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Not just another brick in the wall: Sustainable Total Precast

Sustainable design principles, a 'smart' Total Precast building and a series of spaces designed around the specific teaching and learning needs of students of Dandenong High School are features of this very 21st century learning centre.

One look at Dandenong High School is enough to confirm that we've come a long way since the 'cookie cutter' approach to education – and its architecture.

Designed by Melbourne architect Hayball, the architecture reflects an innovative approach that takes student needs as its starting point. It called for the creation of a group of separate 'learning centres' as part of the $45 million 'Dandenong Educational Precinct Project', in which three separate campuses were amalgamated to form one of the largest co-educational public high schools in Victoria.

Each learning centre is designed to house 300 students and a core of 25 teachers, with students based in one learning centre for their entire education at the school.

Principles of sustainable design were integral to the project, which served as a pilot for the Green Building Council of Australia's Education sector Green Star Rating. The project achieved 4-Stars using the GBCA's environmental performance measurement tool.

Accordingly, as well as passive solar design which maximises the thermal mass benefits of the Total Precast structure, the project uses recycled elements and materials with minimal environmental impact. Soil from the site was recycled into saleable topsoil by garden suppliers and other waste was sent to a recycling centre. Low-emission paint, skirtings made from rubber, rather than vinyl, eco-friendly plywood and Colorbond metal roof and wall cladding were also used to minimise environmental impact.

The project is also positively pressured, using higher airflows to create access to a continuous supply of fresh, tempered air and limiting the impact on room temperature of open doors and windows.

Playing a pivotal role in the project's environmental performance is the precast hollowcore flooring.

Story continues on page 2…

Photographer Peter Clarke

President's column

Over recent Precaster issues we have been promoting the advantages of using precast to reduce energy costs whilst creating a better environment for building occupants. These benefits are well known but in order for the full benefit to be achieved it requires all industry participants including the regulators to play their part in seeking an improved environment.

For real improvement to take place we require Government legislation to enforce how buildings are designed and constructed. For guidance on this issue the European Council Directive on Energy Performance of Buildings (Directive 2002/91/EC of 16 December 2002) came into force in member states in January 2006 with the objective to reduce energy consumption. The occupancy and use of the 160 million buildings in the European Union (EU) account for 40% of its energy consumption and as such are the largest single source of the region's CO_2 emissions. The objective of this directive was to reduce the greenhouse gas emissions to 1990 levels by this current year. Time will tell whether this target has been achieved.

THE EU DIRECTIVE:

- Provided a common framework for a methodology of calculating the integrated energy performance of buildings.
- Placed minimum requirements on the energy performance of buildings, including that required for cooling.
- Required that measured energy use is checked in completed buildings and that they are compliant.
- Stated that passive heating and cooling concepts should be employed.
- Imposed a system of energy certification of buildings thereby increasing the awareness of the issue and improving the market value of energy efficiency.

In Australia we are somewhat behind the EU and it would appear that our Government leaders have not demonstrated a clear vision in developing a framework for the building industry. We recommend that this directive be reviewed and implemented. **Peter Healy**

…Dandenong High School continued from page 1

"The building has been designed to reach 27 degrees before an evaporative cooling element kicks in, which happens after the air is pre-tempered by being drawn through the cores of the hollowcore floor planks," explains Peter Healy, Managing Director of Hollow Core Concrete, which supplied the flooring and worked closely with other project participants.

"The main precast beams innovatively incorporated a composite steel and precast design to allow airflow to pass through the support member without compromising structural integrity," he says.

The speed and efficiency of the project was also enhanced by use of other precast elements, including exposed precast walls and precast columns, beams and cantilevered balconies.

Finally, the project's eco-friendly status is confirmed by environmental data transferred through the building management system and displayed on LCDs throughout the buildings, an innovation that both monitors performance and becomes an educational tool, reinforcing the importance of sustainability to the school.

Certainly, its sustainability is well recognised elsewhere – the project was a finalist in the Public Building & Urban Design category of the 2009 BPN Sustainability Awards and won two awards in the Victorian Government's School Design Awards: Best Overall School Design and Best Secondary School.

