's preference with regard to office layout resulted in larger than optimal structural spans. A typical structural bay built using an onsite flat suspended slab design would have needed to be approximately 360mm thick with roughly 30kg/m² of steel reinforcing. Using light weight precast hollow blocks supported by concrete beam system the suspended floor and roof slabs was designed for the building resulting in a 57% reduction in reinforcing steel (14kg/m²) used and a 20,5% reduction in the volume of



concrete used as compared with the onsite flat slab option referred to above. Overall the design results in a 32% dematerialisation of the concrete structure using this structural system. The significant reduction in material used reduces the environmental impact of the building by reducing the quantities of material used and the associated embodied energy of the structure as highlighted by the GBCSA.

All the concrete for the structure was designed and constructed using a fly ash substitute, (Ulula FlyAsh), a waste product created from coal burned at Kriel Power Station, and a water reducing BASF admix. This design parameter resulted in a reduction of the quantity of portland cement required for the project by just over 30%, thereby further reducing the embodied energy otherwise referred to as 'the carbon footprint 'of the concrete in line with the GBCSA parameters.

The structural properties of the concrete roof system used enabled very large, shaped, cantilevered roof overhangs of average 2.5m beyond the façade that provide architectural feature, shade for the façades and provided structural support for the woven mesh, planted with sun screening ensured a 75% reduction in window solar loads on the building.

This concrete green roof system significantly contributes to the indoor environment thermal control and in general responsible for a 50% reduction in roof transmission loads. The combined result of the roof and façade systems described above reduces the overall cooling loads, demands of the HVAC system by 35%, on a conventional office building while also providing a powerful architectural feature. This reduction in the demands on the HVAC system results in direct energy savings and consequent reduction in carbon footprint.

Team

Client: The South African Roads Agency SOC Limited (SANRAL)

Principal Agent: Rouillard Consulting Engineers

Main Contractor: GD Irons Construction

Subcontractors: Pre-Form

Civil Concepts Pty Ltd

Plantech Consulting Engineers

Submitted by: Activate Architecture

Judges' Citation

This fascinating Green Building Council of South Africa 4-star rated building is a worthy winner of the **2013 Fulton Awards 'Building Structure' and also received a Commendation in the 'Architectural Concrete' category.**

The use of concrete, apart from the accepted reasons of cost effectiveness and low maintenance, was chosen as it provided a visual and structural reference to flowing roads and spanning bridges. The style typifies the projects that South African National Roads Agency SOC Limited has undertaken.

Concrete was used to produce a 'green roof structure' and planted roof garden. This takes advantage of the thermal mass properties of concrete and connects the building to its tree-lined suburban context.

The design approach was particularly commendable as it conceptualised a ' connector building' linking the three main departments of the company via a large, flowing lobby, much like a freeway intersection. Great thought went into the positioning of the building vis-à-vis the natural slope of the land, its relationship to the main road, the views and visibility to nearby private homes.

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

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

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

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

Precast Concrete Construction Of Schools In South Africa

D de Klerk & JA Wium, *Department of Civil Engineering, Stellenbosch University*

ABSTRACT: Providing quality learning environments are consistently objectives state owned enterprises endeavour towards. In South Africa this is also the case, but expectations are as of yet not being met. Prefabrication specifically in precast concrete provides a natural solution in that it provides countless time, cost, quality, and health and safety advantages and can provide quality learning environments quickly and efficiently. However, because it requires an integrated approach to optimally function, the current traditional procurement model for public projects in South Africa encumbers precast application. Addressing only the procurement constraints though, does not suffice as a solution. This is due to other South African specific complications such as the lack of an overly sustainable industry and the creation of employment opportunities. This paper suggests that combining design-build procurement with standardisation and strategic partnership can provide a sensible and feasible method of addressing the education dilemma in South Africa.

INTRODUCTION

Prefabrication, specifically in precast concrete, is not a new concept to the construction sector, locally and internationally. Many projects have been completed successfully using prefabrication claiming notable time, quality and in some cases cost improvements (Haas et al., 2000), (Jaillon & Poon, 2009).

More recently, precast concrete products and methods have been used internationally in the construction of schools due to the time advantages it presents compared to traditional construction methods (Endicott, 2000), (Canadian Precast Concrete Institute, 2005).

South Africa, however, has been slow to adopt this practice for school construction and potentially to its own detriment, as this process allows for a quick and efficient way of addressing the shortage of quality learning environments in South Africa.

Furthermore, South Africa is witnessing increasing levels of investment in infrastructure driven by its commitment to economic and social development. All spheres of government and state owned enterprises are challenged to increase the pace and efficiency of construction delivery. This is visibly demonstrated by the recently introduced Infrastructure Plan that is intended to transform the economic landscape of South Africa. The plan will create a significant number of new jobs and strengthen the delivery of basic services to the people of South Africa (Presidential Infrastructure Coordinating Commision, 2012). First announced by President Jacob Zuma in his 'State of the Nation' address in February 2012, he listed 17 strategic integrated projects that cut across energy, transport and logistics infrastructure to schools, hospitals and nursing colleges. Of significance is Strategic Integrated Project 13:

- **Strategic Integrated Project 13:** National school building programme. A National school building program driven by uniformity in planning, procurement, contract management & provision of basic services.

In addition, the recent budget allocated R770 million for educational infrastructure to the Province of the Western Cape by the Members of the Executive Council. The National Education Department has made available a further R750 million in terms of the 'Accelerated Schools Infrastructure Delivery Initiative'. Thus the total educational infrastructure expenditure for the three financial years 2012/13 and 2014/15 will exceed R3 billion (Carlisle, 2012).

It becomes apparent that there is a clear intention by South African authorities to address the education dilemma faced by the country. Prefabrication, of which precast concrete is a subset, is potentially a sensible and logical avenue the Public Works departments can follow to aid in the success of the above initiatives.

THE DILEMMA

A number of obstacles, however, have been identified, which could deter the implementation of a prefabrication approach, specifically in South Africa.

