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NATIONAL PRECAST CONCRETE ASSOCIATION AUSTRALIA

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Girotto Precast Pty Ltd of Dandenong, Vic

AND

SA Precast Pty Ltd of Adelaide

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QUALITY SPECIFICATION = QUALITY PRODUCT

SPECIFICATION FOR PRECAST WALL PANELS

Frequently, this Association receives requests from design practitioners for assistance on a variety of issues. One such issue is the specification for wall panels. NPCAA offers the following Guide Specification.

SCOPE

This specification sets out the requirements for the manufacture of precast concrete architectural panels.

REFERENCE DOCUMENTS

Where any matter is not specifically covered by this Specification then the relevant Australian Standard shall apply. The following documents are referred to in abbreviated form (eg AS xxxx). The current issue shall be used.

AS 1012	Methods of testing concrete
AS 1141	Methods for sampling and testing aggregates
AS 1302	Steel reinforcing bars for concrete
AS 1303	Steel reinforcing wire for concrete
AS 1304	Welded wire reinforcing for concrete
AS 1379	The specification and manufacture of concrete
AS 1478	Chemical admixtures for concrete
AS 1554.3	Welding of reinforcing steel
AS 2758.1	Aggregates and rock for engineering purposes
AS 3582	Supplementary cementitious materials Part 1 Fly ash Part 2 Slag – Ground granulated iron blast furnace
AS 3600	Concrete structures code
AS 3610	Formwork for concrete
AS 3799	Liquid membrane forming compounds
AS 3972	Portland and blended cements.

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MATERIALS

Cement All cement shall comply with AS 3972. It shall be either Type GP (General Purpose portland cement) or Type GB (General Purpose blended cement).

Water Water shall comply with the requirements of Clause 2.4 of AS 1379.

Admixtures Chemical admixtures shall comply with AS 1478. They shall not contain calcium chloride.

Aggregates All aggregates shall comply with AS 2758.1. For the purposes of this Specification the exposure classification of AS 2758.1 shall relate to AS 3600 as in the following table.

AS 3600	AS 2758.1
A1, A2	protected
B1, B2	moderate
C	severe

REINFORCEMENT

All reinforcement shall comply with AS 1302, AS 1303 and AS 1304 as applicable. Reinforcement shall be deformed bars or welded wire fabric except that plain bars may be used for fitments or distribution steel.

Cutting and bending tolerances shall ensure that the reinforcing cage does not intrude into the cover concrete zone. All welding except tack welding used for assembly purposes shall comply with AS 1554.3.

Reinforcement shall be adequately supported to ensure that the specified cover is maintained. Sufficient intersections shall be tied or tacked to maintain the required spacing.

CONCRETE MIX

Durability For the exposure classifications on the drawings, the minimum cement content, maximum w/c and minimum strengths shall be as below.

Exposure Class	Minimum cement content	Maximum w/c ratio	Concrete strength at 28 days
A1, A2	320	0.56	32
B1	320	0.56	40
B2	390	0.46	50
C	450	0.40	50
U	As specified on drawings		

Target Strength The design strength of the concrete shall comply with the provisions of AS 3600 Clause 20.7 *Project assessment of strength grade.* The design 28-day compressive strength shall be the greater of that stated on the drawings and that required for the specified durability classification.

Chloride Ion Content The maximum mass of acid-soluble chloride ion in the placed concrete shall not exceed the values in AS 3600 Table 4.9.1.

SUPPLY AND DELIVERY OF CONCRETE

Concrete shall be produced and delivered to the moulds so as to comply with the requirements of AS 1379. Mixing time shall ensure uniformity of the concrete. Concrete shall be placed and compacted within one and one-half hours of mixing.

FORMWORK

Formwork shall be fabricated to withstand the loadings specified in AS 3610. The materials, workmanship and methods of construction shall take into account the required number of re-uses of the mould. Construction tolerances shall not be greater than half those of the unit they are required to produce. The dimensions of the assembled mould shall be checked prior to first use. The method of re-assembly shall ensure dimensions are maintained.

SURFACE FINISH

Sample panels shall be prepared from the proposed aggregates, cement and any colouring agents for selection and approval of the type of surface finish.

The surface colour and finish of the production units shall be generally in accordance with the approved sample. The deviation of any individual unit shall be within the range of the agreed reference units chosen from initial production units.

REPAIRS TO FINISHED SURFACES

Damage to and imperfections of surfaces shall be repaired in accordance with the procedures set out in the Quality Assurance Plan.

