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Precast captures moments in time

"The Heritage Circle" is the culmination of a five year community project which has created a striking public artwork in one of Western Australia's premier regional parks, G.O. Edwards Reserve. Innovative in design and enhancing the natural landscape, the artwork celebrates the Town of Victoria Park's unique indigenous and colonial history.

Comprised of six precast concrete panels in a circular formation, each panel stands approximately 2.5 metres tall and 3 metres wide, and weighs approximately 5 tonnes. Each one depicts a different theme through a montage of images relating to past life in Victoria Park – Flora & Fauna, Momentous Events & Community, Sport & Recreation, Industries, Transport and Architecture. The panels capture moments in time often long forgotten.

Initially, through its community committees and staff, the Town provided ideas for the artists, Smith Sculptors, who scrupulously carved the images into polyurethane blocks. Once carved, the panels were sealed and a fibreglass cast was set.

A crisp, clean concrete finish was integral to the success of the Heritage Circle, as the artwork relies on image clarity for historical purposes and good "relief" so that the artwork effectively captures natural light and shade elements.

Manufacturing the precast panels presented several challenges for WA precast manufacturer, Delta Corporation Limited. Cast onto an intricate sculptured fibreglass mould, the precaster's main concern was that the concrete would stick to the fibreglass and possibly damage the pattern during de-moulding of the precast panels.

A trial fibreglass mould was prepared with a special concrete mix selected to colour match the existing limestone sections of the site. Using appropriate mould release agents and casting techniques the casting process proved correct, meeting with the rapturous approval of the sculptors and the Town of Victoria Park.

Project Details

Project name:	The Heritage Circle Sculptured Wall Panels, Burswood, WA
Precast Supplier:	Delta Corporation Limited
Principal:	Town of Victoria Park
Sculptor:	Smith Sculptors

One of the six precast concrete panels, which make up the montage of images relating to past life in Victoria Park

President's Column

Amidst a very busy NPCAA agenda, our most recent meeting was held in Christchurch New Zealand. The joint meeting with Precast New Zealand (PCNZ) began with most of the 21 NPCAA delegates arriving to a cold and wet Wednesday afternoon in the city. By Thursday morning the sky was clear, the sun was shining while the air was crisp and cold, it was a perfect start to a fantastic couple of days.

After separate NPCAA and PCNZ meetings, we joined together in the afternoon to discuss industry issues of relevance to both organisations, such as the testing of hollowcore performance in areas of high seismic risk. This was further explained by Professor John Mander and Dr Stefano Pampanin during our tour on the following day of the seismic testing facilities at the University of Canterbury.

As New Zealand's largest precast manufacturer, Stresscrete was the perfect choice for a factory visit, allowing the Australian delegates to compare notes with their Kiwi counterparts. The tour of two of Stresscrete's projects – the Canterbury Department of Health Board Car Park, and the Dressmart Shop and Car Park, showed us alternative applications of hollowcore and reinforced the economies of a precast solution.

Our thanks to the PCNZ members for their warm hospitality and a special thank you to Alan Kirby of Cement and Concrete Association New Zealand and to John Marshall of Stresscrete for their efforts to make our trip one to remember. I would also like to thank our Executive Officer Sarah Moore for the effort she put in to make the trip a success.

Successful Precast Design Workshops for engineers have been held in Sydney, Brisbane, Melbourne, Adelaide and Perth.

We continue our work to promote precast flooring, and on our review of the first edition of the Precast Concrete Handbook (which, incidentally, is now available on disk from SAI Global). We also continue to work with Australian Standards on reviews of various Standards, with the Australian Safety and Compensation Council on a national code of practice for both on-site prefabricated concrete (sometimes referred to as tilt-up) and off-site manufactured concrete (precast), and with Curtin University on precast course material for undergraduate engineers.

I also take this opportunity to welcome our newest Associate Member – Coates Hire, and our newest (and first) Professional Associate Member – BDO Chartered Accountants and Advisors. Don't forget to check out the full list of Members on the back page of this publication.