These are as follows:

1. The current procurement model in use for public projects, specifically in the construction of schools, does not lend itself to optimal integration amongst the client and project team (Willemse, 2011), (Lewis, 2012). Prefabrication requires an integrated contract strategy for optimum implementation.
2. Previously disadvantaged communities do not readily accept alternative building methods and materials beyond brick, mortar and concrete.
3. South Africa does not have an overly sustainable precast manufacturing industry, which can viably endure random or one-off prefabricated projects.
4. When a school is innovatively constructed by a contracting and design team using precast concrete, the current system of tendering for public projects means a new contractor and design team would most likely be selected for successive projects, resulting in the experience and knowledge learned from the previous project being lost and not taken advantage of.
5. The perceived non-labour-intensive nature of prefabricated construction, although beneficial from a cost and safety perspective, may directly implicate job-losses from a South African perspective.

PROPOSAL

The above reasons provided encouragement for the development of a comprehensive system, or plan, by which prefabrication, for example precast concrete, can be utilised effectively and efficiently but all the while addressing all of the aforementioned issues. By combining the principles of design-build procurement, standardisation and strategic partnering, the following proposed strategy is validated.

A single design-build contractor is awarded by the Department of Public Works a contract, via competitive tendering, for the construction of a predetermined number of schools, preferably exceeding 3, over a given contract period using a standardised design and utilising customisable standardised prefabricated precast construction systems, ie. Precast Concrete.

This proposal has the potential to address all the issues mentioned in the previous paragraphs and the support for this statement, is presented in this paper.

PRECAST CONCRETE

Precast construction is the casting of concrete components off-site in a plant, whereafter they are shipped to site for assembly. This can also be done on-site, of which tilt-up construction is a special application. The Precast/Prestressed Concrete Institute from the USA in its 'Designing with Precast & Prestressed Concrete' guide defines precast concrete as follows:

Precast concrete consists of concrete (a mixture of cement, water, aggregates and admixtures) that is cast into a specific shape at a location other than its in-service position. The concrete is placed into a form, typically wood or steel, and cured before being stripped from the form, usually the following day. These components are then transported to the construction site for erection into place. Precast concrete can be plant-cast or site-cast (Precast/Prestressed Concrete Institute, 2010).

Precast concrete's plasticity allows it to be cast into a wide variety of shapes and sizes. Although precast manufacturers routinely produce custom designs and shapes, designers typically take full advantage of speed and economics by using standard components that can be cast and replicated many times with existing forms. To this end, precast manufacturers provide a number of typical components that meet the vast majority of traditional design challenges (Precast/Prestressed Concrete Institute, 2010). Various uses of precast concrete exist in the form of double and single tees, slabs, panels, beam and girders, stairs, and columns (Canadian Precast/Prestressed Concrete Institute, 2007) **(Figure 1)**.

In South Africa, precast floor systems are the most commonly used structural precast elements (Lombard, 2011). The Concrete Manufactures Association (1999) states that two basic systems are readily available in South Africa and with which designers are familiar, namely: Hollow-core and Beam-and-block. In addition, concrete wall panels are also somewhat established due in part to cases such as Kaalfontein Ext 22 and Vlakfontein Ext 3. Here the Goldflex 100 & 800 precast building systems were used to construct 800 and 404 housing units respectively (Chief Directorate: Housing Needs, Research and Planning, 2010). Other elements such as precast beams and columns can be manufactured in South Africa on request, but this is not often the case. To some degree, precast concrete is often considered not suitable for residential construction due to its poor thermal and acoustic performance (Mackechnie & Saevarsdottir, 2007). However, it is recommended that in a climate such as South Africa where temperatures fluctuate greatly during the day, concrete walls should be limited to a system with suitable thermal insulating properties to save heating energy, and thermal mass to stabilise the internal temperature (Cement and Concrete Association of Australia, 2005). One option would be to use precast concrete frame and floor elements, with traditional masonry infill wall panels. Alternatively, by using insulated sandwich wall panels – 170 mm to 250 mm panels consisting of a layer of insulating material 'sandwiched' between two concrete layers – or a similar insulated system, comfortable acoustic and thermal situations are achieved for school environments **(Figure 2)**. The potential for vandalism on such panels may however, have

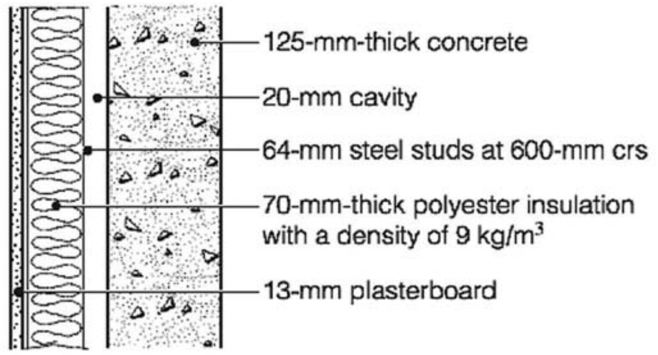


Figure 2 - Example of an insulated concrete wall system (Cement and Concrete Association of Australia, 2005.)

Figure 1 - Precast wall panels and hollow-core floors during the construction of a school (Canadian Precast/Prestressed Concrete Institute, 2007).

to be considered.

However, in terms of design guidelines for precast construction, the SANS 10100-1 is found to be less comprehensive than EN 1992-1-1. The EN 1992-1 used in Europe is more comprehensive and is found to be more up to date with current international precast design practices. Coincidently, a review of the current South African standard is underway, and a substitution with a South Africanised version of the equivalent Eurocode is en-route (Wium, 2012).

Furthermore, prefabrication in precast concrete directly addresses certain issues key from an education facility perspective:

