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NATIONAL PRECASTER

NATIONAL PRECAST CONCRETE ASSOCIATION AUSTRALIA

PRESIDENT'S COLUMN

A recent article in a well respected business magazine espoused the theory that business has a lot to be grateful for from our current (ever-lingering) recession. Indeed, it has forced us all to look closely at the many aspects of managing our businesses in an effort to produce a tighter, generally leaner and more efficient ship. But to say that it has made us all become more competitive needs closer analysis.

If, in the attempt to achieve such competitiveness, we have addressed the issues of Training, Productivity, QA, Customer Service, Client Liaison, Marketing, Product Development – and the list goes on – then, in the long term the result will be of benefit to us all.

Unfortunately, in the current climate, the short-term competitive strategy of price cutting seems the preferred option of the Client. If only in the negotiating arena, as much time was spent discussing the former elements and not the latter, and as a result consideration was given to the cost effectiveness of the project at completion and less on the costs at the beginning of the project, then indeed we will all benefit from healthy competition. **CAROL BERESFORD**

MEMBER PROFILE

This third-generation Tasmanian company formed over 60 years ago with a core business of quarry products has, over the years, diversified into a wide range of construction products and services; included in this diversification is precast concrete ranging from the mundane kerb-and-gutter unit to structural building frames and architectural facades.

Duggans precast yard with its adjacent quarry is located in the picturesque Huon Valley some 45 minutes drive south of Hobart, or somewhat less if you are driving with Patrick Duggan.

Recently, Duggans have manufactured a number of precast concrete structures for the Australian Construction Services and their clients the Australian Antarctic Division.

Use was made of modular panels to provide flexibility for future redevelopment of the base. Panel design provided for wind loads up to 72 m/second and ambient temperatures of –40°C.

Such projects massively exhibit the virtues of using precast concrete with its guaranteed properties of dimensional control, dimensional tolerance, and fit; all ensuring speedy, straightforward erection and long-term durability.

NAME: Duggans Concrete Pty Ltd
ADDRESS: Cradoc Tasmania 7111
MANAGEMENT:
Patrick Duggan, General Manager
David Moon,Contracts Manager

Products:

- Architectural elements, facades, spandrels
- Structural units – beams, columns, solid precast floor planks, piles, retaining walls
- Customised units.

ANTARCTIC SUPPLY VESSEL TRANSFERRING PRECAST PANELS TO BARGE

PRECAST CONCRETE FLOOR PANELS AT DAVIS BASE, ANTARCTICA

Photographs courtesy of R Pulvirenti, ACS

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Auscore Concrete Pty Ltd
Beresford Concrete Products Pty Ltd
Boral EPM Concrete Pty Ltd
Boral Spancrete Pty Ltd
Constress Pty Ltd
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STRETCHING THE PRODUCT

It is interesting to observe the ability of designers and manufacturers to constantly extend the application of precast products. One such product is Glass Reinforced Cement (GRC). This results from a most obvious improvement in the product's track record together with increased imaginative perception of its potential.

Australian manufacturers must be counted among the world's best, an opinion provided by a number of overseas visiting groups and individuals.

Among buildings using GRC imaginatively are 130 Elizabeth Street, Sydney only recently completed, and the Capita Centre.

130 ELIZABETH STREET, SYDNEY

The former building uses a cladding of GRC faced with a reconstructed, precast granite finish with a mix of polished and sandblasted surfaces.

The GRC panels are cast face down with the 12- to 15-mm-thick veneer mix (placed first) consisting of Tarana granite graded from 12 mm to dust combined with off-white cement and a small percentage of red oxide. The veneer is then over-sprayed with a 15-mm thickness of polymer-modified GRC, which is compacted using a serrated roller. The GRC has a modulus of rupture of 21 MPa and provides the panel's tensile strength. A prefabricated lightweight galvanised steel frame is then fixed to the rear of the GRC by flexible anchors.