Gavin Stollery
President

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Use of Hollowcore Flooring in Composite Steel – Concrete Construction: Part 1 – The Advantages

Dr Dennis Lam, University of Leeds, UK
(2005 Royal Society Visiting Fellow, University of Wollongong, Australia)

Professor Brian Uy, University of Wollongong, Australia

Introduction

This article presents the transfer of knowledge from UK to Australia for the use of precast concrete hollowcore slabs in steel-concrete composite construction and the advantages over metal deck composite flooring. Whilst it is common practice to use precast concrete planks in Australian building construction, the benefits of composite behaviour with steel beams have not yet been fully realised with these systems, (National Precast Concrete Association of Australia, 2003). The use of precast hollowcore slabs in steel composite construction has seen rapid growth in popularity since it was first developed in the 1990's. Composite steel beams incorporating precast hollowcore slabs illustrated in Figure 1 are intended to offer designers with an alternative to the traditional steel frame with steel deck flooring method and advantages over the steel decking system. The main advantages of this form of construction are that precast hollowcore slabs can span up to 15 metres without propping. The erection of 1.2 metre wide precast concrete units is simple and quick, shear studs can be pre-welded on beams before delivery to site thereby offering the savings associated with shorter construction times.

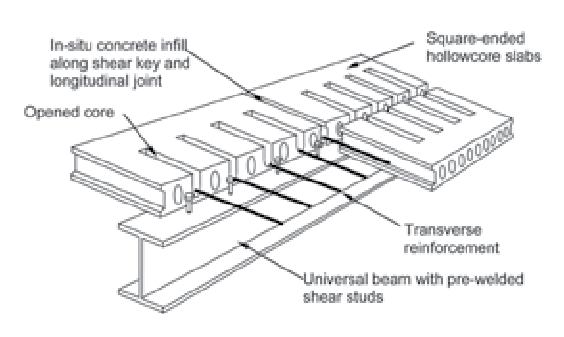

Figure 1: *Composite beam with precast hollow core slabs*

The practical application of the method is illustrated in Figure 2(a), showing the application of this form of construction in Australia in the Sydney Airport, Domestic Terminal Carpark. The application of precast was necessary in this project for the following reasons, according to Cleaver, (2005):

- The existing car park had to remain in operation, whilst construction took place
- No propping was permitted, as this would affect the 24-hour a day operation of parking
- The design solution for the structure had to meet stringent weight considerations
- The new car parking floors had to provide a clean, modern appearance.

Figure 2 (a): *Erection of hollowcore (manufactured by Rescrete Industries) at Sydney Airport, Domestic Terminal Carpark*

Furthermore, Figure 2(b) also illustrates conceptually how the method eliminates the need for secondary steelwork by spanning the pretensioned precast planks between primary steelwork.

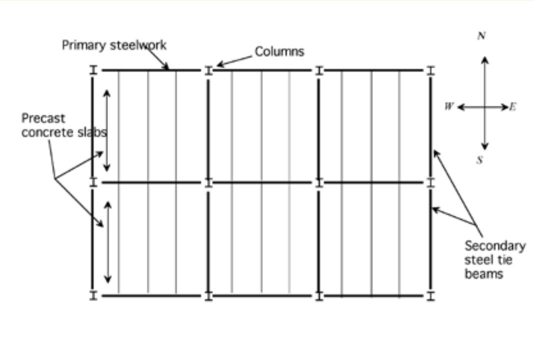

Figure 2 (b): *Typical composite steel and precast concrete floor plan*

Figure 3 shows a direct comparison of the metal deck flooring composite system with the composite system with precast hollowcore