- **Cost -** A total precast concrete system accelerates construc-tion, minimises the number of component pieces, by com-bining structural and architectural attributes into a single piece, and offers single source responsibility from the precast manufacturer saving costs throughout the construction process (Gibb, 1999). In addition, precast concrete can enhance the durability of the building as a result of improved quality control and management (Precast/Prestressed Concrete Institute, 2010). There is also the value of having a guaranteed, fixed cost (McGraw-Hill Construction, 2011). Traditional construction projects are infamous for their increases due to variation during the construction process. Even when prefabrication appears to be slightly more expensive from the outset, the avoidance of unexpected costs during the process is valuable, especially for owners with inflexible budgets such as those in the public sector. Precast concrete hence has the potential to meet strict budgeting needs based on tax revenues.
- **Time -** The main benefit of prefabrication is a reduction in the on-site programme duration. This is achieved by the overlapping of off- and on-site activities, which would be done in sequence using traditional methods (Gibb, 1999). Prefabrication essentially takes work away from site and into the factory, thus reducing the duration of operations critical to the overall programme on-site. Precasting is not constrained by site progress or conditions and can continue independently of on-site operations, whereas site work is traditionally vulnerable to disruption from extremes of weather (Goodchild & Glass, 2004). By using prefabrication the site will be vulnerable for less time and so the risk of delay and requirements for protection will be reduced (Phillipson, 2001). Additional time may be spent in the design phase on complex projects to coordinate the use of prefabrication and modularisation, but the time saved on-site typically makes up for this (McGraw-Hill Construction, 2011).
- **Quality -** Prefabrication, ie. precast concrete, is a product which stems from a climate-controlled environment using efficient equipment operated by well-trained people (Wong et al., s.a.). Factory controlled conditions mean a better quality of build, better finish and fewer defects, all resulting in improved durability. In addition, a material such as concrete is already widely accepted amongst most, if not all, communities. If precast concrete was used for the construction of a school, it would not necessarily require for the community to be informed thereof. A precast school will feel, look and perform similar, if not identical to a conventionally built school and the common school learner would be none the wiser. Additionally it provides a strong, institutional look that conveys an educational image. Architectural precast concrete panels use colours, textures, reveals, finishes, form liners, or thin brick insets to match any required design style. School names, emblems, and other custom touches can be embedded into panels, creat-ing unique accents (Precast/Prestressed Concrete Institute, 2010).
- **Health & Safety -** Construction sites in general are hazardous environments. On-site construction conditions often require workers to potentially be exposed to harsh weather conditions and precarious positions near roads, hazardous protrusions, and the like (Smith, 2010). In a report by the Health and Safety Executive (HSE, 2011) on workplace fatalities and injuries in Great Britain, fatal accidents in construction were found to be almost twice more likely than in the manufacturing sector. Prefabrication reduces the amount of work that is done on-site and there-fore reduces exposure to hazards (Gibb, 1999). Transferring much of the construction programme from an open site to a controlled factory environment reduces on-site time for workers and reduces the potential for site-based accidents and ill health (Taylor, s.a.). The conditioned, dry interior environment of the factory enables responsible manufacturers to make appropriate provision for the health and safety of their workforce. Precast concrete construction can hence minimise congestion and safety concerns on site and in the general vicinity of the school premises during construction. It does, however, remain a construction method, which requires a skilled and experienced contractor. Insufficient training in the setting out and placing of the components can be hazardous, therefore a well-trained, alert team as well as a well-founded health and safety plan is required for it to be implemented optimally and safely.

DESIGN-BUILD PROCUREMENT

The procurement concept in construction has been defined in many ways, but a working definition of procurement was developed by the International Council for Research and Innovation in Building and Construction (CIB) at its symposium in 1991, defining it as 'the framework within which construction is brought about, acquired or obtained' (McDermott, 1999). This definition served a useful purpose as it is both broad, encouraging a strategic interpretation, and neutral, being applicable not only to developed, market economies. The SANS 294:2004 in addition, defines procurement as a process (i.e a succession of logically related actions occurring or performed in a definite manner), which culminates in the completion of a contract for the provision of engineering and construction works, supplies, services or disposals (SANS 294:2004).

Many varieties of procurement strategies exist such as separated, integrated and management-orientated strategies. Although prefabrication can technically be used in any contract structure, most literature is in accord that prefabrication, pre-assembly, off-site fabrication and modularisation requires some sort of integrated contract strategy approach. Integration refers to a process whereby the design and construction processes of a project are interlinked. An integrated approach is, therefore, one approach where design and construction procedures ensue concurrently. This approach has shown to benefit the whole project (Goodchild & Glass,

2004) (Luo, 2008).

In studying the effect of prefabrication on construction sequence, time and cost, Mawdesley et al. (s.a.) developed three prefabricated suited procurement routes during the course of their research:

- **'Traditional'** Construction Procurement
- **'Hybrid'** Construction Procurement
- **'Ideal'** Construction Procurement

Traditional refers to separated contract strategies where construction and structural design is not integrated, and the project team is fragmented. In the 'hybrid' process, initial structural design requires adaptation to accommodate off-site manufactured construction. There is greater cooperation between the members of the project team, although fragmentation is still evident. The 'ideal' method, however, is described as a process where all aspects of design, architecture, structure and construction are carried out in parallel, thus allowing greater integration and co-operation between members of the project team.

For these reasons an integrated approach such as design-build procurement, where the design and construction teams work in unison, can be viewed as the best suited strategy for implementing prefabrication. Furthermore, it is a strategy which the Department of Public Works is willing to explore (Willemse, 2011).

As opposed to design-bid-build, design-build projects 'reduce the overall project duration' (Grobler & Pretorius, 2002). Procurement methods such as design-build allow for early decision making regarding prefabrication systems that can lead to improved coordination and constructability, and finally reduced construction time. In addition, Songer & Molenaar (1996) found benefits of design-build in terms of cost and quality, an added benefit with prefabrication. Design-build also allows for the delivery process to potentially create a smoother flow of information between design and construction organisations. Instead of a handover method, where one group of individuals designs a facility and then simply transfers the responsibility to the next party, design-build methods can collaboratively identify prefabrication as the construction method and execute it as such (Gibb, 1999).

Moreover, some major projects have been procured successfully in South Africa by design-build in recent times (Grobler & Pretorius, 2002):

- Saldanha Steel Plant (R800 million). *(Public)*
- Techno Centre for Vodacom in Bellville *(R116 million)*.
- Prison at Louis Trichard (R300 million). *(Public)*
- Nelson Mandela Bridge in Johannesburg *(R81 million). (Public)*

These successful projects, most of which were in the public sector, provide confirmation that design-build does indeed fulfil the requirements posed by the South African Constitution for a procurement strategy and that no distinguishing actions are required.

Furthermore, school projects have features that are well-suited to prefabrication/modularisation (McGraw-Hill Construction, 2011). Classrooms allow for the use of modular room design, and these projects also benefit from faster construction schedules. The Josiah Quincy Upper School in Boston utilised design-build successfully and combined it with precast concrete (Endicott, 2000) (Smith et al., 2000). Many other case studies exist, showcasing successful implementation of prefabrication in school construction (PCI Project Study, 2006) (Buchan Concrete Solutions, 2011) (Endicott, 2003). Each case study claimed numerous advantages of which shorter schedules were most prevalent. Additionally, all the case studies share one common characteristic – an integrated approach was used, ie. design and construction proceeded in parallel. The design-build procurement route seemingly is the obvious and preferred trend when it comes to prefabricated construction.