CAPITA CENTRE

The placing of the veneer and the GRC and the fixing of the steel frame are executed in one continuous operation while the concretes are still in the plastic state. Similar values for shrinkage strain for both concretes minimises the risk of delamination of the veneer.

Fixing to the concrete structure is by galvanised slotted angle to permit ease of erection. These angles are connected to the steel frame on the back of the GRC panels and bolted to unistruts cast into the floor slab with four fixings used per panel – two at the head and two at the foot.

Typical panel dimensions are 3600 x 3600 mm with window openings 2400 x 2400 mm. Typical panel mass is 750 kg, or 80 kg/m^2.

The waterproofing system uses normal precast concrete technology:

- Horizontal joints are overlapped 75 mm. Typical horizontal joint width is 20 mm. Horizontal joints are sealed with *Willseal* at the top of the upstand.
- Vertical joints use the open drained joint principle. Joints are 20 mm wide with a PVC ultra-violet-resistant weather baffle recessed (20 mm) into the side of adjacent panels. The back of the joint is air sealed with *Willseal*. Horizontal/vertical intersections are flashed with a stainless steel flashing 1 mm thick and 300 mm long.

All panels were pre-glazed prior to erection which reduced total facade erection time and closed off floors as each level was erected, thus allowing internal trades a dry environment to start work. It also reduced the total amount of on-site labour.

Overall, a significant application of GRC cladding offering the appearance of high cost materials, with reduced structural mass and construction time savings.

The Capita Centre has mystified many observers since its completion.

The external steel brace and columns of the Capita Centre provide the lateral restraint to the facade of the building.

Because they are located on the street front, these elements require a four-hour fire rating, and have been encased in concrete.

Curved GRC panels act as the permanent formwork to this concrete encasement, transforming the square brace and columns into round elements.

GRC is strong enough to withstand the pressure exerted when concrete is pumped into the void between the steel and the cladding. It was thought to offer advantages over steel or aluminium sheet because it does not dent and any damage sustained during transportation can be easily repaired. 1200 GRC panels were manufactured and finished off-site. They are 20 mm thick and weigh about 140 kg.

The panels have a multi-coat *Bonnflon* coating to give a matt grey appearance and a long service life. All the internal surfaces

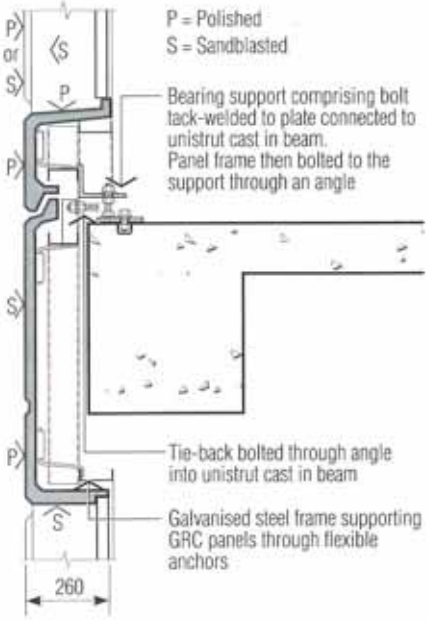
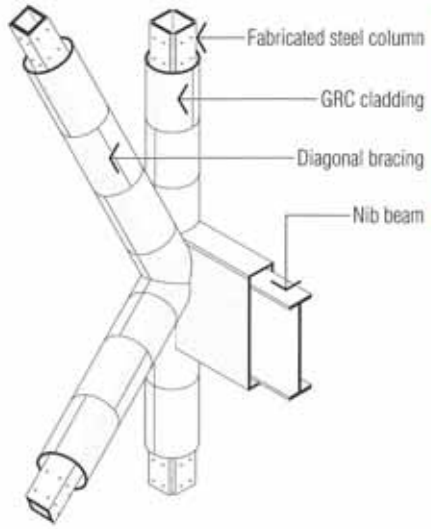
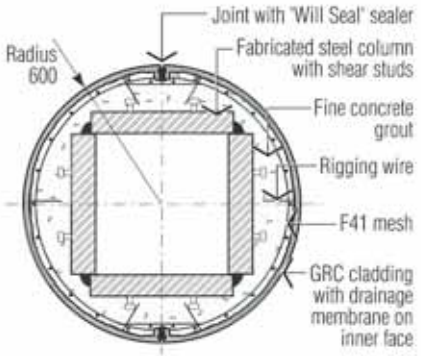