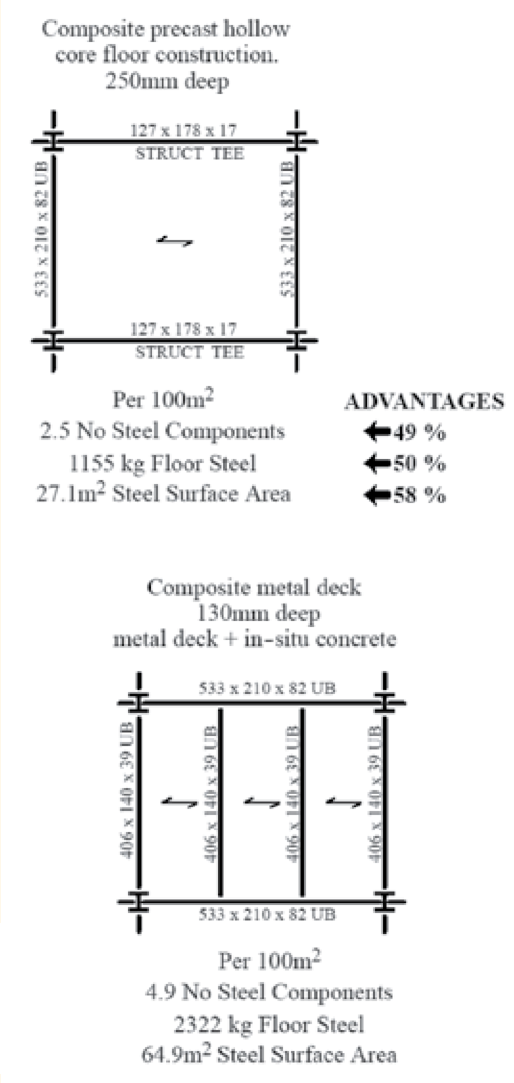

Figure 3: *Comparison between the composite hollowcore systems to the composite metal deck flooring systems (Lam & Uy, 2003)*

Figure 4: *Alternative methods for composite hollowcore system*

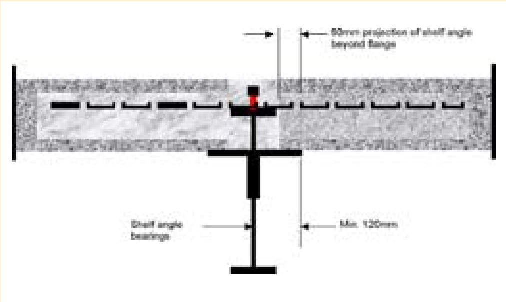

Figure 4(a): *Shelf angle system*

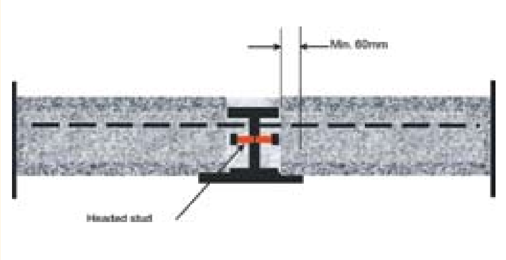

Figure 4(b): *Slimfloor system*

Figure 5: *Precast hollowcore slabs*

Figure 6: *Longitudinal joint with pre-welded headed shear studs*

slabs with a typical bay of 9m × 9m. The comparison showed a typical saving of 50% over steel weight, number of components and more significantly on steel surface area when fire protection and paint treatment are taken into consideration.

In addition, the extra floor depth over the composite metal deck flooring system could be compensated using the shelf-angle or slimfloor system as shown in Figure 4. With careful and proper detailing, this system should exhibit satisfactory seismic performance and fire rating. It has been illustrated in aseismic zones that the governing load combinations for multi-storey composite sway or braced frames, reversal of moment in joint regions would not be experienced, (Hensman and Nethercot, 1999; and Loh *et al*, 2004). Therefore, it would not be expected that this form of construction would suffer any adverse effects. Research on active fire protection using catenary action in these systems is also on-going by the authors.

The N*ew South Wales Government White Paper Construct* (New South Wales Government 1998) has placed an emphasis on seizing opportunities to build a better construction industry. These reports highlight the need to reduce on-site activities and waste as part of the drive to encourage the construction industry to contribute positively towards sustainable development through greater efficiency, improved quality and greater certainty in the delivery of construction projects. For multi-storey buildings, the use of precast concrete slabs in the floors – particularly if this can be done without the need for in-situ screeds will drastically reduce the volume of on-site concreting required.

