

PRECASTER

When is a floor a ceiling?

Formerly known as Spencer Street Station, Melbourne's Southern Cross Station has been developed into a world-class multi-modal transport interchange which strongly features precast concrete. Light, open, modern and safe, the new transport interchange provides Victorians with a new world-class and iconic landmark. It is an impressive gateway that provides an attractive physical link between the City's western perimeter and the rapidly expanding Docklands Precinct.

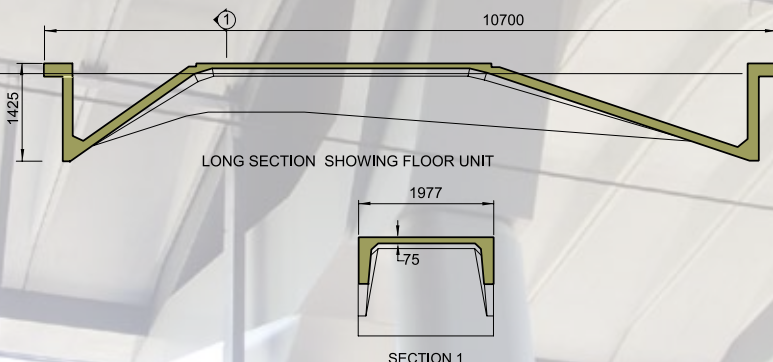
The central features include a wave-shaped roof, a new entrance and concourse on Collins Street, a new bus interchange, a new food court, a bar/restaurant and a number of separate retail outlets inside the station and a separate shopping complex between Bourke and La Trobe Streets.

In keeping with the project's overall modern architectural theme, the internal ceiling and roof elements over the Station's platforms use specially designed precast concrete segments to produce an attractive three-dimensional design. The flat tops of these same precast segments form the sub-base of the floor slab for the expansive main concourse above the rail platforms.

In effect – thanks to precast – the floor is also the ceiling. By deleting the requirement for a ceiling there are considerable savings in cost and construction time. In this case, construction time was critical because any work adjacent to the working train tracks was permitted only in extremely limited hours, late at night.

Manufactured in two sizes, the larger of the floor segments measure 10.7 metres long by two metres wide (with the height being 1.5 metres), while the smaller segments vary only in length at 9.3 metres long. In all, the project required over 200 high quality, complex shaped, thin walled precast concrete floor units. The contract for the manufacture and supply of the precast segments was awarded to Adelaide-based specialist concrete precasting company Bianco Precast.

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200 heavily reinforced prestressed precast segments were transported from Adelaide to Melbourne.

President's Column



Last November I was handed the NPCAA presidential baton from Gavin Stollery of Giroto Precast. This is undoubtedly a substantial honour but one which is made much less onerous due to the very strong support and commitment from all those involved. Our Executive Officer, Sarah Moore, has played a major role in advancing the aims of our Association and she is now ably assisted by Vice-President Peter Webb.

In essence, the core purpose of the NPCAA is the communication of information on all matters pertaining to precast concrete. Many parties are involved ranging from our Associate Members supplying goods and services to the industry through to builders, developers, owners and end-users. These are exciting times for our industry and many initiatives are afoot to facilitate the flow of information.

Precast concrete is on a roll in Australia. We have an ambitious program in place to harness the momentum that has been generated and we look forward to serving the market in ever more substantial ways.

Recently there has been much talk on the 'tipping point' phenomenon. There is a strong argument to support the premise that our industry has reached such a stage, particularly in the building sector where the market is now embracing the full opportunity our products and systems provide.

We have been playing 'catch-up' to most of the first world economies in regard to the level of acceptance of precast building systems. In Australia, it seems, 'custom and practice' is no longer accepted as a reason in itself to do what was done in the past and it is heartening to see all alternative solutions being considered on their merits.

There are many recent examples in every State of Australia, of major developments being based upon precast concrete systems and it has not been uncommon for two or more suppliers to have contributed to these. Such projects very often exceed 20,000m² of precast walling, flooring and structural elements.

Delivery of the required outcome on any size of project is totally dependent upon the appointment of a fully competent precaster. The market can derive considerable comfort from the knowledge they are dealing with a NPCAA Corporate Member and all major precast concrete manufacturers in Australia are now members of our Association.

