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Photographer: Nic Bailey

Precast starlight in Berry

The new Berry Sports and Recreational Centre on the NSW South Coast has some of the most unusual precast concrete panels to be seen in this country. The plain grey wall panels are notable for the inclusion of 374 random 'starlight' windows. Created by architects Allen Jack+Cottier (AJ+C), the windows are intended to introduce sparkling daylight into the interior of the hall during the day, while at night providing an impressive lighting display reminiscent of stars in the night sky.

The challenge for Hanson Precast was how to position each starlight in the panel, how to protect each window face from scratching during casting and finishing of the concrete and how to seal each window from rainwater. A prototype panel was cast that used a removable stripping taper plate for each window. The test panel proved outstandingly successful in delivering each window with a pristine bevelled edge and an unblemished surface to the inner and outer panes.

According to John Whittingham of AJ+C "The placement of the starlights was very simple in as much as there were virtually no constraints on location apart from ensuring that they were not placed directly under beam positions. The only other positions to avoid were at panel bracing inserts, and roof framing fixings. A simple grid used in the shop detailing of each panel created a process of easy review and permitted the quick and accurate positioning of each starlight in the mould. The detailing of reinforcing around each starlight was critical with trimmer bars at each opening."

Two panel types were used - 175mm thick panels for the side walls, and 200mm thick panels for the end walls. The 10 panels on each side, all eight metres high by 3.2 metres wide contained on average around 13 starlights of different sizes, shapes, and colours. Due to the insistence of the architects that no wall bracing be used, the end wall panels, each five metres high by 2.6 metres wide, were designed as shear walls to obviate the need for any bracing. In order to eliminate any diagonal roof bracing a Vierendeel roof truss was adopted to transfer lateral loadings to the shear walls at each end of the building.

The load-bearing precast panels were erected and braced followed by bolting of the steel rafters to suit the curved roof. The long-span prefabricated roof panels, combining roofing, insulation, and ceiling were lifted into position and attached to the rafters. No purlins were required, with the roof acting as a diaphragm.

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Precast features in awards Congratulations to Hanson Precast as precast manufacturer for the Berry Sports & Recreational Centre, which recently won the Blacket Award in the NSW 2008 RAIA Public Architecture Awards. Congratulations also go to SA Precast as precast manufacturer for the Parramatta Justice Building (winner of the Commercial Architecture Award) and to Precast Concrete Products as precast manufacturer for the Parramatta Station Wall (winner of the Architecture Award).

President's Column

The players in the building construction industry operate in a harsh environment where the rules of natural selection apply in earnest and it is only the fittest that survive and thrive.

Unfortunately many factors come into play that are beyond the control of those participating. Some examples are rising material prices, less than adequate performance of the other participants involved in a project and inclement weather.

This leads to a high risk environment where the implication of a less than good result is significant. It would be reasonable to assume that the commercial risk would be fully priced but in general this is not the case. That said, these are the rules of the game and we have two options, to be in or be out - as precasters we are opting to be in. Our challenge is to do what we can to ensure the playing field is level.

The important consideration is that risk is appropriately and proportionately distributed between the participants in a project taking into consideration the potential reward if things go well.

The concept of passing as much risk as possible 'down the line' is inherently wrong given that the party least able to bear the risk is often the one that is left to accept the major portion of that risk. Contracts need to fair and reasonable. There are a number of well established pro-forma contracts such as the Australian Standards series that meet these criteria but as an industry we see these amended to the degree they are barely recognisable.

Contracts can be complex and National Precast has put considerable effort into an education process to ensure our members are aware of the issues involved and thus are alert to the risk shifting activity that often occurs in the shadow of a margin shaving exercise.

It is vital that all the players in the construction industry have a clear understanding of the rules of the game. We must work collaboratively in a team environment to get the optimal outcome for the project and a fair result for all participants, head contractors and sub-contractors alike.

ALAN MORRISON
President

Photographer: Nic Bailey

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The precast concrete walls have been used to assist ventilation and comfort. In summer the higher section of the northern wall is used to create heat, which in turn creates a thermal chimney effect. This chimney effect extracts hot air at the top and draws in cooler lower-level air through low level louvers. The deciduous planting adjoining these louvers, will when grown, assist in tempering the air drawn in from outside. In winter the roof vents are closed to retain heated air. This combined with the very effective roof insulation provides comfortable conditions throughout the year.