Dandenong High School

Project owner: Victorian Department of Education & Early Childhood Development
Architect & project superintendent: Hayball
Service engineer: Wood & Grive Engineers
Consulting engineers: Wallbridge & Gilbert
Builders – Stage1: HMC Constructions
Builders – Stage 2: Buildcorp Commercial
Precast manufacturer: Hollow Core Concrete

Finishes

Precast concrete offers many different **textures** and **colours**, from a basic off-form grey through to a stained formliner finish through to a polished finish. Careful selection of finishes can turn a building's design into an award winning aesthetic masterpiece. The finish you are able to achieve may depend on the manufacturer you choose and to an extent, the type of panel. It is not uncommon to have precast elements with more than one finish. Some of the most common finishes are listed below.

TEXTURES

Honing & Polishing

Honing and polishing are two individual surface treatments that can also be combined as a two-step process to give a superior surface finish similar to natural polished stone or granite. Honing refers to the removal of the outer surface of concrete by using a grinder that has a coarse abrasive effect, exposing the aggregate in the concrete and giving a flat level surface.

Polishing is a similar process taking the finish to the next level, which uses finer abrasive materials to take a finer cut from the concrete. The result is a very smooth, shiny finish. Both processes use lubrication to ensure gouging and scratching don't occur on the surface. Aggregates used for honed and polished surfaces are chosen for colour, durability and ability to hold a polish. Polished surfaces shed water and dirt easily and have minimal surface absorption, and therefore require minimal ongoing maintenance. Polishing and honing of curves and small recesses are possible but the shape of the element must be considered for this surface finish, along with the capability of the individual supplier.

Etching

Etching refers to a process where about a week after the precast element is removed from the mould, it is washed with an acid solution and then scrubbed to remove the outer skin. The result is a flat, sand-textured surface that resembles limestone or sandstone. The high quality of precast concrete ensures that chloride penetration to the reinforcement is not a risk. A very good off-form surface finish with a minimum of voids is required to use this finish successfully.

3D Surfaces

Precast concrete elements can be designed and manufactured with 3D surface finishes to achieve unique textures and/or profiles. This can be done using specially made moulds, form liners, tiles, bricks, stone, void formers or by use of other techniques like bush-hammered or hammered-nib applications. An advantage of using a 3D surface is that it can be made to look like an existing part of a structure, which can be relevant to heritage listed buildings. The 3D surfaces can also have sustainability benefits by using a surface pattern that can self-shade a vertical element, thereby reducing thermal conductivity from the sun. With the use of CAD/CAM/CAE technologies the possibilities are endless.

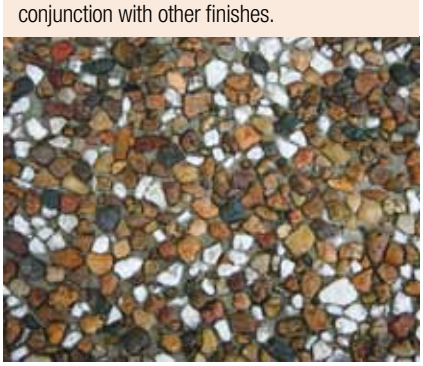
Off-form

Off-form concrete elements are most commonly produced using grey cement. The high quality of the moulds and the quality assured manufacturing techniques used by National Precast Members mean that the quality of finish is extremely high and generally requires no additional finishes to be applied, other than perhaps stain or paint. For variation, false joints and rebates can be incorporated into designs, or alternatively many precast manufacturers are able to include colour pigment into the concrete mix.

The Australian Standard AS3610.1 – 2010, Formwork for Concrete describes the benchmarks for off-form concrete. It defines in detail the characteristics of the classes of surface finish with Class 1 being the highest standard and Class 5 the lowest. Class 1 is only recommended for use in very special features of buildings of a monumental nature and shall not be specified for whole elevations. Class 2 is the most common specification for high quality architectural precast concrete.

Exposed Aggregate

An exposed aggregate finish removes the top layer of the concrete matrix to expose the top surface of the aggregates in the concrete mix. Chemical retarders are often applied to the surface to etch away the concrete matrix without sacrificing the aggregate. Alternatively, a water washing technique may be used. Exposed aggregate finishes are often used in conjunction with other finishes.



Grit (or Sand) Blasting

Grit (or sand) blasting is a technique of abrasive surface preparation using compressed air to propel various particles (e.g. granulated furnace slag, aluminium oxide, glass beads) onto the concrete surface. The process is also referred to bead blasting where larger beads are used.

The surface layer of concrete is removed to expose the aggregates, giving a deeper textured finish. The depth of the grit blasting can be varied to allow a smooth to coarse texture. The aggregate selection, as well as the matrix colour, has a significant effect on the final appearance.

