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PROTOTYPES – Allow for cost and time

Very often the word 'prototype ' finds its way into a precast concrete specification. To avoid confusion, the specifier must be a little more realistic in spelling-out his intentions and requirements.

Whilst prototypes may be specified to cover a variety of purposes, there are essentially two forms of application:

Full prototype To allow an evaluation of appearance or performance characteristics which may lead to a redesign of the element. Such prototypes must be made and evaluated before shop-drawings for the complete project are commenced.

Limited prototype To aid final selection of aggregate type, depth of aggregate exposure in the case of, say, water-washed or tooled finishes, or to develop casting and handling techniques best suited to the design.

Such prototypes may be in the form of sample panels, or the first panels in the main production run.

Designers and specifiers should be most conscious of the high cost and long lead times associated with the first option above, and should specify such prototypes only where there is real doubt as to the feasibility of the design. This sort of prototype is part of the design process and will be, ideally, built and evaluated before tenders are called for the main precast contract. Only complex or innovative designs warrant the expenditure associated with a full prototype.

On the other hand, there is little point in specifying a full-scale prototype to be made from the first panels in the production run, because it is then too late to make any significant design changes.

Typical reasons for a full prototype are:

- architectural considerations;
- weatherproofing (windows and joints);
- weathering;
- erection and handling feasibility.

For a limited prototype, typical reasons could be:

- architectural considerations (colour, texture, aggregate exposure, etc) but not issues affecting drawings and moulds;
- selection of adjacent colours and finishes, eg window frames;
- development of handling techniques leading to the manufacture of turning and transporting jigs, etc.

On all but novel or unique projects, this limited prototype approach is the most likely scenario.

A typical cost and time framework for a full prototype could be:

- shop drawings
  $2500 – $10 000   4 weeks
- mould manufacture
  $5000 – $75 000   8 weeks
- production and erection
  $5000 – $25 000   4 weeks.

Time and costs for evaluation and any redesign must be added to these figures.

It is therefore very obvious that a request for a full prototype should be attached only to a project which is novel or unique and where there is no body of existing knowledge or opinion. In all instances, the value of early (at conceptual stage) discussion with a mainstream precast manufacturer should be recognised. ■

A FULL-SCALE PROTOTYPE SUCH AS THIS UNIT TAKES TIME AND MONEY, BUT MAY BE A WORTHWHILE INVESTMENT.

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SEALING OF CLADDING JOINTS

This article was contributed by
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Joints are necessary in buildings generally to satisfy one or more of the following requirements:

- To accommodate movement induced by changes in temperature, ie expansion or contraction of the structure.
- To accommodate movement associated with the settlement of a new building.
- To accommodate movement induced by variable loadings exerted on elements of a building.
- To facilitate the easy erection of components on site, ie to accommodate tolerance and set-out variations.
- To provide architectural expression.

For a building to perform its basic function of providing shelter, any joint between two elements of a building must be sealed from the ingress of wind, dust and rain whilst allowing the elements to move independently of each other.

As well as performing the obvious task of excluding weather from a building, the materials chosen to seal these joints may also be required to perform to specific requirements relating to:

- fire resistance;
- chemical resistance.

The ability to gain future access to the joints may also need to be considered when evaluating sealant materials.

Precast cladding joints may need to satisfy many or all of these requirements. Some cladding, such as glass fibre reinforced cement or plastic, is more slender than conventional reinforced concrete panels and thus more vulnerable to large and rapid thermal movements. These cladding materials are often less absorbent than traditional building materials, hence more rainwater will run down the wall face.

Sealants in the joints between such cladding panels are therefore called upon to keep this increased water flow out, as well as accommodating larger and more rapid thermal movement.

JOINT DESIGN

The theory behind joint design is outside the scope of this article; however, it must be pointed out that a high percentage of joint-sealant failures occur because the movement in the joint exceeds the design parameters of the joint sealant – the movement accommodation factor (MAF). Consultation with sealant manufacturers at the design stage of the building will ensure that the sealant ultimately chosen will perform over a long service life.