Prefabrication consisting of a combination of precast concrete walls, self-spanning composite roofing and structural steelwork has been utilised for a cost-effective high quality result. This enabled an accelerated program, outstanding quality and cost control. Walls are unfinished concrete, minimising consumption of materials while providing low maintenance and extreme durability.

Berry Sports and Recreational Centre

Location:	660 Coolangatta Road, Berry NSW
Owner:	NSW Department of the Arts, Sport & Recreation
Architect:	Allen Jack+Cottier
Structural:	Acor Appleyard Consultants (formerly Appleyard Forrest)
Mechanical:	Umow Lai Enginuity
Builder:	Ablock Builders
Precast Manufacturer:	Hanson Precast

Photographer: Nic Bailey

In probably the first ever application of acrylic shapes cast into a precast panel, the starlight window effect has been achieved using clear impact-resistant inner and outer window panes, separated by a coloured plastic liner the width of the panel. Different colour liners, white red or black, were used to enhance the display analogous to the effect of a traditional stained glass window.

Ultra fast precast flooring

Mile End in Adelaide has a good example of how to speed up the construction cycle, while eliminating the need for propping and overcoming problems associated with limited site access. In this case the Ultrafloor precast flooring system was selected for a 6,000 square metre two-storey office/warehouse building.

Project Manager John Woodbridge discusses project details with Ultrafloor's Barry Ellis

According to Project Manager John Woodbridge, "To take advantage of the fast erection time of the system, we needed to keep the ground floor as clear as possible during all phases of construction. No propping was required and only minimal temporary propping was required to the underside of the structural steel beams enabling continuous, virtually unimpeded work space at ground floor level."

As compared to a conventional concrete slab with its multiplicity of props and formwork elements, not only was the ground floor kept remarkably free by the precast flooring system, but the time saving was estimated by the builder as 28 days, resulting in savings of $38,000.

John continues, "The Ultrafloor was placed in less than two weeks. In the main, the precast beams were craned in over the load-bearing precast walls from the outside but in a few cases, some were installed from within the building and beneath the already placed structural roof steelwork."

The 2,000 square metres of suspended flooring aesthetically fitted in with the semi -industrial concept of a building with no ceiling. The reflectivity of the metal infill between the precast beams enhances the natural lighting within the building without the need to provide a ceiling or to paint a slab soffit. The effect is deemed attractive and acceptable for ground floor retail outlets and other uses like the intended processing of flowers for the SA and NT markets.

Welding of high tensile bolts

by John Woodside, F.I.E.Aust, F.A.S.C.E, M.I.C.E, M.I.Struc.E

Bolts are a very important design issue in precast concrete and are often not well understood or well specified by design engineers. In recent years, it has become customary for engineers to specify grade 8.8 bolts for precast when in fact, they should only be used where appropriate.

Two main types of metric bolt are used in structural engineering and precast connections in Australia. They are:

- Commercial bolts to AS1111, strength grade 4.6; and
- High strength structural bolts to AS1252, strength grade 8.8.

Commercial bolts are made of low carbon steel with mechanical properties similar to Grade 250 steel plate. They can be welded as for Grade 250 steel. High strength bolts are made by heat treating, quenching and tempering medium carbon steel. Heating or welding can cause significant degradation of their mechanical properties and even failure.

Typical bolt sizes used in precast concrete are:

- M16 for lightly loaded connections;
- M20 for general structural connections;
- M24 for heavier structural connections; and
- M28 and above for special structural connections but the use of such bolts will need careful assessment.

Compliance with Australian Standards

Most bolts used in Australia are now imported. Concerns have also been raised that some batches of bolts, imported from overseas or from an unknown source of supply, do not comply with the relevant Australian Standards where the design has relied upon compliance with these Standards. Either these bolts are not accompanied by any evidence of compliance with the requirements that apply in Australia or the supporting documentation is inadequate. In addition, concerns have been raised that some imported products may be stamped as complying, yet may not comply.

"We have seen projects where the grade 8.8 bolts were specified to be tack welded and they all had to be cut out at a very significant cost and replaced with grade 4.6 bolts which can be welded. In another example, M36 8.8 grade bolts were tack welded in a cage prior to casting into a structural column and failed when tapped with a hammer at the time of erection. " *John Woodside*

Compliance with the Building Code of Australia

It is a requirement under the Building Regulations that all building work be carried out in accordance with the Building Code of Australia (BCA) and this includes structural bolts in precast concrete.