FIGURE 1 TYPICAL WINDOW PANEL AND FIXING



PANEL ARRANGEMENT AT KNUCKLE



TYPICAL COLUMN SECTION

FIGURE 2 COLUMN CLADDING DETAIL

of the panels are coated with a tar epoxy paint to minimise moisture movement.

The panels are secured to each other by stainless steel dowels, while stainless steel straps secure the panels back to the frame during erection.

On a recent study tour by German precasters, several of the group were seen tapping and stroking the surface attempting to convince themselves that this superb finish was not metallic in nature but GRC.■

PRECAST CONCRETE FLOORS

Building is all about compromise and 'swings and roundabouts'; what you may gain on one, you may lose on the other. It's about making judgements based upon as many facts as one can establish, whilst identifying the likely problems and eliminating – or at least minimising – them.

Take precast concrete flooring for instance and examine the 'fors and againsts' of the products. Let's start with the latter.

Disadvantages

- Weight Panels are generally provided in span lengths and to a variety of widths and require handling by crane.

In commercial work this is unlikely to be a problem; similarly in medium- and high-density dwelling development. It would, however, pose a problem in single dwelling construction unless such single dwellings form part of a localised development of numerous close-proximity dwellings.

Advantages

- Off-site manufacture, elimination of formwork, propping and most steel fixing.
- Delivery as required by head contractor, no site storage requirements.
- Rapid placement. Rates of up to 1000 m^2/day are regularly achieved.
- Rapid closure of the structure allowing close follow-up by installation and finishing trades at the under level.
- Safe working platform created at the upper level for personnel and the storage of materials.
- Inclement weather problems measurably eliminated.
- Provides flexibility for internal non-loadbearing wall arrangements.
- Noise transmission measurably reduced, an issue of significant value in multi-occupancies.

CONVERSION OF WAREHOUSE TO APARTMENTS. PANELS WERE PLACED THROUGH EXISTING OPENINGS IN THE BUILDING FACADE WITHOUT REMOVING THE ROOF. SHEAR KEYS TO BE GROUTED; NO INSITU TOPPING REQUIRED.

- Excellent fire resistance.
- The concrete floor, given advantageous orientation can provide most useful passive solar properties.

It does not require a Rhodes Scholar to recognise that the balance of Advantages versus Disadvantages demands that Developers, Designers, Builders and Clients must, at least, consider the merits of precast concrete floor construction.

Available on the Australian market are a number of precast floor products; they include:

- Hollow core panels or planks.
- Permanent formwork arrangements, marketed under the proprietary names *Humeslab* and *Transfloor.*
- Tee units, both single and double.
- Hybrid units.
- Reinforced solid planks.

Hollow Core Planks

These are manufactured on long-line casting beds and sawn to the required length. Plank width is 1.2 m but some suppliers can provide 2.4-m-wide planks. Lengths are to suit required spans with thicknesses varying between 150 and 300 mm, the choice of thickness being determined by loading, fire resistance levels and cover to prestressing strand to meet durability requirements.

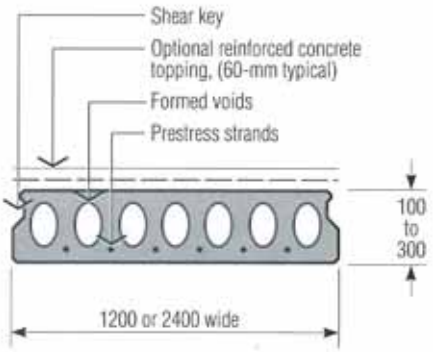


FIGURE 1 PLANK CROSS-SECTION

The planks provide one-way slab action and can accommodate long spans giving flexible open space with fewer beams, walls and supporting columns. Clear spans of over 10 m can be obtained economically.