COLOURS

Painting

Painting is the application of a coating (paint) that adheres to the surface of an element, creating an outer skin. The paint colour will be somewhat transparent unless a thick enough coating is applied to ensure the paint is opaque. The advantage of thicker opaque coats (and coatings such as texture coatings) is that it can mask small surface imperfections. Paint generally will last for 10+ years, but is susceptible to wear damage (scuffing). There is an infinite range of colours and colour matching is available.

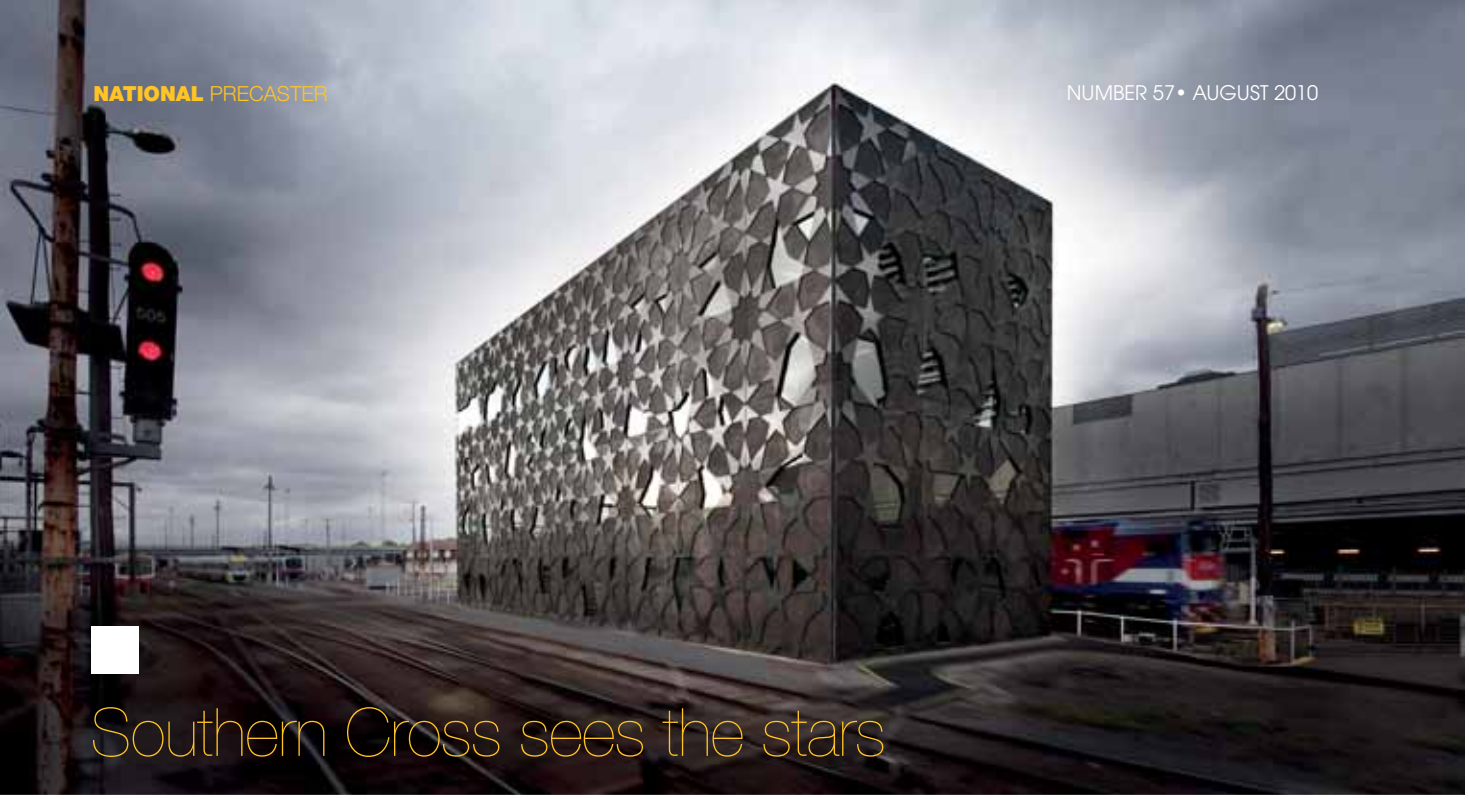
Integral Colouring

The colouring of concrete is achieved through the use of cements, coloured sands, coloured aggregates and pigments (oxides). The basic cements used are grey, off-white and white. The use of cement colour will depend on the final colour choice, with grey cement generally used for darker colours moving to white cement for light colours. The use of coarse aggregates will have more impact visually because of their size, and sand colour will alter the colour of the surrounding cement matrix. Where the desired colour cannot be achieved by using cement, aggregate and sand selection, a wider range of colour can be achieved using pigments (oxides). Coloured precast elements can also have other finishes applied to them like etching, grit blasting, water washing, polishing and honing if requested.