Although design-build is well tested today, it has its problems in that it is usually architect or contractor led. The concern is that if the process is architect led, design will overwhelm values of production, and in a contractor-led model, construction will be the only consideration, finding ways to possibly reduce design features in favour of cost or schedule reductions (Smith, 2010).

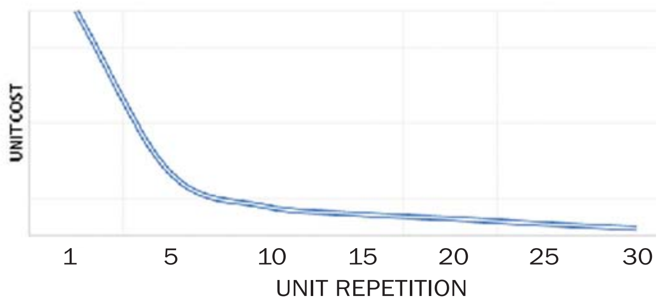


Figure 3 - Relationship between unit cost and unit repetition (standardisation) for precast concrete cladding (Gibb, 2001).

STANDARDISATION

Prefabricated components are essentially part of a manufacturing process which, similar to any factory produced product, works on the 'economy of scale' principle (Gibb, 2001). This simply means that it becomes more economical, if more are manufactured **(Figure 3)**.

In a South African market where prefabricated components are not used all that often, this is an issue. The point here is that although it is possible to construct a single school using prefabricated components, it is financially much more viable to the supplier/manufacturer if many buildings are built using their components (Taylor, s.a.). This suggests a concept of standardisation. Furthermore, standardisation and prefabrication are also considered by some as synonymous (Pasquire & Gibb, 2002). CIRIA (1997) and whilst they can be used individually, the greatest benefit is when they are used together and that benefits from advances in manufacturing industries can only be realised in construction where standardisation is accepted. The construction industry at large is dominated by numerous small and specialised subcontractors, who typically are not technologically advanced enough to embrace automation. The sector that represents factory built buildings (modular, prefabricated, panelised, precast, etc.) conversely is an exception (Neelamkavil, 2009). Therefore, since the products are built in factories, the principles of mass production and mass customisation that are the norm in manufacturing apply. Egan (1998) also argues that construction is not very different from manufacturing. He states that many buildings, such as houses, are essentially repeat products, which can be continually improved and more importantly, the process of construction is itself repeated in its essentials from project to project.

Standardisation, however, is still predominantly perceived as a repetition of components, all having similar dimensions and hence leading to a bland uniformity in the end product (Smith, 2010). This is an inherent characteristic of the mass production concept, whereby large production numbers decrease capital costs. However, this approach is unfavourable and especially so when building schools. The consumer seeks a unique solution to the situation, and therefore the concept of mass customisation comes into play.

Mass customisation combines the principles of mass production and automation to create a manufacturing process whereby standardised components can be tailored to each specific project but also addresses the need of the manufacturer for a constant flow in the production line (Gibb, 2001). Prefabrication can therefore become feasible and sustainable.

In South Africa, the school building can be viewed as a beacon or symbol that uniquely defines a community, especially in rural underprivileged situations. In other words, a school building with its own unique character is required. Mass customisation can potentially achieve this all while still attaining the benefits prefabrication offers.

In addition, standardised design consisting of a suite of drawings and specifications can easily be applied across a wide range of projects, and seen as a potential complementary solution (James, 2011). This does not mean that buildings will all look the same but rather that the designs can be tailored. The aim is to both improve the efficiency of the process of building many schools, but also to facilitate feedback into the design of education environments through periodic reviews of these standard designs, therefore reducing unnecessary design and construction costs (CELE, s.a.).

The economies of scale principle is satisfied and standard prefabricated components can therefore be manufactured or 'mass customised' in the most feasible way possible.

STRATEGIC PARTNERING

One of the principal issues identified by James (2011) in his Review of Capital Education, with the current system of school construction in the UK, is the lack of learning and systematic improvement of quality, cost and time from one school building project to another. This has been caused directly by the design and procurement process, which has resulted in most schools designs being one-off. Among the many knock-on problems that this has created are the high costs of both design and construction, variable quality, a need for every school to pass through an arduous cycle of checks and balances and no opportunity for improvement.

Moreover, Egan in his Rethinking Construction Report (1998) states that the conventional processes assume that clients benefit from choosing a new team of designers, constructors and suppliers competitively for every project they do. Instead he says that on the contrary repeated selection of new teams inhibit learning, innovation and the development of skilled and experienced teams. Critically, it prevents the industry from developing products and an identity - or brand - that can be understood by its clients.

It starts to become evident that what is required is for teams of designers, constructors and suppliers to work together through a series of projects, continuously developing the product and the supply chain, eliminating waste in the delivery process, innovating and learning from experience. Smith (2010) agrees and states that continued alliances that join for multiple projects can yield better results the second or third time around.

This can further be extended to the use of prefabrication. Smith (2010) claims that a client and contractor, who build together often, may find prefabrication beneficial because the systems that are developed may be employed in other projects. This is especially true for project teams that work together on a series of building ventures. The added benefit is that project team members also continue their relationship with the fabricator, who may or may not be the contractor, but becomes a key player in delivering the facilities. Research has suggested that performance, in terms of cost, time, quality, constructability, fitness-for-purpose and a whole range of other criteria, can be dramatically improved if participants adopt more collaborative ways of working (Bresnen & Marshall, 2000).

Consequently, a good deal of attention has been directed towards examining the issues mentioned above and as result the concept of 'strategic partnering' comes to the foreground. The most commonly cited definition for **strategic partnering** is that proposed by the Construction Industry Institute (1999):

A long-term commitment between two, or more, organisations for the purpose of achieving specific business objectives, by maximising the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organisational boundaries. The relationship is based on trust, dedication to common goals and an understanding of each other's individual expectations and values. Expected benefits include: improved efficiency and cost effectiveness, increased opportunity for innovation, and the continuous improvement of quality products and services (CII, 1999).

