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• N A T I O N A L • PRECASTER

NATIONAL PRECAST CONCRETE ASSOCIATION AUSTRALIA

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(above) A massive 150 tonne capacity crawler crane sits atop the completed span. The crane was used to lift ten precast segments making up the next span onto steel falsework. Each segment weighed up to 46 tonnes.

SORELL CAUSEWAY Tasmania

(right) View of the underside of pilecap shell showing holes for piles. Pilecaps were lowered over the tops of piles and levelled prior to the introduction of insitu concrete inside the pilecap shell.

The Australian building and infrastructure industry prides itself over the years for its innovative advances in precast concrete construction. Pioneering examples such as multistorey loadbearing walls and precast floors in Melbourne apartments in the 1960's and the Sydney Opera House roof 'sails' come to mind. The Sorrell Causeway bridge is yet another watermark in this pattern of world leadership by designers choosing precast for major elements in both the superstructure and the substructure of a major bridge.

The 460 m long replacement of the Sorell Causeway across the Pitt Water north-east of Hobart is thought to be the only match-cast precast-segmental 'channel' road bridge built outside of Europe or the United States.

Built by John Holland and designed by Gutteridge Haskin and Davies Pty Ltd, it consists of 18 spans. Extensive use of precast technology achieved the durability requirements of the owner, and improved the constructibility of the bridge. All precast elements were constructed off site under factory conditions, and most formwork used on site was itself precast.

Description of Channel Concept

Figure 1 shows the typical cross section of the bridge. Significant parapets provide longitudinal stiffness and strength, and were designed to remain undamaged after vehicular impact. The bridge therefore behaves as would a box girder with one flange removed.

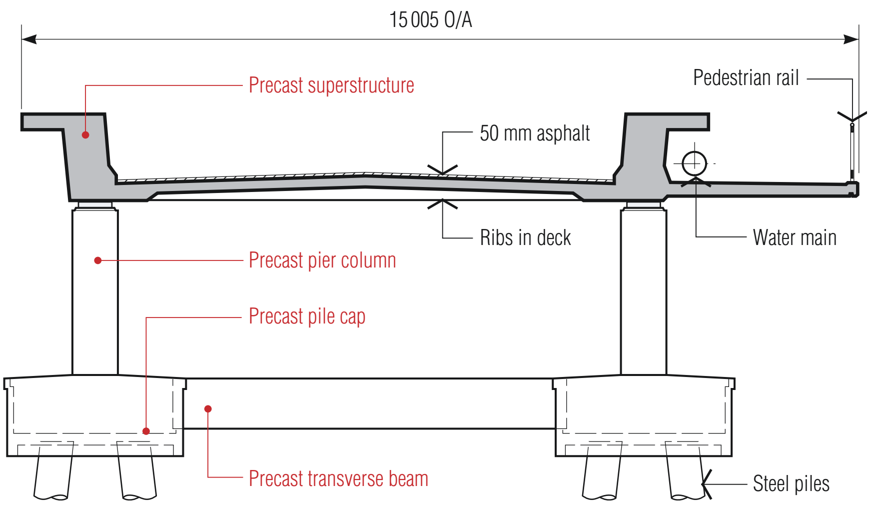

***Figure 1** Typical cross-section of Sorell Causeway showing thin apparent structural depth and unusual form. A pedestrian footpath cantilevers from one side, and provides also for a water main.*

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View of hollow precast pilecap and tie beam shells before the introduction of insitu concrete. Reinforcement was detailed to allow placement of prefabricated cages.

View of hollow precast pier column units. These were match-cast vertically in factory conditions.

Superstructure

Ten similar units weighing up to 46 tonnes each were required per span, and were match-cast using the long-line prestressing method. Spans were built on falsework and lowered onto permanent bearings.

Substructure

To enable swift construction and reduce the amount of works over water substantial use of precasting was also used in the substructure. Two round pile caps per pier were each supported on four steel piles. These were tied together via a compact concrete beam.

These elements were constructed using formwork shells which became part of the permanent structure. The round pilecap 'bathtub' shells included integral floors with holes and were lowered over the tops of the piles. The transverse beam shell was then introduced between pile caps and all joints sealed before placement of main reinforcement and concrete infill. The tie beam increased the robustness of the pile caps and helped resist eccentric construction loads and overcome minor pile misalignments. It also served to 'portalise' the pilecap, which will allow the bridge to absorb impact from minor water-borne vessels and earthquake.

Match-cast and hollow precast pier units were quickly assembled vertically as if they were a child's building blocks and were then post-tensioned to the pile cap below.