Hollowcore slabs possess longitudinal voids and are produced on a long prestressing bed either by slip forming or extrusion and are then saw cut to length (Figure 5). The depth ranges from 150 to 400 mm, with the performance limited to a maximum span / depth ratio of around 50, although 35 is more usual for normal office loading conditions. A 50mm (nominal) dry bearing length is used, although the British Standard BS8110 (1997) permits an absolute minimum bearing length of 40mm where saw cut units bear onto steel surfaces. Current Australian design provisions recommend a minimum bearing length of 70mm for this method of construction which lead to a minimum required width of 220mm for the steel flange (National Precast Concrete Association of Australia, 2003). Research on the effect of reducing the in-situ concrete infill gap width to minimise the width of the steel flange is on-going at the University of Wollongong.

Figure 7: *Transverse joint of the hollowcore slabs*

Figure 8: *Hollowcore slabs with opened cores*

The longitudinal & transverse joint between the units (Figures 6 & 7) is filled with in-situ concrete so that horizontal compressive membrane forces can be transferred through the slab. The compressive strength of the in-situ concrete infill may vary from 20 to 40 MPa, but 35 MPa is normally used for design. Shear connectors are pre-welded to the steel beams and an adequate amount of concrete is to be placed and compacted around the shear connectors. The spacing of the shear connectors is determined from the requirements of the shear force interaction along the steel / concrete interface. The sides of the hollowcore slabs are shaped on the casting bed to the profile shown in Figure 7 to allow for the transverse shear transfer. The tops of the hollow cores in the slabs are typically left open at 300mm centres for 500mm in length to permit the placement of tie steel across the slab (Figure 8). Research work by Lam et al (2000) showed that given the correct geometry and material properties, full or partial interaction between the precast slab and steel beam is possible. For typical geometry and serial sizes, the composite beams were found to be twice as strong and three times as stiff as the equivalent isolated steel section.

The advantages of composite beam design with precast planks

Steel Economy

The use of precast hollowcore and solid slabs for composite steel beam design provides a reduction in the total tonnage of structural sections compared with the use of non-composite and composite metal deck steel solutions.

Speed of Erection

Time-consuming activities such as propping, shuttering and concrete pouring may be virtually eliminated. Using a precast floor, a large volume of work is carried out off-site and saves what can be a complex and time-consuming site operation subject to the vagaries of the climate.

Reduced Site Operations

The use of hollowcore and solid slabs in composite steel beam design greatly reduces the amount of in-situ concrete work on site. The ability of hollowcore slabs to provide bay centres of 7.5m and greater, far exceeds that provided by a metal deck solution. This enables a reduction in the number of steel members for a building and consequently on site programme time. In addition, the provision of factory welded shear studs on the steel beams removes the stud welding operation from the site critical path.

Optimisation of Shear Stud Design Capacity

The use of hollowcore and solid slabs for composite steel beam design allows the optimisation of shear stud design due to the lack of restriction in positioning the shear studs.

Elimination of Deflection

The use of hollowcore and solid slabs in composite steel beam design eliminates the difficulties experienced with local deflection of a metal deck solution between steel beam supports.

Fire Resistance

Standard precast floors can be supplied with a standard fire resistance of up to 4 hours, far superior than metal flooring systems can offer. Available fire ratings are HC150 = 2hrs; HC200 = 3hrs; HC250 = 3hrs and HC400 = 4hrs.

Immediate Unpropped Working Platform

Once a precast concrete floor is placed on site, it is immediately available as a working platform. Steel deck systems by comparison can present problems in achieving level surfaces whilst concrete is poured and in providing access whilst in the wet condition.

No Propping

Propping is not required with the precast slabs designed compositely with the steel framed building. Large savings can be achieved when compared with the large amount of propping required with fully in-situ and semi-in-situ floor systems.

Diaphragm Action

Precast floor slabs are structurally grouted to provide a floor with full diaphragm action as required in most multi-storey frames. This can be achieved without a structural topping.

Finished Soffit

Precast floors are manufactured on high quality steel beds and are suitable in appropriate cases for direct decoration.