Strategic partnering takes place where two or more firms use partnering on a long term basis to undertake more than one construction project (Matthews, 1999). It is generally accepted that strategic partnering relationships accrue time, cost and quality benefits on individual projects, but the scale of the benefits increase as each project undertaken profits from the lessons learnt from previous projects, ie. it allows for continuous improvement (Grajek et al., 200) (Weston & Gibson, 1993) (Bennet & Jayes, 1995).

Moreover, this concept of strategic partnering has the potential to act as the catalyst in how to combine the principles and benefits of 'standardisation' with a design-build procurement strategy. Forming a 'strategic partnership' between a client, design-build contractor and precast manufacturer is regarded as the optimal solution to the issue of implementing precast concrete construction in schools.

The 'strategic partnership' formed between the client, designer, supplier and design-build contractor after a successful open tender creates a situation that stimulates innovation. Methods and techniques can be tested with each party being fully aware of their respective roles, due to the clear lines of communication which design-build and strategic partnerships offers.

Additionally, due to not being limited to only one project, the design-build contractor carries with it experience and lessons learned from each successfully completed previous project onto the next, and so becomes more proficient, resulting in better, higher quality schools delivered in shorter periods and with increased efficiency. Systematically an industry knowledgeable and proficient in precast construction will be created.

Also, the use of precast concrete components in building projects drastically reduces the amount of work on site (Polat, 2008). According to a study by Tam (2002), there could be a 43% reduction in site labour consumption if there is a shift from the in-situ site casting to prefabrication design (Wong et al., s.a.). This factor may be an advantage in developed countries, where the cost of labour is far higher than in developing countries, but when viewed from a developing country's perspective, the use of prefabrication indirectly implies job loss (Gerrie Willemse, 2011).

Strategic partnering, however, counters this by:

1. Granting precast manufacturers a confirmed number of orders for products, who are then assured of a constant flow of income. This translates directly to an increase in both employment and job security at the manufacturing plant;
2. Awarding the design-build contractor guaranteed employment for a fixed period, which will provide job security for employees, with the potential to increase the labour force. In addition, this could result in sustained training and skills development;
3. Allowing the design-build contractor to satisfy further employment opportunities by employing local labour on each project, to complete the on-site work such as foundations, site clearance, etc. and
4. Giving the opportunity for 'Satellite' factories to be temporarily set up at the project location, which would create local employment for the community. This would create a situation where the project is done *'by the community, for the community'*.

DISCUSSION

Some barriers do exist, which could encumber the successful application of the above proposal, and negate some of the potential valuable results. These barriers are as follows:

- The extent to which precast concrete is used and is partly subject to the capabilities, facilities, expertise and skills available to the project team. Due to the scant use of prefabrication in the South African industry, specifically precast concrete, these factors might be found wanting.
- The current South African design codes and standards do not provide sufficient guidance in the design of structural precast concrete construction. This limits the extent to which it can be implemented, as insufficient technical guidance places restrictions on the designs of architects and engineers.
- For a design-build procurement strategy to succeed, a clearly defined project scope is required. The client, in this case the Department of Public Works, will need to be knowledgeable of the strategy and formulate clear project requirements by compiling an appropriate performance specification.
- The potential limitations of the thermal and acoustic properties of thin precast systems may need special attention when choosing an appropriate structural system.

The above constraints are however not impossible to address, and can be accomplished as follows:

- By repeated **instructed** use of precast concrete and prefabrication construction systems, a knowledgeable industry will eventually be created. A knowledgeable industry will demand the most efficient solution to problems, which precast concrete has the potential of being - and so create a demand for precast products. Demand will necessitate a supply and systematically a sustainable precast industry will result.
- The current design codes are in the process of being revised to a South Africanised version of the Eurocode. This code is much more comprehensive than the current SANS 10100-1 and provides ample guidance, in the use of precast concrete construction. Additional guidelines on typical details applicable in South Africa, however, may be needed.
- Through proper education about the benefits and contractual ramifications associated with a design-build strategy, the Department of Public Works, would become knowledgeable and hence understand the requirements of the strategy, and a well-defined scope should be compiled. In other words, an informed client who understands the benefits of precast construction can dictate the type of construction they require for their projects and in this way stimulate the precast industry.

CONCLUSION & RECOMMENDATIONS

The aforementioned suggestions although possible remain theoretical, due to an inherent lack of proof or data of where it was implemented successfully. Case studies do exist where precast concrete was successfully used in the construction of schools, and, furthermore, some international successes exist. However, in South Africa either there are limited or no examples showing successful partnerships on school projects.

In theory, though, this proposal is achievable and is subject solely on how innovative the client strives to be in achieving their specific goals. In a socio-economic situation such as the one in South Africa, where a large numbers of quality education facilities are desperately required, the above proposal is both logical and feasible.

However, to prove the validity and credibility of the aforementioned proposal this would require an actual 'pilot' project. The client, in this case the Department of Public Works, would need to follow for the most part the guidelines presented. Keeping in mind that the specific precast components and system and how it is utilised, remains the prerogative of the project team. The project should be well-documented, so as, to determine reasons for success or failure and so the strength of the proposal.

With its prospective advantages this could potentially pave the way for an efficient and sustainable South African precast industry.

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TECON 2013 Report back

TECON 2013 proved to be a very successful event, in terms of content and organisation, with excellent speakers and relevant topics. However, attendance levels were almost half of the average number of people attending these conferences.

The seminar began with an overview by Bryan Perrie, from the newly-formed Concrete Institute, on current and planned specifications and test methods for concrete. He explained that revisions were currently being carried out on:

- Loading code and basis of design
- Concrete water retaining standard
- Concrete design standard
- Geotechnical design

For the design of concrete structures, the working group decision taken in 2007 involved the adoption of EN 1992-1-1 with its own set of nationally determined parameters. The draft code was planned to be finished for comment by the end of 2012, but it would seem that this is now likely to be the end of 2013.

New specifications are already in place for cement(SANS 50197); fly ash (SANS 50450); silica fume (SANS 53263); Blast Furnace Slag (SANS 55167); admixtures (SANS 50934 1-6) and water (SANS 51008). SANS 1083 covering aggregates will remain as is, whilst a decision is awaited on the specification for metallurgical slags.