Alan Morrison
President

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The precast flooring units formed a coffered ceiling with an architectural finish to compliment the design requirements of the project. The units were poured using a 50% grey and 50% Brightonlite concrete mix with a high quality off-form finish, struck from steel moulds. The use of a 45 MPa mix containing the blend of white and grey cement, provided an attractive off-white colour that performs well as a ceiling in reflecting light for the open, airy effect sought by the designers.

Large triangular shaped void formers were required to create an angled soffit at either end of each unit. Wall thicknesses were restricted to contain the overall weight of each unit to less than 14 tonne. The design required the units to be heavily reinforced. The thickness of the vertical sections of the units commenced at 100 mm at the base tapering to 175 mm. The horizontal section forming the soffit was only 75 mm thick. The units acted as part of a composite floor design. An in-situ slab was poured over the units once in place. Each unit incorporated major penetrations and connection details.

In order to overcome the challenges of selecting an appropriate concrete mix design, the precaster used a concrete mix incorporating a 'new generation' superplasticiser to ensure that the mix was fluid enough (approximately 220 mm slump) to be able to flow through to all areas of the mould and around the densely packed rebar correctly, while still remaining stable enough to prevent segregation within

the mix. The results speak for themselves in the attractive off-white finished appearance of the units without blemishes or any visible imperfections.

Units were placed 15 metres above the railway platforms. The butt joints between units were simply grouted. Fixing to the units resting on haunches required conventional dowel bars that were fully grouted.

Other precast flooring units were also supplied for the project that were simply a pre-stressed plank. The original design of these units called for conventionally reinforced precast concrete planks at 10.7 metres long by two metres wide by 300 mm thick. The weight of these units resulted in cost inefficiencies in that only one unit could be delivered per truck from Adelaide to Melbourne. The precaster worked with the Architect and Engineer to redesign the planks as a prestressed element. This allowed the units to meet the requirements at 250 mm thick and allowed two units to be delivered per truck to Melbourne thus halving the transport costs, while permitting easier handling on site.

As one of the largest public transport infrastructure projects ever to be undertaken in Australia, the massive Southern Cross Station redevelopment looks set to deliver a major boost to rail and public transport for a long time to come. Precast concrete has helped deliver an exciting future for Melbourne.

Southern Cross Station

- Constructing Authority: Victorian Government
- Architect: Grimshaw Jackson JV Pty Ltd
- Engineer: Winward Structures
- Head Contractor: Leighton Contractors Pty Ltd
- Precast Concrete Manufacturer: Bianco Precast
- Other precast manufacturers who also supplied this project – Fabcon.
- Precast Erection: Alfasi

Early consultation beneficial

A project of the complexity of Southern Cross Station, spanning three entire city blocks and still being required to be operational throughout the construction period, threw up challenges to the construction and erection team. No surprises there! Alfasi took care of the precast placement under direct contract to overall construction managers Leighton Contractors Pty Ltd. The result was a testament to the early forming of an excellent relationship between the designers, builder and precast concrete manufacturer that can be crucial. With each party lending its own level of knowledge and expertise to the job, the parties worked together to ensure that the work proceeded smoothly.

The blemish free off-white precast flooring segments also serve as a coffered ceiling.



A Precast Challenge – Adding to the Opera House

Building the Sydney Opera House was a monumental challenge, particularly for the precast concrete industry at the time, with 60 percent of its structure being precast. But it presented an equal challenge to Chris White of LW Contracting, who was given the job of erecting the precast for the new Western Colonnade, the first ever addition to the exterior of the Sydney Opera House.

As with the original construction of Sydney Opera House, there has been a great sense of pride and 'history-making' involved for all those working on the colonnade construction. Chris White's father started the company in 1961. The company is believed to be the longest serving precast panel erecting company in Australia and was involved in erecting precast for the original building; so naturally it seems, it was awarded the contract to do the panel erection. Chris White says it is likely that his company is the only company that was involved in the hey-day of the original construction and still around to handle its extension in the next millennium.

Chris White explains: "The project was the first structural change to the exterior of the building since it opened in 1973. It entailed creating a 45 metre long by five metre wide precast concrete colonnade on the western side. Underneath the colonnade, nine new large windows and doorways meant substantial changes to the original structure to present views from the theatre foyers of the harbour, bridge, and Circular Quay."