In planning a structural arrangement, significant benefits accrue from establishing a framing concept which takes heed of the plank span capability and width module. Non-modular dimensions are accommodated by using partial-width planks obtained by longitudinal sawing of a standard-width plank.

Core layout and amount of prestress can be varied to suit loading requirements.

All manufacturers supply design charts and data on properties for their range of plank thicknesses and profiles.

The National Precast Concrete

Association Australia has available a Technical Manual, *Hollow Core Floors* and additionally has prepared, through its Consultant, a computer design program entitled *PCP3 – Precast Prestressed Concrete Planks for Flooring.*

■ **Installation** Manufacturers deliver (and will erect, if required) the planks to the builders construction schedule, allowing planks to be lifted from the transport and placed directly into position. A prerequisite for placement is a level bearing surface of adequate width as shown in the table below.

Plank thickness (mm)	Minimum bearing (mm)	
	Concrete	Steel
150		
200	80	70
250		
300	120	100

Planks are supplied with a key along each longitudinal edge which requires grouting to allow the individual planks to work together in the transfer of load and shear forces.

Grouting and topping of the planks may be completed in one operation or, if the planks are to be left 'untopped', then keys should be grouted using a 1:3 cement:sand mortar.

Following erection and grouting a level of security and weatherproofing is provided to the lower-level accommodation, permitting finishing work to begin. At the working level, an immediate, safe working and storage area is created.

Openings and penetrations can be readily provided – larger openings, such as for stairs, by using a header plank supported on a fabricated steel angle, while smaller penetrations can be cored through the plank on site, taking care to avoid the prestressing strands **Figure 2**.