Marius Grassman from Concrete Testing Equipment was next to present and provided delegates with a review of equipment used for general testing in a construction environment.

The more common tests were covered in some detail including slump, compression strength, non-destructive tests as well as more advanced testing with very sophisticated machinery.

Plastic cube moulds are now often used

The focus was on the equipment used such as cones, presses, moulds, vibrating tables, compactors and curing tanks, but also covered was state-of-the-art machinery for specialised tests such as flexural, elastic modulus, deflection, deformation of first crack strength, ductility of fibre-reinforced concrete, etc.

The importance of maintenance and calibration of equipment was strongly emphasised, with details of the requirements set out by ILAC-G2 (International laboratory accreditation system) and OIML D 10 (International organisation of Legal Metrology).

'Materials Sampling and Testing for Concrete', was presented by Johan van Wyk of the Southern African Readymix Association. Materials covered were cement, stone, sand, water, extenders and admixtures. Testing these materials was critical to producing a consistently successful concrete, and in identifying any suspect materials before committing them to production quantities. The importance of always preparing trials mixes was stressed.

Bruce Raath, of Letaba Management Services spoke on the interpretation of test results and what they meantto the engineer and other specifiers.

Great attention was paid in the presentation to the cube strength of the concrete as so much importance is placed on this by the specifier. It is common practice for the contractor to supply concrete against a specified cube strength, and yet, according to Raath, is it probably the most poorly interpreted property of all.

In many contracts cube strength is the only specified concrete property, and much of the contract hinges on it. Ironically, cube strength is not, and was never meant to be, the strength of the concrete in the structure!

A case study in concrete testing was presented by Jaco van Niekerk, of the Department of Water Affairs. The project was De Hoop Dam near Steelpoort, Limpopo, and the testing regime covering immersion-vibrated roller-compacted concrete was featured.

This impressive dam utilised over 1,1 million m^3 of concrete and the importance of preparing trial mixes was clearly demonstrated again with the final concrete mix providing impermeability; workability; no segregation; a good surface finish with no honeycombing; durability and cost effectiveness.

Quality control was kept simple with density testing; compressive strength verification; and core testing. The field testing specification of the roller-compacted concrete required compaction of RCC to be within 15 minutes after spreading or a maximum of 40 minutes after batching.

Density testing was conducted by means of a Nuclear Density Gauge and temperature testing by means of an infrared device. During the construction phase, the contractor broke the South African record for RCC placement – 131 000m^3 in 28 days.

Presentation of the next paper was shared by Prof Mark Alexander, from UCT (coastal venues) and Prof Yunus Ballim from WITS (Gauteng venue). The focus here was 'performance testing of concrete'. Review of durability provisions in various codes including the South African code SANS 10100-2 and the presenters concluded that these codes are universally prescriptive in nature. As such, they do not meet the needs of modern code formulations or the demands of modern concrete construction. Prescriptive requirements are virtually meaningless in the light of the multi-role binder types now available and being used. The performance-based approach to specifying concrete outlines the functional requirements

Immersion vibration of the concrete

for the hardened concrete depending on the application. It measures properties of concrete that account for performance, eg. durability and provides requirements that are clear, achievable, measurable and enforceable.

'Preventing Concrete Failures' – Steve Schulte of Construction Management Systems introduced the concept of a reverse engineering process including the installation, calibration and commissioning of a data logger at a batch plant, followed by the reliable, accurate and consistent collection of data from batch plant load cells and other input signals as required.

Samples of collected data were presented and the reverse engineering process explained, involving the safe and reliable long term storage of all collected data and the manipulation of collected data for the purpose of pattern recognition, and the calculations required to recompile mix ingredients from data collected by the logger.

The final presentation of the seminar dealt with factors influencing test results given by George Evans from PPC Ltd. He suggested that:

George Evans, PPC presenting in his inimitable style

Test results can be influenced by:

- Temperature
- Equipment
- Sampling
- Time

Influencers of test results are:

- Training given to testers
- Experience of testers
- Consistency of testing
- Objectivity - non-biased
- No faking of results!

Each aspect was dealt with in some detail and of particular interest was the influence of time on slump test results, and the importance of sampling techniques. Evans demonstrated how the speed with which the tester raises the slump cone from the floor, determines the final slump measurement of a concrete mix. In the example he cited, the slumps achieved with lifting the cone from slow to fast, ranged from 90mm to 150mm respectively.

Question time was lively at all venues and feedback from delegates after the presentations was very positive, in terms of the content of the programme and the quality of speakers.

From the CEO's desk

We have recently finished our last seminar road show for the year – TECON 2013, focusing on specification and testing of concrete and from the reception we received, in all centres, it went down very well.

Delegate support was a little disappointing but we are beginning to realise that October may not be the best time of year to hold our final national event of the year. Be that as it may, the delegates that did attend were exposed to many industry experts presenting their insights and knowledge on this very important topic.

In the past couple of months, the Concrete Society has aligned itself with SAICE with its initiative 'Civilution'. As a long-standing Voluntary Association with ECSA, the Concrete Society is proud to be part of this initiative. Our inextricable links with the engineering profession through concrete makes it essential that we play a meaningful role in this engineering 'revolution'. More on this and the role we will play, as an organisation, will be publicised shortly.

Still with ECSA, their national engineering skills survey was launched on the October 8, to determine the extent of available engineering skills in South Africa. The survey is posted online to ensure easy access by all registered and non-registered engineering practitioners, educated in South Africa, as well as those educated outside of the country but who are currently working here.

We have been asked to assist is soliciting response to this survey and I would ask that our engineering members please respond to this survey by I December 15, 2013. We do have a link on the Home Page of our website at www.concretesociety.co.za

On a lighter note, I had the privilege of attending the Inland Branch Annual Concrete Boat Race Day, in September, and what a day it was. Over a thousand enthusiasts were there to see student and industry boats racing on Victoria Lake, Germiston, in perfect weather conditions. Concrete.TV filmed the event, to view their report go to:

http://www.concrete.tv/categories/news/784-annual-cssa-concrete-boat-race

Planning for 2014 has already taken place and I am pleased to advise members that we have an exciting programme of seminars scheduled.