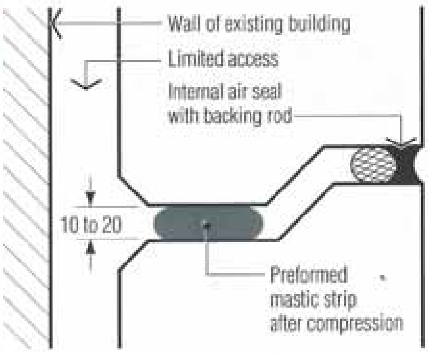

FIGURE 1 PREFORMED MASTIC STRIP

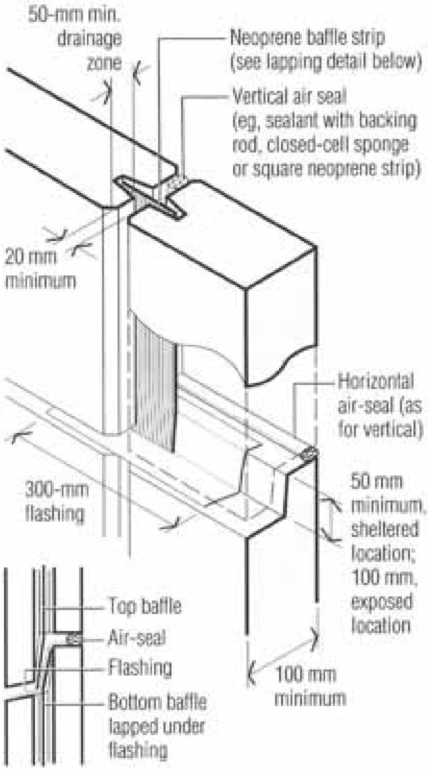

FIGURE 2 OPEN-DRAINED JOINT

JOINT SEALING MATERIALS

Precast concrete cladding construction has enabled designers to become more imaginative in their design and as a result, joint details are sometimes complex. To assist in this area, sealants come in a variety of forms and each has specific characteristics to ensure its suitability in a given structure.

Field-Moulded Sealants, often known as gun-grade sealants, are by far the most common form of sealant used today. These materials are applied onto a prepared joint as a semi-viscous compound which cure to a flexible seal adhering to the faces of adjacent panels. Suitable for vertical, horizontal and overhead joints, these gun-applied materials provide an easy, economical solution to sealing most joints.

These types of sealants come in a variety of forms and material types: one-part; multi-part; polysulphide; polyurethane; silicones; acrylics; and hybrid materials. All have their advantages and disadvantages (often depending on whether you are a specifier or contractor); however, the following is a guide to the most commonly held views for each.

One-part sealants – easy to apply, economical, no concerns over mixing (as with multi-parts), wide choice of chemical type (polyurethane, silicones, hybrids, acrylics). Because most of these products cure by reaction with atmospheric moisture, they can be quite dependent on climatic conditions, especially relative humidity, and prone to unpredictable cure rates. Some hybrid materials are now available which cure by reaction with oxygen in the air and as such are much less susceptible to uneven cure due to changes in the relative humidity. Most modern one-part sealants (with the exception of acrylics) will accommodate greater than ±25% movement over extended cyclic periods and this generally relates well with the movement requirements in cladding applications. Acrylics have much lower MAFs (between 5% and 10%) and are suitable only for low-movement joints. One-part sealants can unfortunately be prone to splitting and adhesion failure due to early movement of the panels being sealed; thermal movement for example is continuous as the ambient temperature rises and falls throughout any day. For a one-part sealant to perform in the long term, it must first survive this movement during its cure period – up to three or four weeks in some cases. Performance-based specifications such as ISO 11600 (which are independent of chemical type) are being acknowledged throughout the world as relating the performance of sealants to actual service conditions. As these specifications are adopted in Australia, the decision as to which sealant is best suited to an application will be much clearer.

Multi-part sealants – although not as easy to use due to the need to mix the components – can be more economical as far as product cost. The most significant benefit with multi-part sealants, though, is the cure rate. The mixing of a curing agent throughout the base polymer ensures that the sealant mass cures at an even rate through the sealant rather than forming a skin and curing inwards as is the case with one-part sealants. This generally means the sealant is able to accommodate earlier joint movement – an important factor to consider with precast panels. Polysulphide and polyurethane are the most common chemical types.

As with the better one-part sealants, most multi-part sealants suitable for use in cladding application are capable of a ±25% MAF over extended periods.

Preformed strips *Figure 1* – these products may be simple impregnated foams for applications between components where limited movement is expected and generally exposed to less-severe weathering. The foam can be placed during or after erection of panels.

A type of preformed strip often overlooked is the preformed mastic strip. These products can be very useful where access to the sealing slot is difficult after erection, eg precast panels to a new building being erected alongside an existing building.

Open-drain joints *Figure 2* – this type of joint requires the incorporation of a baffle strip into a slot cast into the edges of the precast panel. Whilst effective in limiting the ingress of rain through a joint, the open-drain joint is more costly and makes the panels more difficult to erect on site. Tolerances are critical to their success, as is a minimum joint width of 20 mm to prevent capillary action.

Baffle strips are generally made from PVC or neoprene and ribbed on the 'weather side' to limit rain being forced behind the strip in high winds. Any rain reaching the strip simply drains down its length to a short length of horizontal flashing (300 mm) at the bottom of the joint.

CONCLUSION

The decision on how to seal joints in precast cladding is not always clear. There are various methods of sealing joints, and each has its place depending upon the construction method, and sometimes the location. The sealant manufacturers offer technical advice free of charge and by taking advantage of this service at an early stage of the building process an informed decision can be made as to which sealant best suits the application. ■

OVERCLADDING AND GRC

Due to its light weight, its capacity to reproduce the most sophisticated of architectural shapes and its general toughness, glass fibre reinforced cement (GRC) is an excellent medium for use in facade renovation and building extension, particularly where there is a need to reproduce surface detail.

