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• NATIONAL • PRECASTER

NATIONAL PRECAST CONCRETE ASSOCIATION AUSTRALIA

PRESIDENT'S COLUMN

THE LAWYERS ARE THE PROBLEM

Many contractual issues which seemed to have been put to rest in the 1970s have gained a new lease on life in recent years. This trend is being fuelled by construction lawyers who are relying more on their imagination of what could go wrong than on industry experience of what actually does go wrong.

A good example is resurgence of opposition to paying for goods manufactured for a specific project but stored off-site awaiting delivery. This is common with precast concrete but applies to many other areas as well. Those who do agree to pay for goods off-site are increasingly asking for dollar-for-dollar bank guarantees as security.

Precasters will resist this trend for some very good reasons:

- The risk to the client is minimal. There are simply no examples of clients not getting their precast or of having to pay for it twice as a result of a precaster's commercial failure.
- The provision of a bank guarantee is not without its cost. Banks issue such guarantees only when dollar-for-dollar cash or property is lodged as security. Thus such a facility can be an enormous restraint on the precaster's access to funds for expansion and other normal business needs.
- There are simple alternative procedures which give the client adequate security. These include insurance and transfer of ownership on payment.
- It would be more consistent with the inherent risks for the builder or client to provide a bank guarantee to the precaster to secure payment under the contract.

It is important for the future of the construction industry that good use be made of off-site manufacture to boost both productivity and quality. The precast industry is sophisticated and highly capitalised and capable of providing great benefits to building owners.

It is time that organisations such as BOMA started to look at the real interests of their members and to advise them that much of the legal advice being offered is in fact increasing their costs and lowering the quality of their buildings.

In the meantime precasters will doubtless continue to walk away from contracts where the risk allocation is inequitable.

JOHN BURKE

A MATTER OF CHOICE

The recent spate of new prison construction has been of significant value to the precast concrete industry providing – for a number of manufacturers – a sufficient workload to maintain plant viability.

A quite surprising issue noticeable from these recent projects is the variety of design solutions employed. The precast industry has long canvassed 'speed of construction' as one of its major advantages. However, in no building project will the use of precast per se guarantee that advantage. The precast options for a particular situation must be fully explored. For example, precast could be used for cell units in several ways, viz:

- A series of flat panels which can be positioned, braced and connected by welded and/or grouted connections.
- A complete box, but with one side or top missing to allow for stripping of the inside mould.
- Some alternative configuration of floor, sides and roof.

WALL AND ROOF UNIT BEING LIFTED. AS VIEWED, THE UNIT WILL BE REVERSED THROUGH APPROXIMATELY 180° WITH THE LEADING EDGE OF THE ROOF LOCATED ON THE CORBEL, VISIBLE ON THE IN-PLACE UNIT.

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Looking at the first of these options we note that it results in the following:

- Panel shapes offering ease of mould and panel manufacture.
- Ease of storage at precast plant or on site.
- Relative ease of transportation, the criteria being the limit of 22 tonnes for a standard tri-axle semi-trailer vehicle.
- On site, flat panels are likely to require lesser capacity craneage but will require temporary bracing with connections necessary between adjacent units, between wall panels, floors and roof. This requires extra activities and, in the case of welded connections, an additional trade. Importantly, finishing and fitting-out activities are invariably hindered by the presence of propping and other workers.
- Finally, joint sealing will be an extensive operation.

TWO-STOREY REAR WALL BEING LIFTED

CELL BLOCK – PARTIALLY COMPLETED APPEARANCE

The second option mentioned, namely a box structure with one side or top missing to allow for inner mould removal, results in the following:

- Greater complexity of mould manufacture and concrete casting, a difficulty easily surmounted by mainstream precast concrete manufacturers.
- A likely increased storage space requirement.
- The need to limit maximum unit weight to 22 tonnes or move up to specialist transport vehicles.
- Increased crane capacity required for lifting. On many such construction sites, the load capacity is offset by the ability to locate the crane immediately adjacent to the point of placement.
- Exceptional speed of construction requiring only levelling and plumbing of the unit, giving reduced crane time and connections.
- The opportunity to decorate and fit-out the units prior to transporting to site. In the case of the cell units under discussion this could include the pre-placement of door, window or qrilles, sanitary items, plumbing and electrical works and decoration. This comment applies equally to many other construction forms, including motel/hotel, apartment type structures, hospitals.
- The absence of propping, permitting rapid finishing and fit-out if done on site.

The last option mentioned was 'some alternative configuration of floors, sides and roof'. Such an approach is being used at Junee, NSW, where the first of a new breed of privately operated prisons is being constructed by Thiess Contractors Pty Ltd. Here, the configuration of a typical cell unit features a roof, one dividing wall and a front wall with door opening.