CONCRETE PLACING

The rate of concrete supply shall ensure that the casting and compaction of the unit is completed while all the concrete is plastic. In particular, if a facing layer is used then the second layer shall be placed while the first is still plastic. The method of placing and vibrating the concrete shall minimise segregation. The concrete shall be systematically and progressively compacted so as to entirely fill the mould.

CONCRETE CURING

The concrete shall be cured so as to meet the durability requirements of AS 3600. Heat curing of the concrete shall comply with the following:

- The duration of the presetting period (ie interval between mixing the last concrete and commencement of heating) shall be not less than one and one-half hours.
- The rate of increase in the temperature of the air space surrounding the unit shall not exceed 24°C per hour.
- The maximum temperature in the air space adjacent to the heating conduits shall not exceed 80°C.
- The entire air space shall be evenly heated.
- At the cessation of heating, the covers shall remain in place until stripping.
- The curing cycle shall continue until the required stripping strength is attained.
- Test specimens shall be located at approximately the midpoint of the chamber in the lower third and heated by air circulation only.

The effect of the heat curing cycle on the unit shall be checked visually during the production run and adjustments made to the cycle or to mould restraints if detrimental cracking is evident.

SAMPLING AND TESTING

The sampling and testing of the concrete and its constituents shall be in accordance with AS 3600, AS 1012, AS 1141, AS 1478, AS 2758.1, AS 3582 and AS 3972. The frequency of testing shall be in accordance with the Quality Assurance Plan. Compressive strength testing for handling may be carried out at the plant.

TOLERANCES

The dimensional tolerances of the finished members shall not exceed the limits in AS 3610 Table 3.4.3. ■

Glass Reinforced Cement (GRC) was selected as the most suitable facade and cladding material for the recently completed Munno Para Shopping City some 30 km from Adelaide, a complex of some 10 550 m².

The project involved the supply and installation of around 980 m² of external GRC facade and some 300 m² of profiled Plasterglass to the internal mall bulkheads.

GRC panels are manufactured from a matrix of carefully graded, high-quality silica sand and, cement, special fillers and water that is sprayed into purpose-made moulds simultaneously with Alkali Resistant Glass Fibre to form a 10-mm-thick 'skin' to meet the engineering requirements of the desired shape. An engineered steel sub-frame is then attached to the skin by cranked steel rods known as *L Flex* anchors at approximately 600-mm grid centres.

REAR VIEW OF PANELS. STEEL SUB-FRAME FORMED A STRUCTURAL TRUSS, INTEGRALLY CAST INTO THE GRC.

PANELS PARTIALLY ERECTED. NOTE CAST-IN REGLET (THIN LIGHT-COLOURED LINE ON PANEL) TO RECEIVE BULL-NOSED FLASHING OF VERANDAH ROOF.

The *L Flex* anchors (10-mm rod) are designed to allow the GRC skin to move independently of the steel sub-frame and so accommodate thermal and moisture movement differentials.

The sub-frames are engineered to withstand design loads and to provide ease of handling and fixing to the structure on site.

GRC's design flexibility and the ability to incorporate an engineered structurally design sub-frame provided a competitive advantage and a significant cost saving. The GRC structural sub-frames eliminate the duplication of supporting trusses and have been designed to support large panels (up to 8 m long, 2.4 m high) spanning between the structural steel columns.

The completed factory-produced facade panels, which were pre-finished, are transported to site ready for erection. The building is rapidly closed, with the facade being 'hung' on the structural steel columns, aligned and the joints weather-proofed.

An integral part of the panel design is a secondary open-drain joint system.

'A major advantage of the GRC system was the speed of erection on site, which had a large impact on shortening the construction program, which was important to the client', said Mr Alan Galdies of the Adelaide-based firm of Hardy Architects.

The main contractor's (Fletcher Construction) Project Manager, Peter Salveson, believes that the co-ordination of the steel work as an integral part of the GRC (thus eliminating face fixing entirely and minimising long-term maintenance) provides exceptionally fast site erection.

The initial team effort of Hardy Architects, Glenn Industries and Fletcher Construction ensured every conceivable problem was studied and resolved prior to reaching site. Flashing reglets (pre-caulked plastic channels) were cast into the face of the GRC to accept the bullnosed verandah roof.