Staining

Unlike paint that is a surface coating, stain is absorbed into the concrete surface. The colour palette is almost infinite, but is usually based around natural colours and is generally guaranteed for 25+ years on vertical surfaces before the finish starts to fade. Colour matching is also available with staining. Stains can be translucent or opaque and are often combined with the use of form liners (see 3D surfaces) for a very broad combination of aesthetic results.

For more information on any of these finishes refer to 10.5 of the Precast Concrete Handbook (purchase at www.nationalprecast.com or phone 131 242) or talk to one of our Members.



Southern Cross sees the stars

Photographer John Gollings

The distinctive new yardmasters building at Melbourne's Southern Cross Railyards has prominent star reliefs cast into its precast concrete façade, symbolising the iconic Southern Cross constellation for which the station is named.

Acting as a 'gateway' to the railyards and the soaring, Southern Cross Station (previously Spencer Street Station) the building was clearly intended to make a statement and is a far cry from the unremarkable utilitarian style one might expect from a services building.

Although inaccessible to the public, the position of the building renders it highly visible. According to Rob McBride, one of the principal architects on the project, the decision to give it a distinctive and aesthetic identity, in stark contrast to the gritty rail yard that surrounds it, was a considered one.

"It says that public infrastructure matters and, by extension, that the public matters," he says.

The complexity and cost of constructing within a rail environment is significant, so the strategy was to minimise on-site construction, rail disruption and therefore cost. This involved providing as much architectural value off-site as possible – which was achieved by extensive use of precast concrete in both the double skin walls and the flooring.

"The panel system required multiple processes that had not been attempted before and provided enormous value in terms of the building's aesthetic and thermal performance," says Rob McBride. "Panel sizes were geared toward optimising production and minimising energy. Materials were chosen for their robustness – maintenance in this environment comes at a high price."

The four-level building uses loadbearing 'Thermomass' reconstructed polished granite sandwich panels that incorporate an insulation core cast between two wythes of concrete to provide the desired thermal performance. The wall panels were supplied by Bianco Precast, while the precast flooring was supplied by Ultrafloor (aust).

The mould construction was a complex acrylic, steel and timber form developed from the architect's computer-generated star pattern. In total, 76 wall panels were created, typically 7.6m x 3.5m x 310mm. The panels were cast external face down, with the star reliefs placed in the mould, then the insulation, then the structural layer was cast. The repeatability in panel dimensions was to enable effective use of minimal moulds to provide an economical result.

Concrete strength (on delivery to site) was 45MPa. The concrete mix contained Imperial black granite to give its distinctive, high quality polished finish – one which was achieved with no spalling, even on the sharp-edged cast star reliefs.

The vertical joint detail was simple, elegant, and understated with fire rated sealant to both faces. Panels were simply fixed by dowels.

Finally, the patina was created to match the rusted charcoal of the building's environment, as if it had always been there or simply emerged from the ground.

New Rail Building Southern Cross Railyards

Client: Southern Cross Station Authority
Architect: McBride Charles Ryan Architects and Interior Designers
Engineer: VDM Consulting
Head contractor: Fimma Constructions
Precast manufacturers: Bianco Precast – walling, Ultrafloor (aust) – flooring

Playing it safe

The design brief for this urban Sydney park called for a harmonious combination of aesthetics, practicality, safety and the durability to withstand the rigours of its waterside location.

The $26 million urban waterfront park is located on the old water police site at the historic Pyrmont peninsula, on Sydney Harbour.

Designers ASPECT Studios wanted to seamlessly incorporate a modern playground into the broader site in which original elements have been retained to promote a sense of its history as a working industrial site.

The solution was to furnish the park and playground with individually crafted precast elements to provide both form and structural function.

Hanson Precast was selected to provide the playground's barbecue benches, seating areas, flat steps, paving areas, spacers and columns. These were finished in a Class 2 off-form concrete, using off-white cement, as were other new elements. These included 'boomerang' concrete walls that sculpt the grove to ensure they are integrated with the original elements of the restored area.