To achieve compliance with the BCA requirements the following actions should be taken:

- Engineers must adequately specify the bolts to be used in the connection and erection of precast concrete, including the appropriate referenced Standards with which the bolts and their associated nuts and washers must comply;
- Suppliers need to source bolts that comply with relevant Australian Standards. Bolts are called up in AS4100 which in turn is called up in the BCA. Also look for bolt suppliers who are ISO 9001 certified.
- Delivery dockets should have a clear reference to relevant Australian Standards;
- Suppliers should provide a copy of the evidence of compliance to purchasers and end users on request;
- End users of bolts such as builders, erectors or precasters should request evidence of compliance with relevant Standards from their bolt supplier and ensure they comply with the specification and drawings;
- The relevant building surveyor may request a copy of that evidence, or request that the person issuing certification provide specific verification that the structural bolts (and their associated nuts and washers) used comply with the relevant Standards (structural bolts are those bolts used in the structure as opposed to bolts that may be used in architectural elements or building services).

Summary

If any welding is required, including welding of the structural washer, then grade 4.6 bolts should be used. Where bolts are fixed into cast-in ferrules in precast, the ferrules will almost certainly be grade 250-300 so a Grade 8.8 bolt is no stronger than a Grade 4.6 bolt in tension. More importantly, welding (including positional or tack welds) of any high strength structural bolt, nut or washer will almost certainly result in brittle fracture and failure unless very specific welding techniques are used.

REFERENCES

ASI Connections Design Guide 1 Bolting 1st Ed T.J. Hogan and S.A. Munter 2007

ASI TechNote #1-06, High strength bolt assemblies, Certification to AS/NZS 1252-1996.....Reject or Accept? S.A. Munter

Expressing complex geometry with precast concrete

"Spun" – Southbank Education and Training Precinct

Within the heart of the Brisbane Southbank Education and Training Precinct lies "Spun" – a versatile centrepiece which brings together the ingenuity and precision of structural engineering with the fragility and style of modern art.

Spun, designed by prominent Brisbane artist and sculptor Lincoln Austin, combines art with functionality to create a part sculpture and part seating area and shade structure. Amid its spiralling random form and its function as both artwork and furniture, Spun has become a popular and functional meeting place within the precinct for students and locals alike.

The success of Spun in terms of being a practical piece of art is the result of an equally balanced collaboration between the artist, engineer, architect and precaster.

"From an artist's point of view, it was fantastic to work with both Arup and Cox Rayner who didn't attempt to modify the design. They understood the medium and lightness of the sculpture and worked with the design throughout the entire construction process," Lincoln said.

The design team of engineer Arup and architect Cox Rayner, consulted with the precaster and concluded that precast concrete was going to be the most adaptable and versatile material to make the artist's vision of Spun a structural reality.

Working closely with the artist, the design team was able to rationalise the continuous spiralling main structure into discrete, flat and transportable elements which greatly simplified precast geometry.

Arup senior structural engineer Tom Hambley said "Arup made use of the double spiral and designed a unique base connection which allowed loads to transfer between adjacent spirals through shallow foundations."

"This base connection allowed panel thickness to be minimised as well as simplifying precast connections for construction."

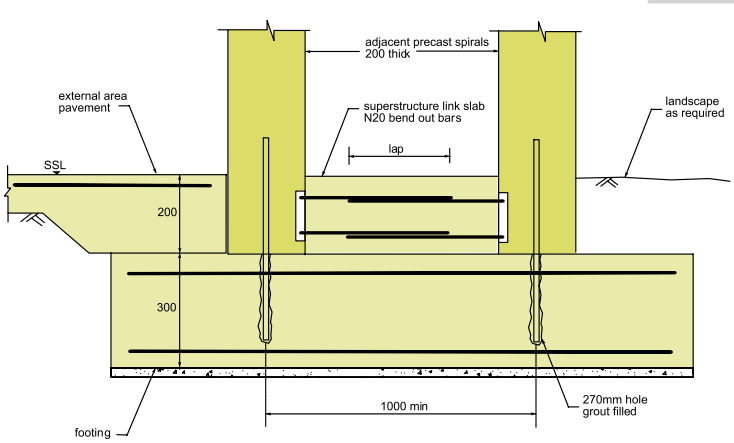
"Use of precast concrete (produced by Precast Concrete Products) provided numerous advantages including simplification of site activities, accurate geometry as well as completing the project with the sought after high quality finish," Tom said. "It's also an excellent and cost-effective alternative to stainless steel."