Advantages of Channel Concept

The shallow 'effective' depth of structure can achieve the following:

- increased clearances or reduced vertical curves
- improved sight distances for traffic
- reduced off-structure earthworks
- reduced cross sectional area and life cycle costs associated with concrete deterioration.

Advantages of Precasting

- Improved durability
- Densely compacted elements
- Reduced reinforcement covers thus reducing element mass
- Speedy construction
- Tight tolerance control resulting from factory conditions
- Easier inspection of units
- Reduction in temporary formwork
- Reduced work in exposed conditions
- Improved site safety
- Safer construction methodology in the Ramsar listed environmentally sensitive site.

View of substructure. Precast pier units were stressed vertically to pilecaps

Acknowledgements

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- Contractor: John Holland Pty Ltd
  Ian Bryant [03] 9934 5394
- Bridge and Roadworks Designer: Gutteridge Haskin and Davies Pty Ltd
  Peter Selby-Smith [03] 9278 2349 ■

Photographs courtesy of John Holland and GHD.

VERSATILE GRC

GRC (Glassfibre Reinforced Concrete) is an exciting cementitious building material that can be formed into a great variety of products which has won favour amongst designers, architects, engineers and end users for its flexible ability to meet performance, appearance and cost parameters.

GRC panels can be manufactured to almost any shape or size, and a large range of finishes is possible. This offers the specifier a unique opportunity to express individuality and creativity in a way not offered by most other materials.

The NPCAA which represents the GRC industry in Australia has available for purchase 'A Recommended Practice – Design, Manufacture and Installation of Glass Reinforced Concrete (GRC)'. In addition, as a design aid for specifiers, the NPCAA has now published in downloadable format, the 'Recommended Specification for Manufacture, Curing and Testing of GRC Products' on its website www.npcaa.com.au.

To further stimulate your interest in GRC, we feature three NSW projects manufactured in Adelaide by NPCAA Member, Asurco Contracting Pty Ltd, which illustrates the versatility of this exciting material.

PROJECT 1: MOTORWAY NOISE BARRIERS

GRC panels have been used extensively in NSW by the RTA as noise barriers on the sides of motorways and overpasses.

The largest, most prominent project is the section of the M4 Motorway from James Ruse Drive, Rosehill to Church Street, Parramatta. Some 1400 GRC panels were supplied to line both sides of the viaduct together with on and off ramps.

Landscape architect, Michael Sheridan of Hassell Pty Ltd, used bold patterns in each face of the panels which sometimes projected above and below the general line of the panels. He further accentuated the pattern by painting one side of the motorway in bright purple and the opposite side in bright yellow. To finish a run of panels various tails made of GRC and painted in the same colour were used.

GRC was chosen because of its weight as it is about one-tenth the weight of an equivalent precast concrete panel. A pattern projecting 40 mm from the face of the panel was formed on each face of the panels.

Each face of the GRC was cast separately in a GRC mould and joined after demoulding. The polyurethane coating to the patterns was then applied. Each panel was 2980 mm long, 2000 mm high and 90 mm thick or 180 mm overall when 2 faces were joined. Galvanised steel 100 x 100 RHS columns were chemically anchored to the sides of the viaduct. The panel simply slipped over the RHS and rested on a bottom fixing, which allowed the panel to flex with the movement of the viaduct.

As the road is one of the busiest in Australia, it had to be kept operational during installation, and only a single lane was closed during fixing of the panels. The simple fixing method allowed 30 panels to be fixed during a 6 hour lane closure.

Other NSW noise wall projects using GRC have been the Gore Hill Freeway, Anzac Bridge Access Ramps at Ultimo Sydney, Mulgoa Road Overpass at Penrith and West Charlestown bypass at Newcastle.

PROJECT 2: SUTHERLAND HOSPITAL CLADDING PANELS

GRC is being used extensively as the external cladding on hospitals in Sydney.

The latest is the Sutherland Hospital at 430 The Kingsway, Caringbah for the NSW Department of Health. Architects were Peddle Thorp & Walker with the builder being Barclay Mowlem Construction Limited.

The contract is a type which allowed Barclay Mowlem Construction Limited to investigate many different facade construction methods before deciding on GRC as a solution. One of the main benefits of GRC is that panels span from column to column, a distance of up to 8.0 m and form a spandrel 1.6 m high. The GRC skin is 10 mm thick constructed to a steel stud frame of 75 x 50 RHS with flex anchors to allow movement in the GRC skin. The steel stud frame also supports the windows and sunhoods and is lined internally with plasterboard.