Other key advantages of the GRC product were:

- cost effectiveness;
- minimal maintenance;
- lightweight engineered system reduces size of structural members, transport and handling costs and increases speed of erection;
- freedom of design with the ability to form complex shapes with intricate detail;
- no exposed fixings on the surface to detract from its long-term appearance;
- factory-applied surface coatings or integral finishes under quality controlled conditions;
- high impact strength;
- non-combustibility;
- the sub-frame design can also accommodate direct fixing of the internal linings. ■

SPOT-ON FABRICATION

The Prospect Water Filtration Plant located in Western Sydney is presently nearing completion and is among the largest drinking-water plants in the world. With a daily capacity of 3000 megalitres and provision for expansion to 4200 megalitres, it will supply 80% of Sydney with quality drinking water.

The project is the result of a partnership between Sydney Water and private enterprise in the form of Australian Water Services (a partnership between Lend Lease, P&O Australia and Lyonnaise des Eaux, the latter partner being a world-wide provider of water-treatment technology and management).

The Prospect Water Filtration Plant is being delivered under a 'build, own and operate' contract in which Australian Water Services will operate the facility for 25 years.

Within the scheme there are some 24 water-filtering chambers.

Contained within each chamber are precast launder units some 384 in total at around 3 tonnes each, 1728 filter slab elements and 816 dwarf-wall supports for the table elements. Within the total scheme, the precast content is somewhat minor, yet the precast content was of a most exacting nature with very fine tolerances on dimensions.

Typical is the permitted tolerances of +0-1 mm required for the precast filter slabs. Of benefit to the precaster was the repetitious nature of the work which justified the development and funding of special manufacturing techniques. The following photographs indicate the sequence of manufacture and erection of these elements:

OVERALL VIEW OF THE FILTERING CHAMBERS

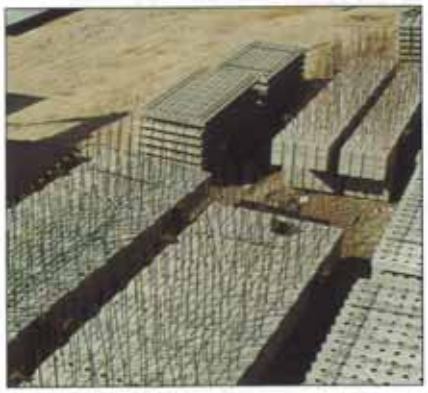
PHOTO ERIC SIERINS

MOULD FOR PRECAST FILTER SLAB; REINFORCEMENT AND MATS OF FILTER NOZZLE INSERTS IN PLACE. JOINTS BETWEEN MATS TAPED. THE PLASTIC MAT AND UPSTANDS REMAIN ATTACHED TO THE PRECAST ELEMENT WITH ONLY THE WHITE CAPS REMOVED. DIMENSIONAL TOLERANCE ON THESE UNITS WAS +0-1 mm.

DWARF WALL ELEMENTS BEING POSITIONED. THIS SECTION OF THE WORK WAS UNDERTAKEN BY BARADOM PTY LTD, SPECIALIST ERECTION CONTRACTORS. *PHOTO ERIC SIERINS*

CONCRETE PLACEMENT; SURFACE FINISHED FLUSH WITH SURFACE OF NOZZLE INSERTS. TEXTURED SURFACE FINISH PROVIDED TO GIVE BOND FOR ON-SITE TOPPING. UNIT READY TO ENTER STEAM CURING CHAMBER. THE PRESENCE OF THE PLASTIC MATS AT THE BASE OF THE FILTER SLABS REQUIRED THE PRECASTER TO DEVELOP A CURING REGIME WHICH WOULD ELIMINATE DIFFERENTIAL SHRINKAGE AND THE POTENTIAL FOR EDGE CURLING TO DEVELOP.

FILTER SLABS, LOCATED ON DWARF WALLS. LAUNDER UNIT ALSO IN POSITION. PLACING AND FIXING OF THESE LATTER UNITS BY LW CONTRACTING, SPECIALIST ERECTION CONTRACTORS. *PHOTO ERIC SIERINS*



DWARF WALL UNITS WITH CONTINUITY REINFORCEMENT AND FILTER SLABS STORED ON SITE AWAITING PLACING.

Whilst there were some initial concerns regarding the very close tolerances required for the precast elements, by the completion of the project both head contractor and client consortium were generous in their praise of the precast content of the project relating both to product quality and rate of delivery.