Lincoln, who built an entire model of the site before starting on his design, said the concept of one place leading to another was something he wanted to express while still considering the issues of durability and accessibility.

"It was my intention to create an open space, something that could sit nicely and blend into the landscape rather than being oppressive or standing out."

Spun

Client:	SETP PPP Consortium - ABN Amro, John Holland Group, Spotless
Artist:	Lincoln Austin
Engineer:	Arup
Architect:	Cox Rayner
Builder:	John Holland Group
Precast Manufacturer:	Precast Concrete Products



Base Connection Concept - Developing Frame Action Between Precast Spirals

Arup Engineer Matt David with artist/sculptor Lincoln Austin.

Bioscience incubates within black polished precast

Australia's first purpose-built bioscience business incubator has been built at Thebarton in Adelaide. The BioSA Incubator is a $12.9 million, 3,600 square metre building, located on a 3,781 square metre site at Thebarton's Bioscience Precinct. This purpose-built facility will provide office and wet-laboratory space coupled with an extensive business support program for up to 16 early-stage, bioscience companies. Its purpose is to assist commercialisation of new technologies and to nurture growth of early stage bioscience companies.

With its clean black polished precast concrete walls, the BioSA Incubator will be setting the style for future buildings within the Thebarton Bioscience Precinct. The Incubator has been designed by international firm Henn Architekten in collaboration with local Adelaide architects Jackman Parken Evans and Capital Architecture. According to Professor Gunther Henn, principal of Henn Architekten, the Incubator is designed as a "space for awareness and knowledge".

Black polished precast panels were selected by the architects and client for their beauty and durability and the need for minimal long-term maintenance. The panels are used on the East and West walls of the building and create a striking effect at the main entry. The North and South walls are primarily glass.

Precast panel sizes were typically 3,580mm wide by 8,080mm high with thicknesses of 175 and 200mm. The panels incorporated 20mm wide vertical sealed joints between panels. To emphasise the horizontality of the building, 50mm wide by 25mm deep horizontal grooves were cast into the panels approximately 600mm apart. The horizontal grooves returned on the panel edges to emphasise the solid masonry effect sought by the architects. Panel edges were given a 12mm arris. Fixing of panels comprised grouted dowels to the floor and a structural steel connection at the first floor level. Floor to floor level is 3.8 metres. In all, some 54 panels of 45 MPa concrete strength were provided.

Achieving perfection with black oxide

Black oxide used in concrete mixes sometimes produces inconsistent colour finishes between adjacent panel surfaces in particular, with off-form finishes. So how did SA Precast ensure a consistent, blemish-free colour finish throughout all 54 panels used on the building?

Claude Pincin of SA Precast Pty Ltd shares how he achieved such a consistent colour on all black panels: "The advantage of a polished finish is that you remove 4 to 5mm of the surface during the polishing process, which takes away the risk of colour variation. We used Black Imperial granite and 330 Bayer black oxide mixed in our own batch plant. Having our own batch plant made it possible to maintain the quality control required."

"The black granite was crushed to give a crusher run of 14mm aggregate right down to granite dust. This meant there was no need for other sand fines in the mix. The mix contained six percent of black oxide. Using only crushed granite and oxide ensured that there was a consistent colour finish throughout the panels," he said.

The BioSA Incubator

Constructing Authority:	Land Management Corporation
Client Agency:	Bio Innovation SA
Architects:	Henn Architekten with Jackman Parken Evans and Capital Architecture
Structural Engineer:	Connell Wagner
Project Manager:	Coffey Projects
Builder:	Badge Constructions
Precast Manufacturer:	SA Precast

Meeting Part J of the BCA at the BioSA Incubator

To meet the Building Code of Australia Part J requirements for thermal performance, the architects found use for the load bearing properties of the precast wall panels. By casting shallow concrete columns on the back of the precast to integrate panels with the structure, a 300mm wide column-free cavity between the back of the precast and the wall lining, allowed for the addition of insulation. The space also provided for sufficient space to handle a multitude of concealed service runs for now and in the future. The Part J wall insulation requirements of the BCA were handsomely met with a high R-value for the total wall assembly.