Painted profiled GRC noise walls on M4 Motorway, Sydney

Curved GRC fascia panels provide aesthetic definition to Club foyer entry

Lightweight GRC facade panels being installed at Sutherland Hospital, Sydney

The builder found savings in not having to provide a structural steel frame as is necessary with alternative light weight cladding systems. He further benefited from not having to provide external scaffolding as the panels are factory coated with an acrylic membrane and sealant and touch up coating is done from a boom lift.

In all, 4000 square metres of GRC in 18 loads was delivered to site from the Adelaide factory and erected by the resident Sydney site crew.

PROJECT 3: FASCIA PANELS TRADE UNION CLUB

Contractor Paynter Dixon have used GRC on a number of clubs in the Sydney area to produce fascias not possible in other materials. On the Sutherland Trade Union Club completed recently GRC was used to form a fascia as a focus to the main entry of the club.

Architect Brian Booth of Curtin Bathgate & Somers Pty Ltd made a feature of the curved entry fascia by designing three horizontal recessed troughs cast into the GRC to provide cover for neon tubes which make the club a landmark on busy Kingsway Road at night.

The shape and multi colours applied to the horizontal bands between the light recesses also make the entry highly visible in daylight hours.

Panels were 9 m long and 1.6 m high, curved to a radius of 26 m. A structural steel frame was connected to the GRC skin with flex anchors during casting. Each panel including steel frame weighed only 800 kg. Site erection to main structural members took two days using a small mobile crane.

In all, the project was highly successful and provides another example of the design flexibility possible with GRC. ■

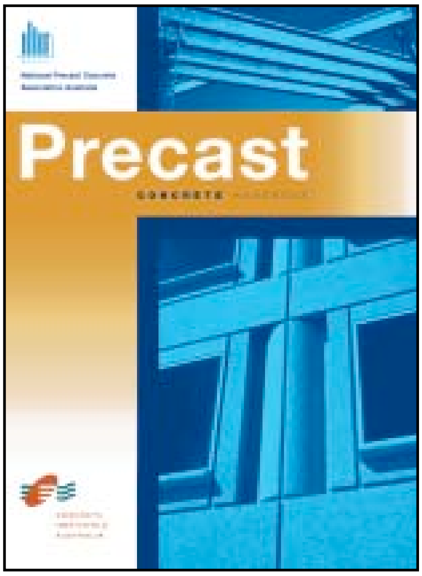
PRECAST Pushes Concrete Boundaries

Since the early part of last century, precast concrete has played a significant part in the improvement of construction productivity and in the creation of architectural shapes and textures impossible to achieve with in-situ methods. The evidence of the prominence of this versatile material in Australia includes iconic projects such as the Sydney Opera House, Parliament House in Canberra and the Sydney Olympic Stadium.

Precast concrete in Australia has been widely embraced by designers and constructors for over 40 years. Its increasing acceptance resides in the wide range of uses of the material as it continues to push the boundaries in what can be achieved with concrete. the possibilities of this versatile material continue to enthuse designers in their search for architectural expression structural solution and economy of construction.

The recently published *Precast Concrete Handbook* was jointly produced by the National Precast Concrete Association Australia and Concrete Institute of Australia. The Handbook encapsulates the collective experience of the Australian precast industry and will serve as an authoritative source of information in providing solutions to building and civil infrastructure projects utilising precast concrete.

This 416-page book is the only detailed publication on the market specifically devoted to all aspects of Australian precast concrete construction including design, specification, manufacture and installation. The Handbook reflects current industry best practice featuring the latest innovative applications of precast concrete; these range from simple structural elements to industrial and skeletal frame buildings, to decoratively finished complex-shaped architectural facade panels and sophisticated bridge girders. It provides guidelines in the form of graphs charts and worked examples to assist in the design of precast concrete structures in accordance with current Australian Standards. The Handbook is intended for architects, engineers, project managers, quantity surveyors and students as well as those involved in the building, infrastructure and construction industry.



One of many typical design aids included in the *Precast Concrete Handbook*:

2.2.2 WALLS

2.2.2.1 ARCHITECTURAL WALL PANELS

GENERAL DESCRIPTION

Precast concrete wall panels create a building's character, provide fire resistance, control the thermal environment in the building and attenuate sound influx and emissions.

The surface finishes available are described in detail in Chapter 10 *Architectural Elements*. They range from heavily-textured to smooth and polished. The methods used to achieve these textures include:

- Water washing
- Grit blasting
- Bush hammering
- Acid etching
- Honing and polishing.