"The architect didn't want to see any of the cast-in lifters in any of the precast units," explains Adib Jomaa, Engineer at Hanson Precast. "In most building projects these are patched afterwards, but they can be unsightly if they are not done well."

To meet both this and the durability and maintenance issues posed by units that were built either over or near the water, a unique erection process involving a special lifting bracket and strategically concealed cast-in lifters was used.

Safety was another key requirement, with the precast steps and slabs requiring falls in their surfaces to prevent water pooling and thereby creating a walking-hazard.

"These units varied in shape and had to be cast face-down in special moulds that demanded a high degree of attention in design and setup," Adib explains. "Tolerances were also important, as even a small change in the surfaces between units could become a trip hazard."

Testimony to the successful blending of its elements was the park's receipt of best overall project in the 2009 CCAA Public Domain awards.

Former Water Police Site, Pyrmont, Sydney

Client: City of Sydney Council
Builder: Ford Civil Contracting
Architect: ASPECT Studios
Precast manufacturer: Hanson Precast

International Concrete Conference & Exhibition (ICCX)

Melbourne, 21-24 February 2011

Following an overwhelming response to the first ICCX Oceania in March 2009 in Sydney, planning for the second ICCX Oceania is now well underway.

ICCX Oceania 2011 will be held at The Sebel Albert Park, Melbourne on 21 – 24 February 2011. It offers a unique opportunity for participants and exhibitors to establish personal contacts with industry leaders and suppliers to the concrete and precast concrete industry.

Three technical courses will be held on Mon, 21 February covering:
- Sandwich panels & the role they play in energy efficient buildings;
- Best practice health and safety in the factory and on site; and
- Precast design: connections, accidental loading and fire.

The ICCX exhibition and conference will be held on 22 and 23 February. More than 80 exhibitors from all over the world will showcase their products and services for the concrete and precast concrete industry. The conference component will be based on a new 'Industry Concept'. It will consist of presentations by exhibiting companies, whereby similar products will be presented in succession, in the same session. This will allow visitors to see and compare the offerings of competing companies. On Thursday 24 February, plant tours will be organised to visit some of the most advanced precast and concrete products plants in Melbourne.

For more information about ICCX Oceania 2011 go to **www.iccx.org**.

Sydney Desal uses segmental shaft linings

Whilst the use of precast tunnel linings is becoming more prevalent in Australia, the use of segmental shaft linings is a new concept in this country.

Precast manufacturer Humes was recently involved in the construction of two temporary shafts using the caisson technique, a method that proved extremely successful for the Water Delivery Alliance (WDA) constructing the desalination pipeline in Sydney.

The precast concrete lining used to sink the shaft is designed to form the permanent lining, offering significant savings in construction costs. The caisson technique involves jacking concrete segments into the ground to form a shaft structure. This approach reduced shaft construction times and provided considerable cost benefits over other temporary structures.

With international experience in constructing caisson shafts in tight locations, Alliance partner McConnell Dowell investigated the suitability of this construction method for the desalination pipeline project. Following discussions with the precaster regarding the application, economic viability and availability of the system, the WDA decided to proceed with this construction technique. By introducing the use of segmental linings into an urban project with restricted access, significant benefits with the caisson technique were gained including cost efficiencies, reduced plant and personnel numbers for installation, reduced noise pollution, and reduced hazards as operatives were not required to work inside the shaft during excavation.

The WDA sub-contracted Humes to supply and design the proposed shafts, who then in turn engaged Halcrow to check the segmental linings, design the shaft and all temporary works for the shaft construction process, and provide details for openings in the lining to receive the tunnelling machine being jacked from another shaft. Both of the temporary shafts were designed with a 7.5m internal diameter and measured 12 to 15 metres deep.

Segmental linings for the construction of shafts in both temporary and permanent conditions provide a viable alternative to the techniques traditionally undertaken in Australia. They can be cast in various sizes and are available throughout Australia. The adoption of the caisson and underpin methods provides significant benefits, especially in time and cost savings to both the contractor and client.

The Sydney desalination plant and pipeline has been built to deliver up to 250 million litres of water a year, and at full capacity will supply up to 15 percent of Sydney's water needs each year. The plant's power needs are fully offset by renewable energy produced at Capital Wind Farm.

Desalination Plant, Sydney

Client: Water Delivery Alliance (McConnell Dowell, Bovis Lend Lease, Worley Parsons, Kellog Brown Root, ERM and Sydney Water)
Precast manufacturer: Humes Australia
Engineer: Halcrow Pacific

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