Keeping R-values consistent

The term Effective R-value has recently caused grief among builders and developers using the Building Code of Australia's Deemed to Satisfy Options for External Walling. In some instances building surveyors have rejected already installed insulated walling systems, because the Steady State R-value has been less than what is prescribed in the BCA. The remedial work to a building with this problem comes at a huge cost.

Section J in Volume 1 of the BCA currently defines R-value as "the thermal resistance (m2.K/W) of a component calculated by dividing its thickness by its thermal conductivity". This R-value is commonly referred to as the Steady State R-value.

The term Effective R-value comes in to play when the benefits of insulated thermal mass are taken into account. There is plenty of research and empirical data which confirms the benefits of insulated thermal mass. Also, it is well accepted that insulated thermal mass can boost the thermal performance of a building element, over and above its identified Steady State R-value.

As such, some insulation suppliers refer to the Effective R-value, as an R-value which factors in this additional thermal boost that is created by an insulated thermal mass (such as an insulated concrete wall) in a building in a particular climate zone.

Probably a more correct terminology would be Mass Corrected R-value as it better describes this boost.

Whilst there is general acceptance concerning the benefits of insulated thermal mass and that it should be factored in when calculating an element's R-value, the BCA does not make allowance for it.

Until the BCA is amended to do this, it is therefore not recommended that an R-value be used which is different to that prescribed in the BCA. To do so may result in significant cost.

Section J: complying with precast

The following are working examples of complying commercial buildings (class 4, 5, 6, 8, 9(a), 9(b)) designed for 'conditioned' space, where the BCA Section J requires a minimum total R-value for walls of R1.8:

Precast concrete sandwich panel	with 65mm concrete / 50mm XPS closed cell extruded polystyrene / 150mm concrete	=> 0.045 + 1.85 + 0.104 = **R 2**
Precast concrete sandwich panel	with 65mm concrete/ 65mm EPS expanded 'bead board' polystyrene / 150mm concrete	=> 0.045 + 1.80 + 0.104 = **R 1.95**
150mm precast concrete panel	with 75mm glass wool insulation, with lined timber stud	=> 0.104 + 1.80 + 0.059 = **R 1.96**

Although there are several options which will allow for a reduced R-value of the walls (including combinations with other measures like shading, air gap plus insulation, surface density, etc), these options may not be practical for many of these types of buildings (such as supermarkets, shopping centres, factories etc).

Precast drops in to Designbuild Melbourne

Designbuild Melbourne visitors were treated to a visual display of the many possible finishes and products available from National Precast Members.

A 5 panel stand weighing a total of 8.1 tonne was manufactured in Adelaide by Bianco Precast, transported to the event and craned into place at the Melbourne Convention and Exhibition Centre.

According to Peter Webb, National Precast Marketing and Education Manager, the stand was a star attraction. "Most people just couldn't help themselves and had to touch the different finishes. And the more technically minded were fascinated by the joints, connections and fittings display at the rear", he said.

National Precast will also be exhibiting at Designbuild Perth from 17-19 October.

National Precast Office Administrator Rachel Parsons and John Joveski, Managing Director of Reckli Formliners, answer visitors' enquiries.

NATIONAL PRECAST
CONCRETE ASSOCIATION AUSTRALIA

CORPORATE MEMBERS

Asurco Contracting ■ [08] 8240 0999
Bianco Precast ■ [08] 8359 0666
Delta Corporation ■ [08] 9296 5000 (WA) or [08] 8363 4817 (SA)
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ASSOCIATE MEMBERS

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PROFESSIONAL ASSOCIATE MEMBERS

BDO Kendalls ■ [02] 9286 5850
Connell Wagner ■ [02] 9465 5751
Moray & Agnew ■ [02] 4911 5400
Robert Bird Group ■ [02] 8246 3200
Strine Design ■ [02] 6282 4877

OVERSEAS MEMBERS

Golik Precast Ltd (Hong Kong) ■ 852-2634 1818
Halfen GmbH ■ [03] 9727 7700
OCV Reinforcements ■ [66 2] 745 6960

Published by
National Precast Concrete Association Australia
6/186 Main Road
Blackwood SA 5051
Tel [08] 8178 0255 Fax [08] 8178 0355
Email: info@npcaa.com.au
Executive Officer – Sarah Moore
www.nationalprecast.com.au