# C&CI is closing down

After 75 years of serving the construction industry in South Africa, the highly respected Cement & Concrete Institute (C&CI) will be closing down at the end of April 2013. This decision was reluctantly taken by the C&CI Board following the resignation of the Institute's main funding members.

This article, by structural engineer and C&CI staff member Gary Theodosiou, was submitted to *Civil Engineering* a few weeks ago, i.e. before this turn of events. We have decided to publish the article, nevertheless, as the engineering information remains valid, particularly for our structural engineering readers.

# Promoting precast concrete usage – **also for structural engineering**

THE CEMENT & CONCRETE INSTITUTE (C&CI) is [was] leading a special task group comprising consulting engineers, specialist precast concrete contractors, main contractors, academics and an architect, to promote the greater use of precast concrete construction in South Africa.

Constructing with precast concrete elements offers several advantages. These include: quicker construction owing to reduced propping; improved and consistent quality thanks to the controlled environment that factory-based production provides; and enforced coordination and teamwork because construction, layout and connection details have to be planned well in advance.

Despite these benefits precast concrete falls considerably short of its full potential in South Africa. Not that long ago it was far more widely used. For example, half the Sandton City retail, commercial and hotel development, as well as buildings in Sandton's business precinct, were built using precast concrete elements; and so was much of Sun City.

Property developers are missing out on the superior design opportunities offered by precast concrete, particularly in the use of columns, beams, and staircases. Professionals who tend to favour structural steel construction as a faster construction technique are probably unaware of the quick lead times and the huge amount of flexibility offered by precast concrete. Structural precast concrete contractors could perhaps do more to market their products and expertise among structural engineers and other professionals.

Precast panels about to be hoisted into position

As a building material, concrete can either be cast in-situ, precast on site (as in the case of tilt-up and stack-casting), or precast in a factory environment. All of these techniques can be combined in a single project. Moreover, individual concrete elements can be designed and built combining in-situ and precast concrete in what is known as hybrid concrete.

Hybrid concrete takes full advantage of the inherent qualities of both forms of casting. The accuracy, speed and high-quality finish of precast components can be combined with the economy and flexibility of cast in-situ concrete.

For instance, hybrid concrete construction simplifies the more complex connection details sometimes associated with normal precast concrete construction. It also allows engineers to design structures or elements with full continuity, similar to that found in in-situ construction, as opposed to pin-joint designs which are sometimes associated with precast concrete.

Hybrid concrete construction produces simpler, more competitive structures. The client is given better value and the contractor benefits from increased off-site component

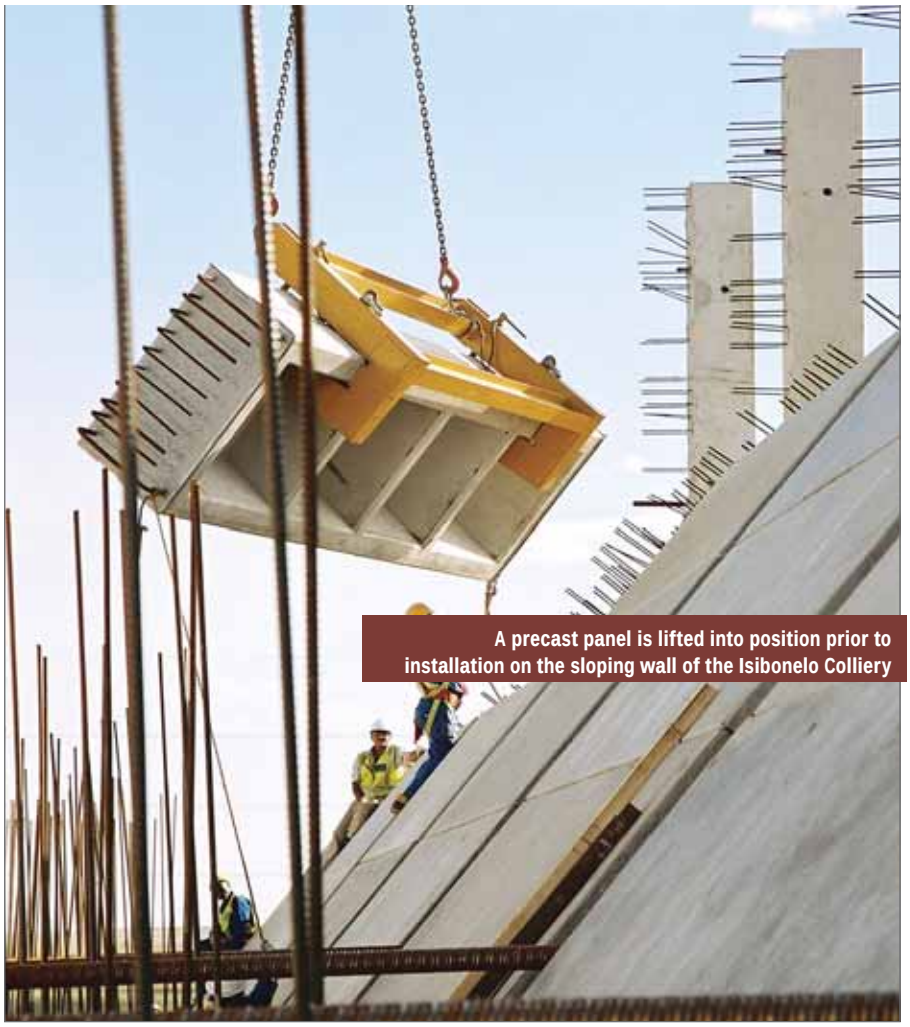
manufacture, safer and faster construction and consistent performance.