Factory Engineered Components

Precast floors are factory produced, being manufactured in an environment which is more readily controlled than a building site. Quality control systems are properly implemented and are independently examined on a regular basis under the quality assurance scheme.

Product Application

Composite steel beam design offers an economic solution whenever a steel frame is being considered. It has been proven successful in the design and construction of office, commercial industrial, hotel, stadium and car park developments.

Raised Access Floor

No additional finishes may be required to the top surface of hollowcore units prior to the installation of a raised access floor.

Conclusions:

This article has presented the use of hollowcore flooring in composite steel – concrete construction and the advantages over the traditional composite metal deck flooring system. Research is on-going to provide for the transfer of knowledge from the UK to Australia taking account of the subtleties that exist in relation to hollowcore manufacture between the two nations.

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cut off

John Burke – a tribute

Anyone who knows John Burke would agree that the next phase in John's life will not be retirement, but rather a transition from one set of priorities to another – an "organic rather than a cataclysmic change" as John so well describes it.

Born in Newcastle in 1943, John Burke graduated with a BE Civil at Sydney University in 1964 and a Master of Science in Management from New York's Rensselaer Polytechnic Institute in 1969. His working life began in estimating and design in the States and Canada, after which he returned to Australia to work as Production Engineer with Melocco Bros at their Gladesville Factory. Following his transfer to Melocco's Melbourne factory in 1970, John was appointed State Manager, Precast Concrete.

On 1 April 1973 John joined Rescrete Industries as a minor shareholder and Managing Director. One wonders if he knew back then that he would never again be promoted.

A precaster transforms

The 1970's were difficult years and saw most precasters in Sydney closing their doors. Rescrete did not escape this difficult time and went into receivership in November 1974 but continued to trade.

With a new group of shareholders in 1976, a new holding company Hepta Holdings Pty Ltd was incorporated – so named because there were 7 equal shareholders, among them, John Burke, Serge Arciuli and Emil Ludvik. All 7 shareholders were talented in their own areas and all had one thing in common – they were all commercial – they all knew that companies that make losses go broke, and they all fought for every dollar within the constraints of their trade and their ethics. All retired over the years until John, Serge and Emil were left owning the company.

In the years that followed, under John's leadership, the company was able to pay all secured and unsecured creditors and see the receiver retire in June 1979. Only 2% of receiverships end up with the company surviving and only a small percentage of those pay creditors in full. For John and his team to successfully run and build a company with "Receiver and Manager Appointed" on the letterhead is indeed an achievement to be proud of. Modest as he is, John suggests that "being too thick to know when to give up helps".

While others have come and gone, the Rescrete companies have been continuously profitable since February 1975, to a point where by 2005, Rescrete has become the largest player in the precast market in Australia, and probably one of the most diversified internationally.

John and his team can today be proud of Rescrete's fine reputation, being widely recognised as a team of professionals with an enormous amount of technical competence.

Lessons we can all learn from

John attributes Rescrete's fine reputation to a number of things. In his words, "we had a set of ethics that stood us in good stead - we paid our bills on time, we were fair with people and with firms who were fair with us, but were always prepared to take on those who weren't. We didn't allow shoddy work from consultants to be reflected in our work without a fight, we confronted our problems rather than hoping they would go away if ignored and we knew how to say no. We had an uncompromising approach to contractual issues and are proud of never having been to arbitration or litigation over a contractual matter."

But times move on…

As the Directors of Rescrete, John, Serge and Emil had for years recognised that organising constructive succession was their major problem. They didn't, in the interest of their employees, the industry and, of course, themselves, want to be leading the company in their old age and so, when opportunity presented, sold the company to Hanson.

As John says "All good things end and that's sometimes sad but I am proud that we had the ability to get out when we were on top of the game rather than waiting for the effluxion of time to force our hand. And of course we had a lot of fun along the way."

A national Association is formed

John Burke has always looked at the big picture… and in this case on a scale much larger than Rescrete. He always recognised that the work of an industry Association would be crucial to the success of the precast industry as a whole, the benefits of which not only Rescrete, but also others, would enjoy. With Godfrey Smith (SCI) and others, John started the NPCAA and was the first president.