The design of the colonnade with its demanding requirements in terms of the tolerances required for its precast elements, was overseen by Jørn Utzon in collaboration with his son Jan, and local architect Richard Johnson of Johnson Pilton Walker. Colour control of the precast had to be exemplary and all arrises had to be razor sharp. In addition to the colonnade, the precast work involved the removal of existing wall panels.



The colonnade itself comprises ten equal bays, with twenty paired columns supporting beams and a flat roof with a concrete panel parapet identical in finish to that on the original adjoining walls. Achieving the same finish as the original precast dating back more than 30 years provided Hanson Precast with a challenge as the original precast panels had aged. The original honed and acid etched soft pink crushed granite aggregate takes on a more matt finish when it ages. For this reason, new precast elements were not to be given as high and reflective polish as the original that would set them apart from their neighbours. To ensure a uniform finish with even fines to all sides of the 400 mm square by three metre long precast columns (because they are seen in the round), the concrete for the columns was pumped into the precast moulds from the bottom.

Chris White continues: "The tolerances permitted were absolutely exacting, we were working literally to the millimetre. To let you in on a little secret, the local architects were even more demanding on tolerances than the Utzons. We are proud that we could meet these requirements and when you look at the precast you can see that there is no deviation from dead straight. There are no changes in colour that can arise due to the angle of sunlight that can show up even the slightest out of plumb positioning."

"Fortunately, the precast panels that comprise the 'broadwalk' – the terrace in front of the colonnade were strong enough to support semi-trailers, which meant we could get the panels to where they needed to go. Handling them off the truck was something else – we ended up buying a five-tonne crawler crane to do the job. Additional cranes were also used, as some panels required a three-crane lift. Behind the colonnade the wall needed nine new openings, three doors and six windows. The window panels contained windows that were 1.95 metres wide and 2.1 meters high and required very careful handling. This meant before we could erect the colonnade we had to take the original façade panels off, then install the window panels, then erect the colonnade with its precast columns, beams, roof slabs, and roof edge parapet," he said.

"There were a few additional interesting aspects to this project – the colonnade was designed to be 'explosion-proof' as internationally



Erector Chris White worked with exacting tolerances to meet architect requirements.

prominent buildings can unfortunately be seen today to be at potential risk from extremist attack. This meant that the joints were provided with secure stainless steel dowels fully grouted in place, unlike the bolted bronze precast fixings of the original precast panels. The high level of site security meant our workers had to pass security checks and that we had to be mindful at all times of ensuring a totally secure site," Chris White concluded.

The outcome of the efforts of all parties on the project is a colonnade that apart from showing the attributes of fine quality precast also provides added functionality to the western boardwalk, providing undercover entries to the interior facilities. With the new colonnade, there are a series of window niches in the thickness of the podium wall. These openings modulate the light to make a beautiful transition from the outside daylight to the relative darkness inside. Plays are now presented in the theatres off the now-light-filled foyer that opens onto the elegant harbour-fronting Western Colonnade – a fresh addition to the Opera House by its extraordinary creator, Jørn Utzon.

The New Western Colonnade, Sydney Opera House

Client:	Sydney Opera House Trust, per Sydney Opera House Building Development Group
Architect:	Utzon Architects with Johnson Pilton Walker
Structural and facade consultant:	Arup
Project manager:	CGP Management
Builder:	St Hilliers Contracting
Precast:	Hanson Precast
Erection:	LW Contracting

Joints in Precast

Joints between precast elements are necessary because:

- panels have to be of manageable size so that they can be manufactured, transported on public roads, and erected;
- allowance for relative movement is required between adjacent panels and between panels and the supporting structure;
- tolerances in the precast unit, the structure and placement during erection require clearance around the unit.

Joints of sufficient width will ensure that unintentional and indeterminate forces are not developed in the precast element and its fixings. These may be caused by shortening of the supporting structure, instantaneous and creep deflections of horizontal beam support structures, movement due to temperature variations, and lateral deflections of the supporting structure under applied loads, eg wind and earthquake.

Joints between precast elements provide physical separation between the units and in conjunction with joint sealants, prevent the ingress of water and air into the building and provide fire resistance.

Types of Joints

The most common types of joints between precast concrete cladding and/or wall panels are:

- Open-drained;
- Face-sealed; and
- Compression-seal.