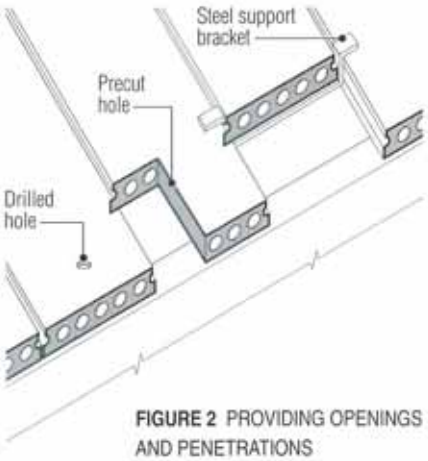


FIGURE 2 PROVIDING OPENINGS AND PENETRATIONS

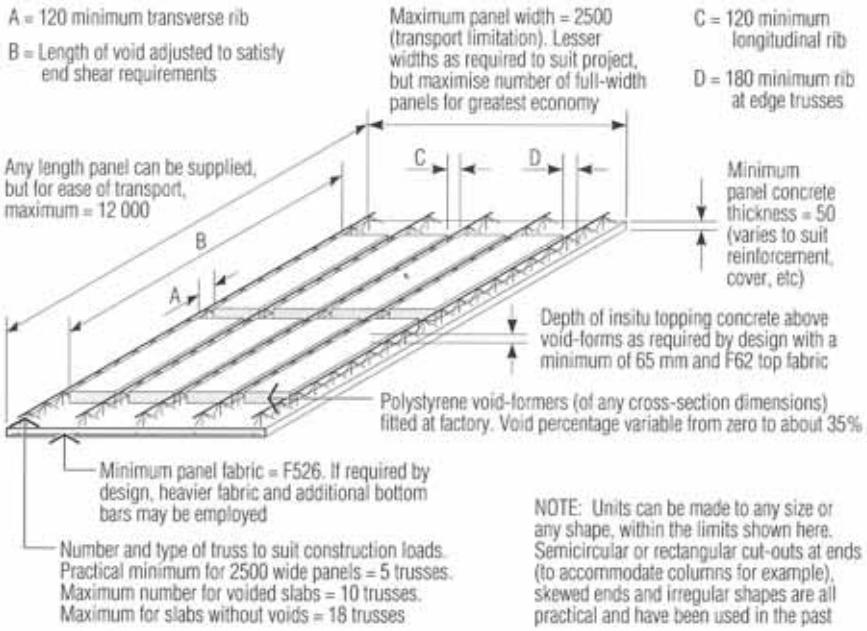


FIGURE 3 TYPICAL PERMANENT FORMWORK UNIT ARRANGEMENT

Planks are sometimes topped to develop composite action and eliminate the camber effect inherent in prestressed members. A 60- to 80-mm-thick, 25-MPa concrete topping using a light reinforcing mesh to control shrinkage cracking is normal as is the use of contraction joints.

There is increasing use of untopped planks. Care is needed in selecting untopped units to reduce the effects of differential camber between planks, although adjustment between planks at the time of grouting the shear keys is quite simple.

Permanent Formwork Arrangements

This involves a combination of a precast concrete soffit and insitu concrete topping. The soffit comprises a 55-mm-thick precast concrete panel which provides the soffit of the eventual floor.

The bottom reinforcement and bottom chords of the trusses are embedded in the soffit concrete as is any additional reinforcement required by the designer. Polystyrene void formers are placed between the trusses to reduce the self-weight of the unit. **Figure 3** illustrates a typical unit.

Generally, panel dimensions are a nominal 55-mm-thick soffit, panel width up to 2.5 m and length up to 12 m.

Casting involves a traditional wet-cast operation using a steel mould, thus providing a smooth soffit which may be painted direct or battened-out with a sheet type ceiling.

Additionally, plan shapes can be varied and blockouts for openings and services readily provided. The Nikko Hotel, Sydney (having on plan two crescent-shaped towers) exemplifies this advantage, panels being trapezoidal in plan to match the 4° taper of the radial band beams.

Interestingly, on this project the top reinforcement, F72 fabric, was welded in place at the factory, rather than the commonly used option to fix on site. This approach led to a massive reduction in on-site steel fixing. Provision of services in the slab needs consideration when top reinforcement is factory placed.

■ **Installation** As with all precast, the supplier must be made aware of the builder's schedule and delivery requirements. Mass of these units is in the order of 140 kg/m^2 for a panel having a 55-mm-thick soffit; a panel say 6 x 2.5 m would weigh approximately 2 tonnes. Typical placing rates are in the order of 150 m^2/h with a four-man crew. Large panels, whilst possibly increasing crane requirement would give an increased rate of placement.

As with hollow core, adequately wide and level bearing surfaces are necessary.

The stable working deck gives ready access for trades such as electrical and plumbing. Chases for pipework are readily formed in the polystyrene void formers using a hot-wire cutting tool.

Following placement of services and reinforcement, concrete topping is placed to a minimum thickness of 65 mm above

LOCATING PANELS

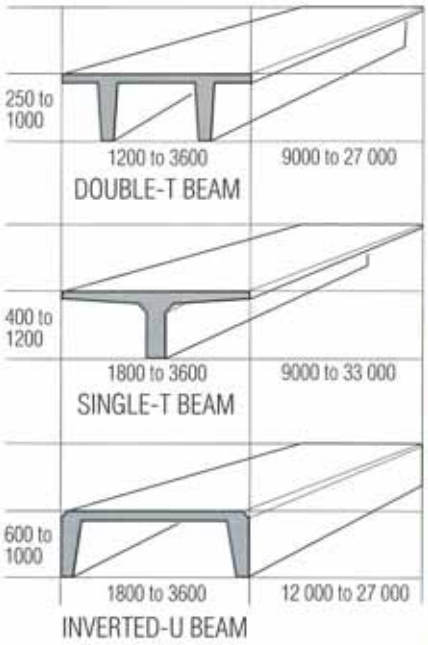


FIGURE 4

the polystyrene. Top reinforcement content and the presence of laps in the steel may require a thicker topping to meet durability requirements, particularly in exposed locations.

Wide Flanged Beams

These include Single Tee, Double Tee and inverted U-beams.