For economy, the facade should be divided into the largest units that can be transported and on-site cranage can handle. The usual dimensions are storey-height by bay-width. Robustness dictates that the overall slenderness of a panel should be 1:40 or less. The fire resistance requirements of the building will often determine the thickness. This effectively sets it between 120 mm (2 hr FRL) and 170 mm (4 hr FRL). The minimum is 100 mm for sufficient cover to reinforcement. Panels 125 mm thick and less have only one layer of reinforcement. The nominal joint width between precast members is 20 mm, with 35 mm between insitu construction and precast.

Frequently, panels are shaped to shade the interior of the building from direct solar radiation. Even shallow profiling can give significant reductions in the energy requirements of a building. The thickness and density of panels results in a lag in energy transmission between interior and exterior, reducing peak cooling and heating loads. These characteristics also reduce the transmission of sound, giving a quieter building interior. These subjects are further discussed in Chapter 9 *Thermal and Acoustic Properties*.

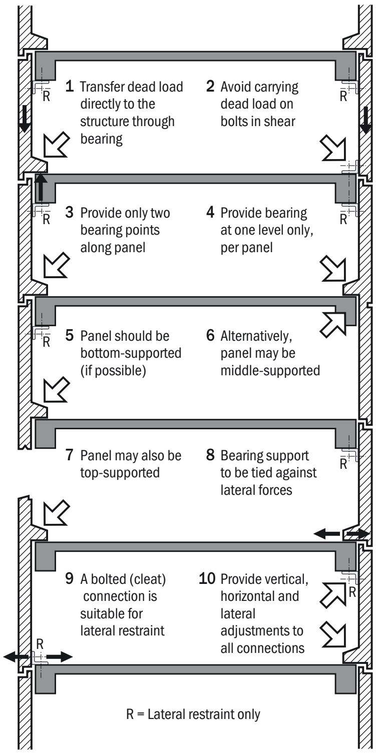
Non-loadbearing panels are usually supported by concrete haunches, or similar, in direct bearing on the supporting structure. Metal angles provide restraint. See *Design Principles for Cladding Panel Connections*.

Precast panels have an inherent structural capacity. On the exterior of the building, window panels can be utilised to carry floor and column loads. Spandrel panels can span between supports to carry floor loads. The design of connections for loadbearing wall elements follows principles similar to those for columns. Loads are transmitted either by direct bearing or by dowelled connections. Progressive collapse must be considered in loadbearing wall panel construction. Alternative load paths in the structure are provided by continuity of reinforcement across joints and supports (see *Design Principles for Loadbearing Panels*).

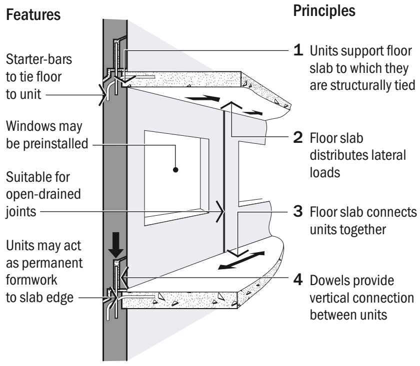
Flat reinforced panels are used for loadbearing members internally in multi-story construction, particularly for apartment and hotel structures. Flat panel construction is an economical and simple way to build low-rise commercial and industrial buildings. The panels may be fire-rated cladding or may be loadbearing walls which also provide the lateral stability to the structure.

The thickness is usually the minimum required for fire resistance or to act as slender columns in loadbearing applications in accordance with AS 3600 , Sections 10 and 11, or in accordance with an accepted higher-tier method.

DESIGN PRINCIPLES FOR CLADDING PANEL CONNECTIONS



DESIGN PRINCIPLES FOR LOADBEARING PANELS



Double lift of one of the 23 tonne cable jointing pits at the Kelvin Grove site.

MEETING A Hi-Tech Challenge in Queensland

NPCAA precasters produce a wide range of drainage, stormwater and utilities products, both of 'standard' dimensions and geometry and 'customised' elements to suit their customers' particular requirements. The following project is an excellent example in cooperation to convert a traditional in-situ telecommunication structure into an economic precast solution.

PROJECT: Electrical/communication cable jointing pits for a new urban village development at Blamey Street, Kelvin Grove in Brisbane, incorporating residential, recreational and commercial facilities. The complex will be the home of Queensland University's new creative industries precinct for high tech research and development.

PARTICIPANTS IN THE PROJECT:

- Queensland Department of Public Works and Housing
- Energex
- Connell Wagner Consulting Group
- Precision Pipe and Cable Pty Ltd (approved Energex contractor)
- Abi Group (major development contractor for project)
- Icon Industries Pty Ltd (approved Energex precast manufacturer)

THE DEVELOPMENT: Projects such as these have traditionally been carried out by contractors on site with in-situ concrete pours. However, Ian Rogers, a director of Precision Pipe and Cable Pty Ltd (PPC), in association with Icon Industries management, identified a method for precasting a range of electrical/communications pits for use in this, and similar projects.The identified benefits included cost containment, quality and installation improvement.