For more information about joints in precast, refer to Chapter 8 of the *Precast Concrete Handbook* (available from Standards Australia on 1300 654646).

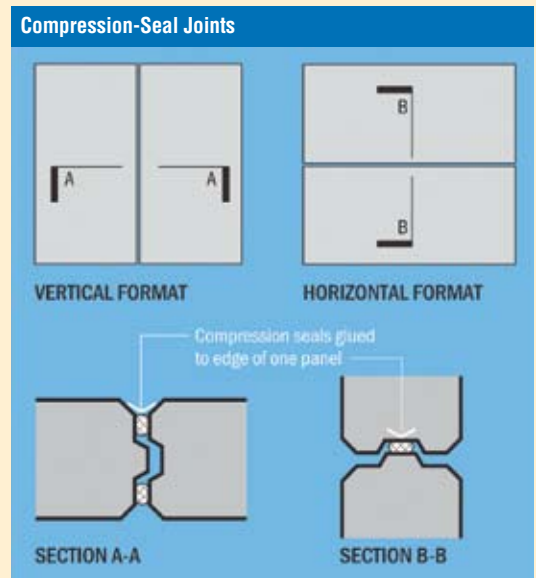
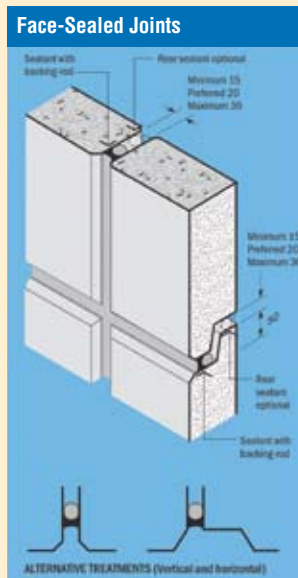
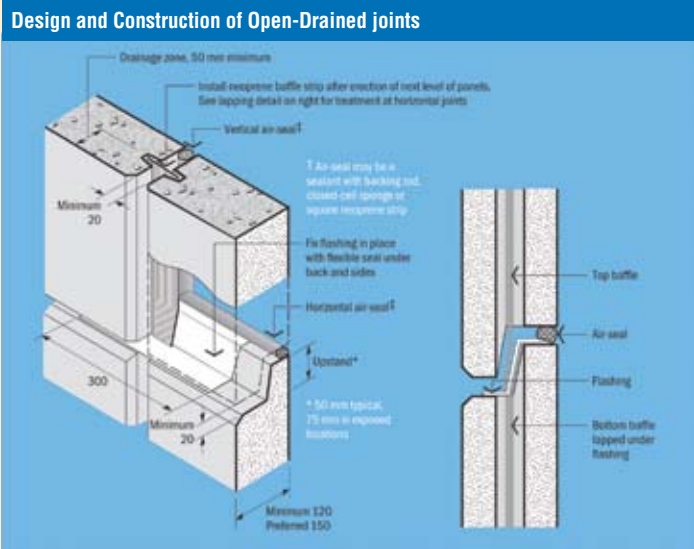
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Advantages and Disadvantages of Joint Types

Joint Type	Advantages	Disadvantages
Open-drained	<ul style="list-style-type: none"> Can tolerate large movements. The rear sealant is protected from UV light and weather. Can be installed from inside the building (no scaffold required). Long maintenance-free life. Best for medium- and high-rise construction. 	<ul style="list-style-type: none"> Careful supervision is required during installation as it is difficult to remedy defects due to poor workmanship.
Face-sealed	<ul style="list-style-type: none"> Panel edges can have simple profile, no grooves required. Can be used for complex panel shapes (angled or curved) without any sealing problems. Can have a rear seal as a second line of defence. Lowest first cost. Can be readily inspected, repaired or replaced. Best for low-rise construction. 	<ul style="list-style-type: none"> Must be applied from external scaffolding or other form of access. Sealant is exposed to UV light and weather – needs more maintenance. Requires careful application to ensure good adhesion. In a single-seal system even a small failure may allow water penetration due to capillary effects and pressure differentials. When a back-seal is also provided, water penetrating the front seal must be drained to the exterior of the building.
Compression-seal	<ul style="list-style-type: none"> Simple and quick to install. Panel edges can be plain or simple profile. Economical. 	<ul style="list-style-type: none"> Cannot be fully weatherproof, so limited to low-rise industrial buildings. Joint width is critical. Maintaining compression on seal at intersection of horizontal and vertical joints is difficult. Difficult to maintain and/or replace.