Full details will soon be featured on our website, but in summary we will be running events in March (Concrete's Role in Human Settlements; June (Developments in Cementitious Materials and their Influence on Concrete Properties) and September (Design of Concrete Structures – the latest developments).

We are always mindful of the needs of our members and if anyone has a burning issue that they think should be featured in one of our seminar roadshows, or for that matter at a local branch level, please do not hesitate to contact me or your local branch chair, with your request.

The President in his message has already mentioned the departure of Jeanine Steenkamp from Head Office and I too, would like to thank her for her loyal support and hard work during her time with us, and for helping to create our new, stronger 'corporate' image and website. I wish her and her husband Bernard, good fortune with their new venture in sheep farming in the Karoo.

Yours in Concrete.

John Sheath

Shaping the future of concrete in Africa

The inaugural 2013 Totally Concrete Expo event was held at the Sandton Convention Centre. Exhibitors, sponsors, delegates and visitors alike were impressed with the technical content, excellent keynote speakers and exciting social activities.

The dates have been confirmed for the 2014 event and the event will run from May 27 and 28 for the main conference and exhibition, with a number of pre-conference workshops taking place on May 26 and post event site visits on 29 May 2014.

With over 150 speakers from 40 countries, five pre-conference seminars, three high- level conference tracks, 4 000 visitors and a uniquely interactive exhibition, the Totally Concrete Expo 2014 guarantees attendees extended access across Africa to the entire concrete ecosystem from concrete technologist to consulting engineer.

Infrastructure spend is forecasted to be on the rise in 2014. In Southern Africa alone cement consumption is predicted to increase to more than 18,1 million tonnes by 2018. The South African government plans to spend in excess of R4 trillion on a massive state-led infrastructure drive over the next 15 years. Business prospects for the construction, cement and concrete industries are brightening across the southern continent, with the rest of Sub-Saharan Africa not far behind.

Developed by the industry for the industry, Totally Concrete has already put in place its 2014 Advisory Board with members from over six African countries including Cape Verde, Ghana, Nigeria, Kenya, South Africa and Tanzania and participation and support from leading industry associations like the Concrete Society of Southern Africa.

"It's an exciting time for the concrete industry, as we continue to grow and adapt to the challenges of the current climate and prepare for the very many exciting infrastructure projects in Africa. We have exciting plans to make the 2014 edition even bigger and better and ensure that we deliver all the resources and knowledge needed to maximise opportunities and strengthen our attendees' organisations." says Soren du Preez, Programme Director of Totally Concrete 2014.

CONCRETE SOCIETY OF SOUTHERN AFRICA NATIONAL OFFICE PROGRAMME			
DATE	**MEETING/EVENT**	**VENUE**	**CONVENOR**
31 October 2013	Membership Renewal Notices	E-mailed to all CSSA Members	CSSA Administration
End of November 2013	Concrete Beton	Posted to all CSSA Members	Crown Publications
March 2014	Concrete Beton	Posted to all CSSA Members	CSSA
3 – 6 March 2014	Seminar Road Show: Concrete's Role in Human Settlement Development	Durban, Port Elizabeth, Cape Town & Johannesburg	Seminar Committee
26 March 2014	AGM	Port Elizabeth	CSSA President
27 March 2014	Board Meeting	Port Elizabeth	CSSA Administration
April 2014	2014/2015 Source Book	Posted to all CSSA Members	CSSA
June 2014	Concrete Beton	Posted to all CSSA Members	CSSA
9 – 12 June 2014	Seminar Road Show: Development in Cementitious Materials and their Influence on Concrete Properties	Durban, Port Elizabeth, Cape Town & Johannesburg	Seminar Committee
26 June 2014	Board Meeting	Johannesburg	CSSA President
31 August 2014	Closing Date for 2015 Fulton Awards Nominations	-	CSSA Administration
September 2014	Concrete Beton	Posted to all CSSA Members	CSSA
8 – 11 September 2014	Seminar Road Show: Design of Concrete Structures – The Latest Developments	Durban, Port Elizabeth, Cape Town & Johannesburg	Seminar Committee
23 October 2014	Board Meeting	Johannesburg	CSSA President
31 October 2014	Membership Renewal Notices	E-mailed to all CSSA Members	CSSA Administration
November 2014	Concrete Beton	Posted to all CSSA Members	CSSA
30 November 2014	Closing Date for 2015 Fulton Awards Entries	-	CSSA Administration

CONCRETE SOCIETY OF SOUTHERN AFRICA KWAZULU-NATAL PROGRAMME			
DATE	**MEETING/EVENT**	**VENUE**	**CONVENOR**
February 2014	MTM	University of Natal	Committee Member
March 2014	Event: AGM / Concrete Achiever Award / Cocktail Party	Tentative: Durban Country Club	KZN Chair
April 2014	Site Visit	TBC	Committee Member
May 2014	MTM	University of Natal	Committee Member
June 2014	Site Visit	TBC	Committee Member
July 2014	MTM	University of Natal	Committee Member
August 2014	Event: Golf Day	Beachwood Golf Club	Committee Member

CONCRETE SOCIETY OF SOUTHERN AFRICA KWAZULU-NATAL PROGRAMME CONTINUED			
DATE	**MEETING/EVENT**	**VENUE**	**CONVENOR**
September 2014	Event: EPD and Cube Competition	Berea Rovers Club	Committee Member
October 2014	MTM	University of Natal	Committee Member
November 2014	MTM	University of Natal	Committee Member