The design allowed for the units to be freestanding, with the roof of the unit also supported on a continuous corbel cast on the adjacent wall. The cell blocks illustrated contained sixteen cell units, eight at ground level.

Located on an insitu concrete slab, each of these units supported a further unit to provide a two-storey block. A two-storey-high, rear-wall panel then closed the structure.

The precast concrete supplier provided a very significant design input, the design allowing two cell units and one rear wall unit to be transported as one load.

Crane time for each element was in the order of 15 minutes. With allowances for down-time, meals, etc the erection of a 16-cell unit was possible in one working day. Such an erection programme places a responsibility on the supplier to keep up the rate of delivery to site. This requirement is best served by the client/contractor providing adequate 'lead-time' for the preparation of shop drawings, mould manufacture and casting of the units.

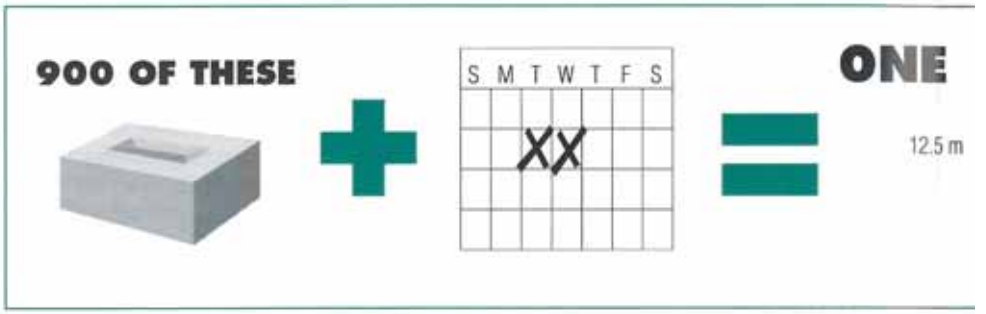
This article is not meant to suggest that one arrangement of panels is superior to another; rather that each project must be judged on its merits and the method offering the most advantages selected. Since, by virtue of his experience, the precast concrete supplier can provide vital input to the selection process, he must be involved in planning discussions at the earliest opportunity.

ON-SITE CASTING – FABRICATED STEEL EDGE MOULD, REINFORCEMENT, ETC IN PLACE. BED TO BE CLEANED BY AIR-BLASTING PRIOR TO CASTING CONCRETE.

Another interesting approach on the Junee project was the choice by Albury Precast Concrete to precast on site. Using the floor slab as a casting table and fabricated steel edge moulds, panels of up to 50 m^2 were cast, generally by the 'stack cast' method. The use of the steel edge moulds gave good dimensional and shape control, characteristics not necessarily found in site casting, whilst the availability of steam curing ensured adequate panel maturity prior to lifting irrespective of ambient conditions. ■

HOLLOWCORE WALLING

PANELS, STORED AWAITING CONTRACTOR'S DIRECTIONS



Cost Saving and Speed of Construction
One of the precast concrete industry's most spectacular successes, has to be the introduction in the mid-1970s of the Hollowcore machine capable of forming voided panels, initially manufactured to the full length of the casting bed (100 m or more) and subsequently sawn into panels of the client's required length – limited only by the capacity to transport the panels to site.

It may be remembered that at the time of Hollowcore's introduction, masonry – due largely to the costs associated with laying brick and block – cost the proverbial arm and leg.

Significantly, the speed of construction of Hollowcore and the ability to enclose the structure quickly, were not lost upon the client. It is hardly surprising that an advertisement for Hollowcore by the Boral Group, similar to that shown here, was instantly understood by clients.

Hollowcore is now manufactured in Brisbane, Sydney, Melbourne and Perth with a combined output of around 750 000 m^2 a year.

The major applications for Hollowcore are:

- walling, essentially quality industrial buildings, warehouses, workshops and commercial structures including shopping centres, laboratories, schools and car parks;
- flooring (not discussed in this article).

Resulting from its widespread use, intending clients can now form realistic expectations of the product including cost, construction time, durability and weathering characteristics.

Manufacturers are constantly seeking to improve the product and create more visual appeal. The finishes presently available include:

- plain, as cast. Such panels are invariably treated with paint or applied coatings – ideal where a specific company identity can be created by paint colour and geometry;
- water-washed exposed aggregate. Where quality aggregates exist, this finish has proved very popular, weathering extremely well. Selected coloured aggregates such as those of the granite family, water-washed to expose the stone, can be most attractive;
- ribbed or striated finishes. This is a recent development by the manufacturers in their search to offer visually pleasing alternatives;

Visual expression can further be provided by the way in which panels are placed, either vertically or horizontally.