■ Precast delivers benefits for Centrelink



When architects, builders and precasters team up early, the rewards can be significant for all parties. GSA Group Architects, working with Multiplex Constructions on the new Centrelink National Support Office in Canberra found that teaming up with Ultrafloor (Aust) Pty. Ltd. delivered the rewards of a fast-track and largely problem-free construction.



Centrelink is a large decentralised organisation of 24,000 people, with its head office located in Canberra. Its growth found it occupying eleven separate buildings in Canberra, so a decision was made to construct the National Support Office in the Tuggeranong town centre precinct, with the majority of staff in Canberra in the one building. Centrelink has achieved this through the development of the new Greenway building of NFA 40,000 square metres, for its intended 2,750 on-site staff.

The new building consists of two parallel north-facing buildings of four and five storeys, with large floor plates and an internal 'Main Street' atrium. The buildings stretch over 180 metres in length and are joined by a six-level glass atrium, known as 'Main Street'. The design provides flexibility for office spaces to be simply reconfigured as needs change. The building also delivers ample meeting rooms, breakout areas, a café, an auditorium, a kiosk, and 1,100 car parking spaces. A basement of 5,000 square metres below general ground level is provided for services, archive storage etc.

Tim Pope, Multiplex Construction Manager, said: "To maximise the success of a project,

and to obtain the maximum advantage of using precast, an early coming together of all parties is essential, to pre-plan for the eventualities that are part of the building process."

The tight construction programme set by Multiplex required that the installation of the floors was a critical element. Ultrafloor were able to respond by installing up to 5,000 square metres of flooring each week. That's the equivalent of a massive 50 house floors in area. The requirement was for six levels of suspended precast concrete flooring, amounting to 50,000 m² GFA in total.

Providing the architect's viewpoint, Warren Meadley from GSA Group said: "The constraints involved with precast flooring require the input from all services' consultants to ensure that the services requirements are met. The development of the structure incorporating the precast flooring system was an absolutely collaborative process."

The design live load of 4.0 kPa generally, with 10.0 kPa in compactus areas, all in addition to a static design load of 1.0 kPa. Typical floor-to-

floor height is 3.85 metres.

A structural grid of a generous 8.4 metres by 8.4 metres dictated that an innovative development be required that allowed floor-to-floor heights to be minimised. The solution chosen was a metal deck system supported on band beams. In each band a notch 1500 mm wide x 220 mm deep was formed to accommodate air-conditioning ducts. This innovative development allowed floor-to-floor heights to be minimised with the downstand band beam concept having nil effect in this regard. Band beams at notch locations were wet-cast prestressed elements 1800 mm wide by 150 mm deep.

Precast band beams were supplied up to 11.6 metres in length for special locations. The deck was tied into precast panels around the perimeter and at lift shafts and stairwells. Product was supplied from the precaster's ultra-modern production facility in the Hunter Valley of NSW.

Fit-out is planned to be completed by November 2007.

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Precast delivers benefits for Centrelink

Centrelink National Support Office

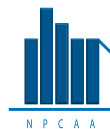
Cnr Athllon Drive & Soward Way, Tuggeranong ACT

Value:	Reported as \$120.5 million
Start Date:	2005
End Date:	2007
Architect:	GSA Group Architects
Engineer:	Robert Bird Group Sellick Consultants
Head Contractor:	Multiplex Constructions Pty. Ltd.
Precast Concrete sub-contractor (Flooring):	Ultrafloor (Aust) Pty. Ltd.
Erection:	Ultrafloor Installations Pty. Ltd.

Other precast manufacturers who also supplied this project – Advanced Precast.

4.5 Star Rating

Matching the pedigree of its structural solution, the new building will achieve a 4.5-star Australian Building Greenhouse Rating. The building incorporates leading-edge ecologically sustainable development innovations in areas such as energy consumption, greenhouse gas emissions, stormwater and grey water containment, and minimisation of water consumption and waste. Chilled beam air conditioning will provide substantial energy savings. To help reduce water consumption levels, the site will have tanks for half a million litres of rainwater for use within the building. Hot water for the building will largely come from renewable resources, such as solar panels and/or wind generators on the roof.



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