Figure 4 illustrates the geometry, dimensional range and possible spans. Fire resistance levels of up to 1½ hours are possible.

A 50-mm-thick insitu topping is normal to tie the units together and develop a diaphragm to distribute lateral loads; alternatively, the units can be jointed by welding steel plates cast into the edges of the units.

The geometry of the units offers great scope for bold architectural expression.

Hybrid Floor Units

Resdeck is typical of such hybrids. Based upon hollow core floor technology *Resdeck* uses a 350-mm-wide hollow core beam, with beam depths of 150 and 200 mm. Spans of up to 6.5 and 8 m respectively can be achieved without propping. A 1½ hour fire resistance level is achieved.

The beams are placed on a level bearing surface at 700-mm centres, *Hardiform* is placed between beams, any required penetrations made, top crack-control reinforcement positioned, and insitu topping placed.

Normal topping thickness is approximately 60 mm. This gives a total thickness comparable with brick course dimensions. Where a flat ceiling is required, ceiling hangars are provided to support a suspended plasterboard ceiling.

The range of precast flooring products discussed here can meet the needs of most construction from commercial to residential. The risk reduction in construction, achieved by the use of factory-made precast units demands their consideration. ■

TEE UNITS BEING PLACED, ABC STUDIOS, ULTIMO

PRECAST PEDESTRIAN BRIDGES

Recently, at several locations around Australia, commuters have been surprised at the sudden presence of over-road pedestrian bridge structures. With possibly nothing more than the abutments visible on their way home after work they are confronted the following morning with a total bridge structure spanning 30 metres or more.

Such a situation occurred recently in Perth's Mounts Bay Road.

Initially, only the two side beams of the structure were to be precast. After taking into account the problems associated with an insitu deck over a busy city roadway the decision was made to precast the 25-m deck despite the calculated load of the unit at 93 tonnes.

The two main side beams were manufactured with post-tensioning ducts accurately located and stressed at 3 days

TEE UNITS; CARPARK APPLICATIONS

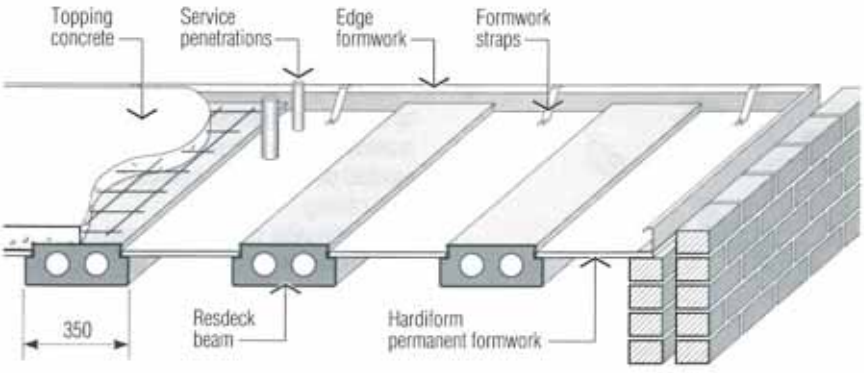


FIGURE 5 *RESDECK* FLOOR SYSTEM

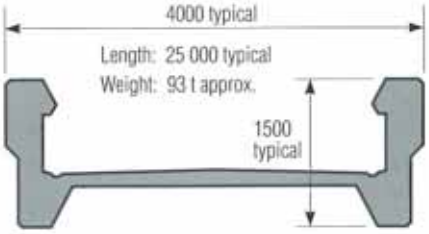


FIGURE 1 CROSS SECTION THROUGH DECK STRUCTURE

ERECTION OF 93-TONNE PRECAST BRIDGE DECK

when the concrete strength was 28 MPa; strength at 28 days was 50 MPa.

To speed project completion, the unit was painted prior to delivery and canopy connections and electrical requirements installed.

Erection was scheduled early on a Sunday morning some three weeks after casting. The deck was in position by midday, canopy installed by mid-afternoon and the road opened to traffic that afternoon.