As President, John's ambition for the Association was, firstly, to upgrade the image of the precast industry to reflect better the sophistication of its people and processes, secondly, to increase the total volume of precast purchased and, finally, to have the industry better represented in the various commercial and technical forums in which we had a stake. In addition, the Association provided its Members with the opportunity to meet other manufacturers and suppliers, and to share ideas and appreciate that their problems were seldom unique to each.

Fourteen years later, and thanks to the dedication of John and others during these formative years, the NPCAA is now a well recognised voice for the precast industry in Australia, with a plethora of achievements to chalk up. On behalf of the industry, our thanks to you John, and our very best wishes for your transition, organic as it may be!

Sarah Moore
Executive Officer

Smartfloor provides a smart solution for Brisbane Mater Hospital

An 11 storey carpark taking shape at South Brisbane is the first building to incorporate a precast, prestressed and post-tensioned concrete beam shell developed by Queensland Precaster, Precast Solutions.

Due for completion in late 2005, the new $22.5million Water Street carpark will provide an additional 1018 parking spaces for staff and visitors to the six hospitals that form the Mater Hospital complex.

Site access was a high priority issue for builder Watpac, because the construction floor plate took up the entire site which didn't leave an area for site offices, materials etc. The constricted site conditions made the selection of off-site manufactured structural components a necessity.

Precast concrete provided the answer, not only in reducing on-site construction but also in providing a clean, attractive, and economical structural solution. The precaster delivered a complete precast package with their innovative Smartfloor prestressed precast floor system. The Beamshell system was also used, where precast prestressed 'shell' beams act compositely with the in-situ topping and the precast flooring planks to create an economical two-way structural system. The result is a system that offers considerable savings in structural depth compared to one-way flooring systems. By reducing beam depth to the minimum the system affords a clean, almost level, soffit that aids the even spread of lighting. It is noticeable in carparks where there are deep beams that the beams cut off the lighting at night, leaving dark areas that can seem threatening. When staff work late shifts, as at the Mater, this factor is of real importance in itself, and is a positive and lasting benefit of this flooring system, something which is sometimes not considered when selecting a carpark structural system.

The precast flooring system measured up in other areas as well, having been developed to meet an increasing demand for precast and prestressed concrete components, where time and cost savings compared to conventional forms of construction, are required. The two-way structural spanning capabilities lend themselves well to any project, having the flexibility to fit any building plan, unlike one-way spanning systems.

The system, once complete, consists of a fully bonded concrete topping to form composite structural sections. The thickness of the topping slab varies with span and loading. The topping slab, reinforced with steel mesh, develops a diaphragm action that provides strong resistance to lateral loads. The system is lighter than conventionally reinforced concrete floors of equal capacity and provides long, unobstructed spans, which in return make it possible to reduce beam column and footing loads, providing further economies all round.

This flooring system is a formwork-free solution that is suitable for any project, with spans up to 8 metres, off-site quality controlled production, and offering immediate access for sub trades below. It becomes an immediate safe working platform, with minimal reinforcing to tie and mesh to place. Its low sound transmission and excellent fire rating, combined with its extremely cost efficient attributes make it hard to go past in any rational structural selection process.

"The combined use of formwork and precast concrete components has given us the perfect result. The main benefit of this system is speed. We expect to save about five to six weeks on this project".

John Earnshaw, Project Manager, Construction and Project Management Australia Pty Ltd.

A level soffit aids the even spread of lighting

Project Details

Project name:	Mater Hospital Complex Water Street Carpark, South Brisbane
Precast Supplier:	Precast Solutions Pty Ltd
Principal:	Mater Misericordiae Health Services Brisbane Ltd
Project Manager:	Construction & Project Management (Aust) Pty Ltd
Architect:	Peddle Thorp Architects
Structural Engineer:	Cardno Alexander Browne
Precast Design Engineer:	Bruce Lemcke Engineering
Construction Manager:	Watpac Australia Pty Ltd

NPCAA

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