Note that the horizontal application is an effective procedure where poor ground conditions exist; footings for columns can be used to support the panel ends, the panels acting as deep beams between supports. A further significant advantage of Hollowcore is the ability to erect walls ahead of the floor thus permitting the concrete floor to be placed under cover. This gives it protection from inclement weather, including hot, windy conditions that could promote rapid evaporation and induce cracking of the insitu floor slab.

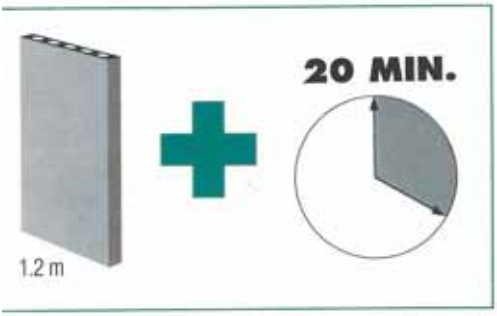
Like all precast concrete products, the merits of Hollowcore are well defined and include:

- **Speed of supply** This obviously varies, being affected by the availability of designer's requirements, complexity of the job in relation to 'special' panels (ie half-width panels). Generally, two weeks should be allowed for the production of shop drawings and a further two weeks for manufacture and delivery, noting that delivery to site could commence soon after the first panels are produced.
- **Speed of construction** Manufacture is off-site. It can be paralleled with site

TECHNICAL AND WAREHOUSE FACILITY. HORIZONTAL, EXPOSED-AGGREGATE-FINISH PANELS. NOTE USE OF DARK RIVER GRAVEL IN BOTTOM PANEL TO SUGGEST PLINTH.

SUBURBAN CINEMA

EXPOSED AGGREGATE



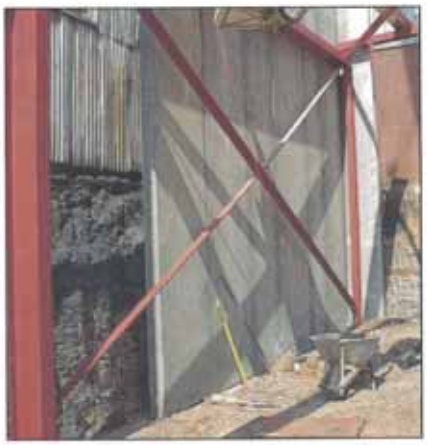
RIBBED FINISH

VERTICAL PANEL APPLICATION

preparation, earthworks, drainage, service roads, footings and frame. Rate of erection (assuming a single crew generally comprising one crane operator plus three riggers) can be expected to be in excess of 300 m^2/day. It is worth noting that the longer the panels, the greater the rate of erection since crane time, locating, connection and grouting, etc is measurably the same, be the panels 8 or 12 m in length.

- Massive reduction in project risk due to **inclement weather**. Apart from product manufacture and erection, the ability to place the floor after wall and roof construction eliminates many construction hazards posed by adverse weather conditions.
- **Reduction of on-site labour**
- **Ability to capitalise on restricted sites** with units able to be placed adjacent to existing boundary structures.
- **Crack-free** nature of prestressed units.
- **Good weathering and durability characteristics**, promoted by the product's concrete strength, density and crack-free nature.

All these considerations add up to one large plus for Client and Contractor, namely the very significant **reduction of risk.**



WALL PLACEMENT – NOTE PROXIMITY TO BOUNDARY. FLOOR NOT YET PLACED.

PANELS BEING SAWN TO CLIENT'S REQUIRED LENGTH

HOW CLOSE IS CLOSE?

TYPICAL TOP FIXING, TWO CLEATS PER PANEL.

Hollowcore panels are available in 1.2- and 2.4-m widths and are cut to the required length. Designers will benefit by using a planning grid to match these two modular widths. If necessary, part-width panels can be produced as can panels to accommodate openings for doors.

Panel thicknesses vary from 150–300 mm, choice of panel thickness being determined by loading conditions, fire resistance level and cover to strand to meet durability requirements. Stressing strand (both number of strands per panel and strand diameter) can be varied to suit loading conditions.

To limit deflection in service, the ratio of span (between fixings) to total thickness is usually restricted to 50. For handling and erection considerations, the ratio of overall length to thickness should not exceed 60.

Connection details have become well established and practical. Bottoms of panels are dowelled and grouted, with top connections invariably provided by cast-in ferrules and fixing clamps.