CONCRETE SOCIETY OF SOUTHERN AFRICA INLAND BRANCH EVENT PROGRAMME			
DATE	**MEETING/EVENT**	**VENUE**	**CONVENOR**
12 February 2014	Committee Meeting	UJ, Auckland Park	Hanlie Turner
March 2014	QTM	Protea Hotel, Willow Lake, Bloemfontein	Hanlie Turner & Natalie Johnson
12 March 2014	Committee Meeting	AfriSam, Constantia Park	Hanlie Turner
April 2014	Site Visit	To Be Confirmed	Debbie Harvey
9 April 2014	Committee Meeting	Ash Resources, Longmeadow	Andrew Schmidt
7 May 2014	QTM	University of Johannesburg	Hanlie Turner & Natalie Johnson
14 May 2014	Committee Meeting	SARMA, Randpark Ridge	Andrew Schmidt
11 June 2014	Committee Meeting	Chryso-abe, Jet Park	Andrew Schmidt
July 2014	Site Visit	To Be Confirmed	Debbie Harvey
9 July 2014	Committee Meeting	PPC, Sandton	Andrew Schmidt
15 August 2014	Committee Meeting	BASF, Midrand	Andrew Schmidt
22 August 2014	EPD Casting	-	Donovan Leach, Jannes Bester & Johan Delport
10 September 2014	EPD Crush-In	PPC Jupiter Works	Donovan Leach, Jannes Bester & Johan Delport
10 September 2014	Committee Meeting	Sephaku, Centurion	Andrew Schmidt
13 September 2014	Boat Race	Victoria Lake	Andrew Schmidt, Michelle Fick, Johan van Wyk, Tina Coetzee & Johan Delport
9 October 2014	Committee Meeting	Lafarge, Longmeadow	Andrew Schmidt
12 November 2014	Committee Meeting	To Be Confirmed	Andrew Schmidt
13 November 2014	Chairman's Breakfast	Blue Valley Golf Estate	Committee Vice Chair

Company Membership Details

Platinum	Principal Member	Address	Tel No	Email
AfriSam SA (Pty) Ltd	Mr Mike McDonald	PO Box 15 ROODEPOORT Gauteng 1725	011-758-6000	mike.mcdonald@za.afrisam.com
BASF Construction Chemicals SA (Pty) Ltd	Mr Morgan Govender	PO Box 2801 HALFWAY HOUSE Gauteng 1685	011-203-2405	morgan.govender@basf.com
Lafarge Industries South Africa (Pty) Ltd	Mrs Sheena Murugan	PO Box 1637 North Riding RANDBURG Gauteng 2162	011-257-3114	sheena.murugan@lafarge-za.lafarge.com
Pretoria Portland Cement Company Ltd	Mr Donovan Leach	PO Box 40073 CLEVELAND Gauteng 2022	011-626-3150	donovan.leach@ppc.co.za
Gold	**Principal Member**	**Address**	**Tel No**	**Email**
AECOM SA (Pty) Ltd	Ms Siyanda Ngebulana	PO Box 3173 PRETORIA Gauteng 0001	012-421-3500	Siyanda.Ngebulana@aecom.com
Chryso Southern Africa Group	Mr Norman Seymore	Postnet Suite 59 Private Bag X1 EAST RAND Gauteng 1462	011-395-9700	charne@chrysosa-abe.co.za
Sika South Africa (Pty) Ltd	Mr Paul Adams	PO Box 15408 WESTMEAD KwaZulu-Natal 3608	031-792-6500	adams.paul@za.sika.com
Silver	**Principal Member**	**Address**	**Tel No**	**Email**
Ash Resources (Pty) Ltd	Mrs Alta Theron	PO Box 7121 GREENSTONE Gauteng 1616	011-657-2300	alta.theron@ash.co.za
Mapei SA (Pty) Ltd	Mr Christo Van Der Merwe	PO Box 75995 GARDEN VIEW Gauteng 2047	011-552-8476	c.vdmerwe@mapei.co.za
NPC Cimpor (Pty) Ltd	Mr Pieter Strauss	PO Box 15245 BELLAIR Kwa-Zulu-Natal 4006	031-450-4411	straussp@cimpor.com
Stoncor Africa (Pty) Ltd	Mr Jonathan Starmer	PO Box 2205 HALFWAY HOUSE Gauteng 1685	011-254-5500	jstarmer@stoncor.com
The Concrete Institute	Mr Bryan Perrie	PO Box 168 HALFWAY HOUSE Gauteng 1685	011-315-0300	bryanp@theconcreteinstitute.org.za
Twintec Limited	Mr Martin Kerrigan	Unit 409, The Cliffs Niagara Way, Tyger Falls BELLVILLE Western Cape 7530	021-914-7752	m.kerrigan@twintec.co.za
W R Grace	Mr Deon Van Den Berg	64 Rigger Road Spartan KEMPTON PARK Gauteng 1620	011-923-4630	deon.vandenberg@grace.com
Bronze	**Principal Member**	**Address**	**Tel No**	**Email**
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
CLF Concrete Laser Flooring (Pty) Ltd	Mr Peter Norton	PO Box 2589 WITKOPPEN Gauteng 2068	011-704-5557	peter@concreteflooring.co.za
Concrete Manufacturers Association	Mr Wally Armstrong	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 FONTAINEB-LEAU 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
Group Five Civil Engineering (Pty) Ltd	Mr Nkosana Mhlophe	PO Box 1750 BEDFORDVIEW Gauteng 2008	011-922-3734	njmhlophe@groupfive.co.za

Company Membership Details				
Bronze	**Principal Member**	**Address**	**Tel No**	**Email**
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.hmp@iafrica.com
IMP Scientific and Precision (Pty) Ltd	Mr Wessel Delport	PO Box 1110 BOKSBURG Gauteng 1460	011-916-5000	wessel.delport@imp.co.za
Jeffares & Green (Pty) Ltd	Mr Jacobus Burger	PO Box 794 HILTON KwaZulu-Natal 3245	033-343-6700	burgerk@jgi.co.za
Malani Padayachee and Associates (Pty) Ltd	Mrs Malani Padayachee-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	031-714-2130	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
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	clive@penetron.co.za
PERI Formwork Scaffolding Engineering (Pty) Ltd	Mr Andrew Rowe	PO Box 2668 BELLVILLE Western Cape 7535	021-907-2100	andrew.rowe@peri.co.za
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Ruwacon	Mr Pieter Ruthven	PO Box 13596 Noordstad BLOEMFONTEIN Free State 9302	051-403-0400	pieterr@ruwacon.co.za
S A Ready Mix Concrete	Mr Linda Nyathikazi	PO Box 884 New Germany PINETOWN KwaZulu-Natal 3610	031-765-1546	linda@saconcrete.co.za
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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
Stefanutti Stocks Civils	Mr Werner Jerling	PO Box 12394 ASTON MANOR Gauteng 1630	011-522-4011	werner.jerling@stefstocks.com
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Topfloor Concrete Limited	Mr Peter Lord	PO Box 124 SANLAMHOF Western Cape 7532	021-951-7700	peter@awl.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	PO Box 15991 VLAEBERG Western Cape 8018	021-426-0243	llynch@xypex.co.za