Working closely with PPC and Energex, Icon was able to establish a standard manufacturing procedure for the products that included single or multiple bell-housings that ensured total compliance with specification and quality standards.

A team of approved contractors, including team transport (responsible for the delivery of the pits to site) have been involved in the development of this unique manufacturing and supply capability.

The project has also eliminated major OH&S risk issues associated with the excavation and the building of the pit structure ready for in-situ pouring within the excavation

THE PRODUCTS: the products include a series of 2 m to 11 m electrical/communication pits fitted with large bell housings for directional changes to the electric/communication cable layout. The pit body for the 11 metre cable jointing pit weighed 23 tonnes and the pit roof 4 tonnes, and included 40 MPa premix concrete (50 MPa at 28 days) as supplied and managed by local supplier, Sunmix Concrete. Reinforcement included a combination of N12, N16, N20 and F82 mesh. The total weight of reinforcement to the unit was 850 kg.

Stainless steel cable pulling eyes, designed and supplied by Energex were incorporated into the structure – these being designed for SWL 70 kn (hauling only). The roof for the 11 metre pit incorporated three 2-part Energex-approved Gatic AS 3996 Standard Mark certified Class B load-rated access cover assemblies.

Plastic encapsulated, model MWT 253 *Mijama Nextep* step irons, as approved by Energex, and incorporating safety reflectors on each step were inserted in the pit directly below each access cover. These replaced the conventional galvanised ladders previously used.

The full project included 56 cable jointing electrical/communication pits of which 4 were the 11 metre length units with single or multiple bell housings.The total precast concrete used for these pits in this project is represented by 435 tonnes which would have previously been done in-situ.

MANUFACTURING FACILITY: Icon Industries precast factory at Nujooloo Rd, Slacks Creek. Brisbane.

PROJECT MANAGEMENT: The overall precast concrete production program was jointly managed by Icon Industries and Precision Pipes and Cables. The on-going involvement of Energex personnel has been a contributing factor to the success of this project. ■

STOP PRESS

Our congratulations go to architects Bligh Voller Nield (Qld) and Troppo Architects, winners of the **2002 Robin Boyd Award for Housing** for the predominantly precast Lavarack Barracks Redevelopment featured in Issue 28 of *National Precaster*. ■

Good blending of glass and precast wall panels to achieve striking aesthetic effect in Norwest Business Park office

MEMBER Profile

The origins of **SASSO PRECAST CONCRETE** were set in the early 1980's, culminating today in their modern new premises at Wetherill Park in Sydney. Set on five acres, with 4500 m^2 under roof, their 'state of the art' manufacturing facilities and techniques, allows the company to meet all it's client's needs now and well into the future.

The team at Sasso is composed of skilled experts who invite their clients to be innovative, and are resourced to be involved in all facets of any project, from pre-design consultation, budgeting, shop drawings, to full and final installation.

The latest in CAD drafting utilised by the in house design office ensures the company is able to have meaningful input from day one. It's QC System, (currently being accredited under ISO9001/2000 certification) ensures a benchmarking in products services, manufacturing and installation for the architectural and structural precast concrete industry.

Exceeding client expectations permeates through the organisation. Some recent projects that have exceeded client expectations with unique challenges are a block of four storey terrace houses at **Renwick Street Redfern**, featuring highly detailed architectural precast, engineered to carry the floor and roof loads. Access to this site was considerably difficult but all the challenges were met and overcome by working in close liaison with the builder, South Sydney Council and The RTA.

A modern office block for EDC at **Norwest Business Park**, with its use of a myriad of varying angles also meant that close liaison and attention to detail in the design and manufacturing stage was recognised as being an important ingredient in the ultimate success of this project.

The success of these projects is due in no small measure to preparation. Working in close consultation with all parties, who have their own unique needs and requirements, ensures a successful and timely outcome. This commitment to service, backed up with the company's in house expertise and experience sees the company positioned to meet the ever-increasing requirements of the precast concrete industry. ■

Loadbearing cladding panels in Redfern Terrace House development, Sydney

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NEW MEMBER

The President, Directors and Members welcome the following new Overseas Member to the Association:

- **Halfen-Deha Pte Ltd** – International supplier of anchoring systems for precast concrete.

PRECAST NEW ZEALAND INC.

FOR FURTHER INFORMATION about the New Zealand precast industry including Member details, list of publications, visit Precast NZ Inc at:
www.precastnz.org.nz