Connection details are well documented in the NPCAA's *Hollow Core Walling Technical Manual* which is available for $10.00 from the National Precast Concrete Association Australia and Regional Offices of the Cement and Concrete Association of Australia. A companion document *Hollow Core Flooring Technical Manual* is also available at $10.00. ■

GLASS REINFORCED CEMENT

Properties

GRC is essentially a cement and sand mortar reinforced with a high-tensile-strength glass-filament reinforcement. The glass filament is treated to resist attack from alkali-rich cement.

These ingredients produce a material with several most-useful characteristics. These include:

- It is easy to mould – making it possible to create fine surface detail and the most complex of shapes. The material can also be used to produce flat or corrugated sheet material without the health hazards of the former, widely-used asbestos cement.
- It has a high resistance to cracking.
- It produces lightweight units (resulting from the thin section) with advantageous transporting and erection properties.
- The reduced weight of units can make the supporting structure more economical.

GLASS FILAMENT

SPRAYING OF GRC

'OVERCLADDING' OF EXISTING FACADE.

PERMANENT FORMWORK, CEILING DETAIL

Manufacture

There are a variety of manufacturing methods, determined by the required production volume or the complexity of the product. The following are used:

- Manual spraying – a very versatile technique for the production of high-strength components of a simple or complex nature.
- Automatic traverse spraying – for volume production of standard components. The degree of automation and investment depends on final output requirements.
- Vibration casting – for the low-cost production of utility components.
- Extrusion systems – for volume production of linear, profiled elements.

Glass filament is generally used at around 3–5% in factory-manufactured products either by the spray process or by traditional casting methods.

ARCHITECTURAL FACADE – PARK LANE HOTEL AND TATTERSALLS BUILDING, SYDNEY; USE OF SOME 5000 PANELS, PROVIDING A FACADE AREA OF 11 220 m^2. SURFACE FINISH IS A HONED, RECONSTRUCTED GRANITE.

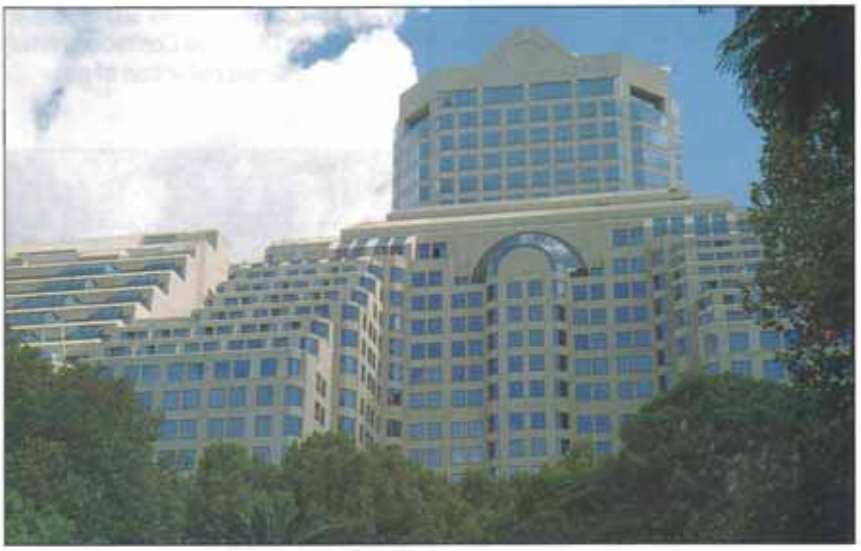


TABLE 1 TYPICAL PROPERTIES OF GRC

Property		Hand or machine spray	Vibration cast
Typical filament content (weight %)		5	3
Bending:	Ultimate strength, MOR (MPa)	20–30	10–14
	Elastic limit, LOP (MPa)	7–11	5–8
Tensile:	Ultimate strength, UTS (MPa)	8–11	4–7
	Elastic limit, BOP (MPa)	5–7	4–6
Shear:	Interlaminar strength (MPa)	3–5	N/A
	In-plane strength (MPa)	8–11	4–7
Compressive strength (MPa)		50–80	40–60
Impact strength (kj/m^2)		10–25	10–15
Elastic modulus (GPa)		10–20	10–20
Strain to failure (%)		0.6–1.2	0.1–0.2
Dry density (t/m^3y)		1.9–2.1	1.8–2.0

Applications

The properties of the material provide for a multiplicity of uses, eg:

- Cladding for buildings, including the 'overcladding' of existing structures as a part of building rehabilitation. A wide range of finishes can be provided from 'as cast', to honed and polished. The surface nature of the product, allows for ease of coating or paint application.
- Permanent formwork, eg permanent floor soffit formwork with the ability to add detail, moulding, etc to the exposed soffit face.
- Noise barriers.
- Architectural details – moulding for capitals, cornices, corbels, balustrades, column casing and porticos.
- Sheet material (flat or corrugated) as a replacement for asbestos cement in fire partitions, roofing and access floors.
- Drainage and water-supply products including access pits, gullies, tanks.
- Landscaping products: rock environment and waterscapes, creating visually satisfying structures for parks, zoos, garden features around buildings and the like.