However, as the photograph below shows, one does not have to wait until Sunday.

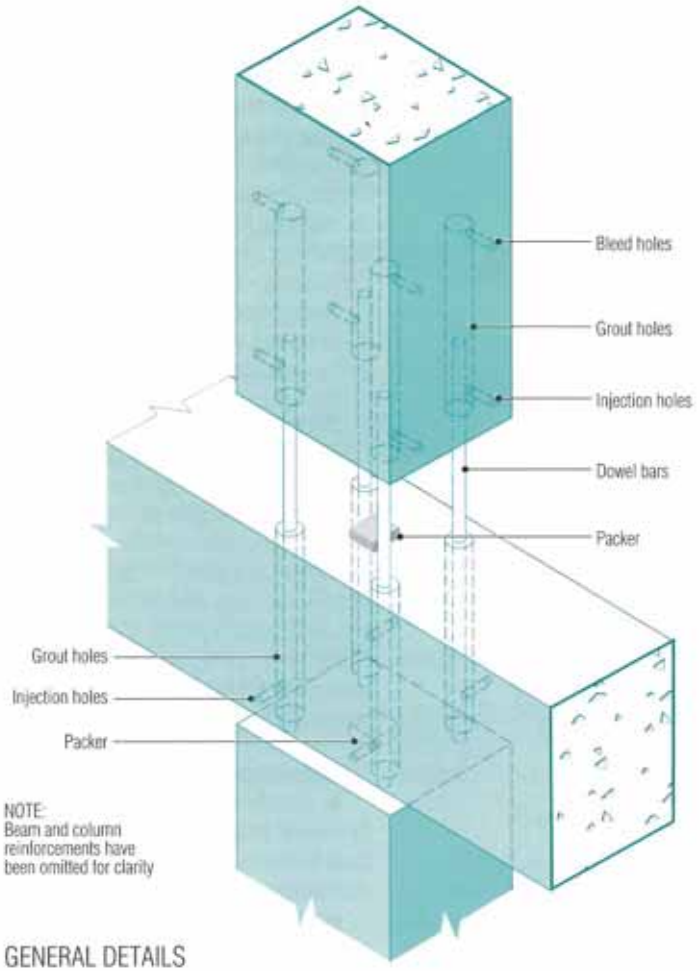
The whole operation, highlighted the certainty and speed associated with precast concrete construction. ■

QUALITY ASSURANCE POLICY STATEMENT

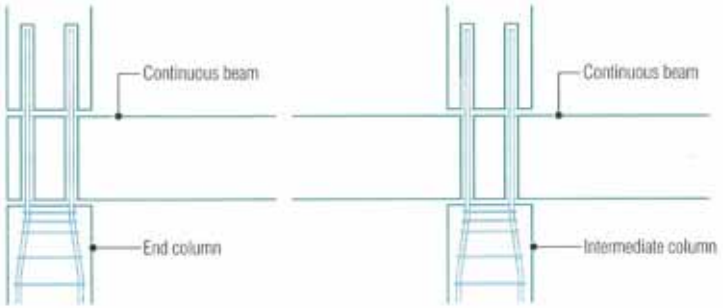
The Association supports, encourages and advises members in their efforts to achieve and satisfy clients' quality and quality assurance requirements. This Association and its members are committed to providing real quality and quality assurance to users of precast components in accordance with the specification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

TYPICAL DETAIL

THIS ISSUE: CONTINUOUS BEAM TO COLUMN



GENERAL DETAILS



TYPICAL ARRANGEMENT

DOWELLED CONNECTION

- *This connection is able to transmit large vertical and fairly large horizontal forces. It can also transfer significant moment and has high fire-resistance levels*
- *To avoid transport difficulties through long starter bars, the lower column can also be provided with dowel holes in which, at the time of erection, separate dowels are embedded with grout. This offers the added advantage that the upper and lower columns are identical in shape and reinforcement*
- *There are erection advantages in using one dowel bar longer than the others to act as a locating and guiding device*

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