This project emphasises the advantages obtained by all parties when the precaster is sufficiently involved at an early stage of the project and a non-adversarial climate exists between the parties. Given adequate lead time, the precaster was able to develop both a manufacturing process and special casting and handling arrangements to ensure effective manufacture and delivery.

Client – **Sydney Water Corporation**
Australian Water Services
Head Contractor – **John Holland**
Project Management – **Civil and Civic** ■

PRECAST LAUNDER UNITS BEING LIFTED FROM PURPOSE-MADE TRANSPORTING FRAME

Quality Assurance Policy Statement

The Association supports, encourages and advises members in their efforts to achieve and satisfy clients' quality and quality assurance requirements. This Association and its members are committed to providing real quality and quality assurance to users of precast components in accordance with the specification requirements for each project.

MEMBER PROFILE

THE USE BY THE COMPANY OF THE REID SWIFT LIFT, ENSURING IMPROVED SAFETY AND EASE OF PLACEMENT.

BERESFORD CONCRETE PRODUCTS PTY LTD

Beresford Concrete Products represents one of the precast concrete industry's great success stories.

In the early 1970s, Paul Beresford ran a successful plumbing and drainage business on the Central Coast (of NSW) but was experiencing problems with the supply of precast products. This provided the motivation for Paul to start manufacturing a small range of precast drainage products and septic tanks for this own requirements.

Increasing demand from other local plumbing contractors eventually saw the company build a factory at Charmhaven and become a small player in the industry.

In the past ten years, hard work, commitment to customer service, and an innovative approach to product development has seen Beresford Concrete Products become one of the largest precasters in Australia, producing a complete range of precast drainage, trade-waste, civil and construction products.

BCP is recognised as a market leader, supplying to major private development and public infrastructure projects.

In 1994, BCP commenced production of reinforced concrete drainage pipes incorporating an improved method of lifting and handling, using the *Reid Swift Lift* system.

The company's capacity for manufacturing flexibility, between standard products and 'specials', has been one of the cornerstones of the company's success, as has its capacity for product design and innovation. The company has continually sought to provide these considerations so often requested by clients. This commitment culminated in 1993 with the company acquiring Quality Assurance Certification.

Necessary to maintain consistent product quality is worker education. BCP has become a leader in this field with full commitment to competency-based training. Training programmes are now in place to provide worker training to ASF levels 1 and 2.

The company's range of standard products includes: drainage pits, headwalls, kerb lintels, drainage pipes, box culverts, access chambers, detention tanks, grease arrestors, electrical pits, and cast iron covers.

Recent major projects supplied by BCP include:

- electrical pits for Mascot Airport's third runway;
- precast platform units for the SRA's station upgrading programme including Concord, Strathfield, Hamilton, Allawah, Menangle, Menangle Park and Douglas Park Stations;
- retaining walls to create a sediment basin at the Forster Sewerage Treatment Works;
- a five-cell box culvert for Wyong Council's Saltwater Creek project;
- conveyor wall units for the Kooragang Island Coal Loader; and
- supply of approximately 2600 box culverts and link slabs for RTA at Moree.

STANDARD 'KNOCK-OUT' PITS – PART OF THE WIDE RANGE OF STANDARD PRODUCTS.

TWIN-CELL HEADWALL AND BOX CULVERTS. THE COMPANY HAS RECENTLY COMPLETED MANUFACTURE OF A FIVE-CELL, SINGLE CASTING UNIT FOR WYONG SHIRE.

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Pacific Highway Charmhaven NSW 2263
PRINCIPALS:
Paul Beresford – Managing Director
Carol Beresford – Director
OPERATIONS MANAGER:
Terry Cloutt
TEL: 043 92 3300
FAX: 043 92 2642

PCP 4.0 PROGRAM AVAILABLE

ONE HUNDRED AND FORTY VARIABLES, AND STILL COUNTING

That is the order of magnitude when you are designing a precast prestressed hollow core concrete plank. It's not surprising that some engineers delegate the chore to a manufacturer. The problem is that such delegation may be seen as abdication. Many engineers don't delegate and don't have the time to tackle the task long-hand. As a result, they end up not specifying what may well be the most economical and best performing system for a given project.

The National Precast Concrete Association Australia commissioned Helmut Schmidhofer, CPEng, to develop a computer program for the design of precast prestressed hollow core planks. The program called PCP4, is a module of a most interesting program called *Engineers' Compendium*. A quick test of PCP4 will show that the software is report driven. In less than ten minutes, you create a report, complete with letterhead and addressee, that is a summary of your deter-minations of the exposure classification, creep factors, shrinkage strains, fire rating and durability thicknesses and covers, bending moments and shears for a number of load cases complete with graphical output, a selection of manufacturer and plank type and a design of tendons and reinforcement for each load case, all contained within a comprehensive report of several pages.