As with most cementitious materials, it is normal to consider the mechanical properties of GRC at 28 days after casting. Typical mechanical properties are indicated in Table 1.

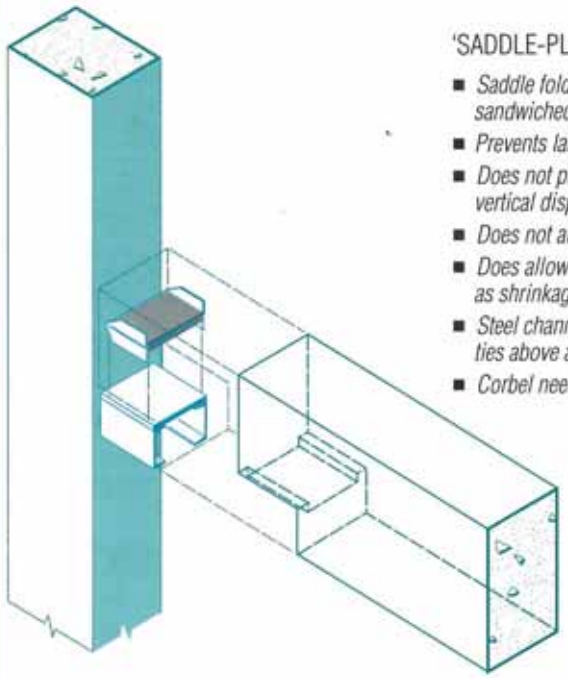
Manufacturers of GRC in Australia include the following NPCAA members: Asurco Pty Ltd, Glenn Surface Coatings Pty Ltd, James Hardie and Co Pty Ltd, Precast Concrete Pty Ltd, CSR Fibre Concrete Pty Ltd and Rescrete Industries Pty Ltd. ■

ARCHITECTURAL DETAIL – COLUMN CAPITAL RESTORATION OF QVB, SYDNEY

ARTIFICIAL-ROCK STRUCTURES

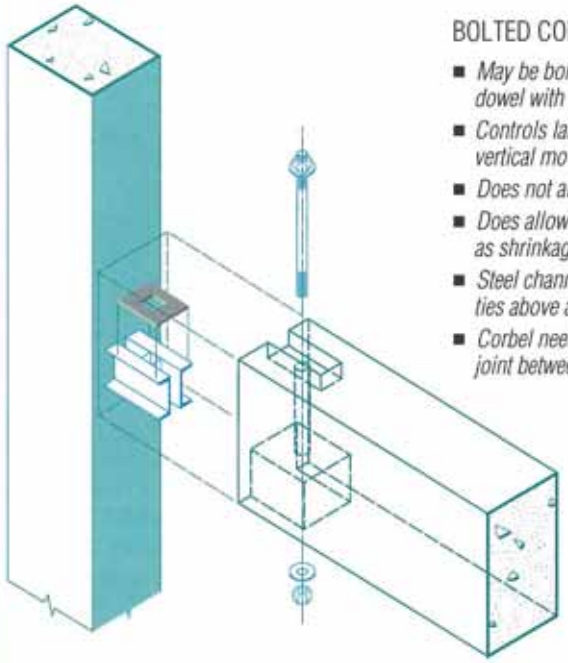
TYPICAL DETAIL

THIS ISSUE: BEAM TO COLUMN



'SADDLE-PLATE' CONNECTION

- *Saddle folded from sheet metal and sandwiched between neoprene pads*
- *Prevents lateral movement*
- *Does not provide for longitudinal or vertical displacement*
- *Does not allow moment transfer*
- *Does allow for minor movements such as shrinkage and creep*
- *Steel channel corbel requires extra ties above and below it in the column*
- *Corbel needs to be fire-protected*



BOLTED CONNECTION

- *May be bolt, threaded rod or threaded dowel with retaining nuts and washers*
- *Controls lateral, longitudinal and vertical movement*
- *Does not allow moment transfer*
- *Does allow for minor movements such as shrinkage and creep*
- *Steel channel corbel requires extra ties above and below it in the column*
- *Corbel needs to be fire-protected at joint between beam and column*

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.

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