Precast concrete construction addresses all the important requirements for sustainable concrete structures, including durability, quality, speed of construction, appropriate finishes and cost-effectiveness.

Concrete, both in-situ and precast, is one of the world's most durable materials. Well-designed, well-produced concrete offers exceptional performance and long life, and is a first line of defence against most forms of erosion.

Precast production facilities can either be situated in an established factory or on site. Because precast concrete is produced in a controlled environment (typically referred to as a precast yard), it is possible to monitor all stages of production, including curing, compaction, the quality and depth of cover concrete, and strength requirements.

Precast concrete is generally cast at ground level, which assists with safety and productivity and offers greater control of quality and workmanship, unlike the exposed and awkward access sometimes associated with in-situ casting. In addition,



A precast panel is lifted into position prior to installation on the sloping wall of the Isibonelo Colliery

A cross-sectional view of the Isibonelo Colliery bunker under construction, showing the cast in-situ vertical columns, the sloping precast concrete beams, the precast panelling, and the cast in-situ bunker floor, approximately one metre thick

An external view of the Isibonelo Colliery bunker while still under construction, showing the vertical cast in-situ columns, precast concrete sloping beams and the precast panelling

the precast route often results in better durability, with consequent savings in maintenance costs, time, materials and energy.

Moreover, the forms used in precast concrete production may be reused hundreds if not thousands of times before being replaced. This ensures that the costs of formwork per unit are lower than that of in-situ construction, where formwork can cost between 35–60% of the cast elements.

## CASE STUDY: ISIBONELO COAL BUNKER

An 8 000 ton coal bunker at Anglo Coal's Isibonelo Colliery illustrates the advantages and flexibility of hybrid concrete technology. Designed by Lyonell Fliss & Associates and constructed by Murray and Roberts in 2005, the foundations and columns were constructed with in-situ concrete.

The horizontal bottom slab was cast in-situ on precast beams, which in turn rested on in-situ columns. The remainder of the bunker, including inclined and vertical wall panelling, as well as sloping beams, were all constructed with precast concrete elements and lifted into position by crane.

The use of both in-situ and precast concrete meant that connecting the various concrete elements to one another was considerably simpler.

An appreciable amount of time was saved by casting the precast elements in concert with the excavation work and the in-situ construction of the foundations, columns and the horizontal floor-slab. This meant that the precast elements were ready to be lifted into position soon after the in-situ concrete columns had been completed.

Another benefit of using precast concrete for the bunker was the quality and finish of the concrete panels used to build the inclined and vertical bunker walls. A 60 MPa concrete with a surface hardener was specified to produce a smooth, durable and hard-wearing surface so that the abrasion caused by the loading and off-loading of coal in the bunker could be resisted.

The panels were cast horizontally under ideal conditions, and after seven years of continual usage, the concrete shows no visible sign of deterioration. By contrast, in-situ constructed coal bunkers usually require 50 mm thick steel plates or rail liners for added wear protection. This is because in-situ casting in sloping formwork often results in honeycombing and inadequate compaction, leaving a 30 MPa concrete vulnerable to the abrasive nature of sliding coal.

Controlling quality standards is much easier in a precast yard, and concrete elements which do not meet the quality requirements can be rejected before installation. It is far more difficult to assess and maintain quality in an in-situ constructed bunker, where climbers are required to assess and repair poor quality concrete in awkward, dangerous positions/heights.

In short, the advantages of constructing the concrete bunker walls and floor in precast concrete as opposed to in-situ concrete are as follows:

- Cost savings on steel plate or rail liners
- Better concrete durability
- Easier jointing
- Speed of construction
- Cost savings due to less labour and material required
- Superior quality resulting in less maintenance.

## NOTE

In light of the fact that the C&CI is busy closing down their activities, comments on this article should please be sent to the editor (verelene@saice.org.za) who will then pass them on to the author. □

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