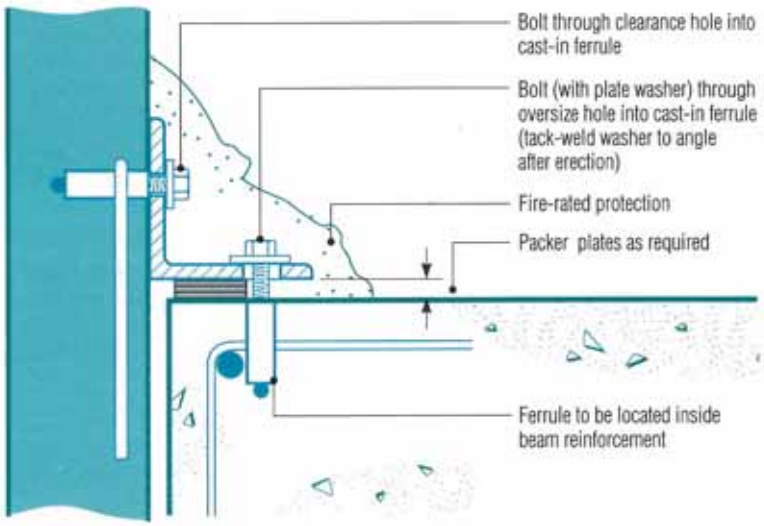
As impressive as this is, you will be really excited by *Engineers' Compendium*. Built around the motto 'you invent – we check – colleagues use', the program lets you develop solutions to engineering problems within a report-driven environment. The on-line server works with any Windows® word processor. It is a full-featured function interpreter and maintains a database of all user created project variables. You are invited to submit your work for inclusion in a growing list of cue cards. If your solution means that colleagues don't have to reinvent the wheel, you receive a royalty for your intellectual property.

PCP4 is available from the author (phone: 048 62 1295) at a cost of $395. A bonus offer by the author will provide purchasers with a free first-year subscription to Engineers Compendium plus 1000 usage units. ■

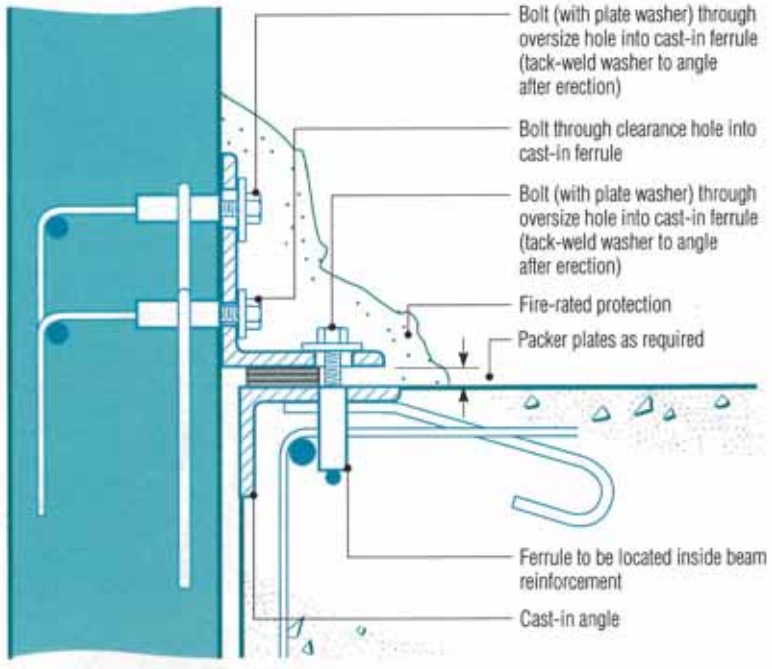
TYPICAL DETAIL

ANGLE-SEAT BEARING CONNECTIONS

- *Additional to corbels, steel angles may be used to support cladding elements*
- *Two examples are shown, (b) being a stiffened arrangement to support a greater load*
- *Note that confinement reinforcement is needed around the embedded ferrules. This adds ductility to the connection and is highly recommended*



(a) ANGLE SEAT FOR LIGHTER LOADS



(b) ANGLE SEAT FOR HEAVIER LOADS

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