The panel face can be made to match the colour, texture and profile of almost any material and surface. Using a range of moulding techniques the panels can duplicate extremely complex shapes and patterns.

Many facades which require renovation are located in congested city areas where space for construction activity is severely limited. To this end, the advantages of GRC as a lightweight panel product are invaluable. The options extend from:

- relatively small panels capable of being manhandled into place or by the use of small winch, to
- large panels where lifting equipment may be needed; here, the advantage may be the limited number of fixings required. This may allow fixings to occur in those areas of the facade where support for the element is available.

A number of projects, both in Australia and overseas, serve to highlight the

technique. Some of these are discussed very briefly:

Overcladding of a Brisbane Facade *(above)* The use of a simple box-shaped panel, enclosing the existing structure, providing sun screening and a plain facade having lateral emphasis.

Rebuilding a Classical Facade *(top right)* This Glasgow (UK) structure, completed in 1898, featured a steel and brick structure with faience cladding. Gutted by fire in 1981 with little damage to the building exterior, the building remained empty until 1989 when developers decided to refurbish to provide office and retail accommodation. Part of the scheme required complete removal of the faience and replacement with GRC, the panels to exactly match the original detail. GRC was chosen on the criteria of weight, construction costs and the ability to recreate the existing detail.

Some 300 different panel types (including handed versions) were required, while a total of 435 panels were manufactured. Typical mullion pier panels had face dimensions of 2.45 x 2.35 m with a 100-mm zone depth for ribs and a general 15-mm skin thickness, all in a white portland cement finish. Typical cornice panels had face dimensions of 3.95 x 0.65 m with particularly complicated and detailed features creating an overall depth of panel of between 750 and 1050 mm.

To reproduce exactly certain features on the face it was necessary for the manufacturer to take rubber moulds on site prior to the facade being removed. Panel weights were generally of the order of 200–300 kg up to a maximum of 870 kg for certain cornice-type panels. All fixings were of stainless steel, with generally two support brackets taking vertical load and lateral wind load. Two top-restraint fixings take just lateral wind load.

Facade Refurbishment Plus Bonuses A recently completed refurbishment contract near Paris has cleverly combined the renovation of the facades of a number of apartment buildings with an upgrading of the facade's thermal performance. The project featured nine 11-storey apartment buildings and used some 9000 m^2 of Cem-Fil, GRC cladding.

Thermal improvement was achieved by glass fibre insulation, mechanically fixed to the original building surface prior to overcladding.

Facade Restoration, Chicago, USA
(below) From photographs of the original building, a sculptor reproduced the spandrels and column capitals. Rubber moulds were also made of portions of the facades and of the existing deteriorated column covers. Plaster positives and subsequent rubber moulds were made from these impressions for use as moulds for the GRC elements. The original terracotta finish was matched with the GRC.

All sitework and erection had to be performed at night due to the high level of pedestrian and vehicular traffic by day. This resulted in a deliberate choice of large GRC panels to provide quick closure. The photograph shows completed cladding to the column, cornice and entablature.

Adelaide refurbishment *(above)*
Involved refurbishment to previous plain brick facade using: GRC infill panels on steel subframes to three levels below windows; GRC fascia to replace sheet metal fascia; and GRC, two-piece pediments.

CHAMFERS

The sophisticated moulds available for architectural and structural precast concrete mean that the variety of shapes and effects is limited by little more than the designer's imagination.

It must be borne in mind, however, that precast units have to be finished, stripped, stacked, turned, loaded, carted, erected and lined up. During each of these procedures the unit is exposed to the risk of damage. Damage caused by relatively minor bumping or pressure will be all but eliminated if all external corners are chamfered (12 mm is enough) rather than sharp **Figure 1**.

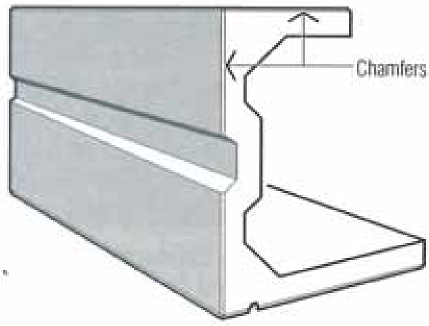

FIGURE 1 PRECAST PANEL SHOWING CHAMFERS TO VULNERABLE EDGES

Observance of this guideline will obviate the need for extensive minor patching and is therefore highly recommended.

NEW PRES!

At its AGM, the National Precast Concrete Association Australia elected Godfrey Smith – Managing Director, Structural Concrete Industries Pty Ltd – as its new National President, succeeding the retiring President, Carol Beresford of Beresford Concrete Products Pty Ltd, to whom the industry extends its grateful thanks for her dedication and enthusiasm. *Pictured are left to right, Godfrey Smith, Carol Beresford and John Burke (Founding President).*

CATCHING THE TRAIN

The State Rail Authority, NSW is continuing its programme of station upgrading and, in the process, making good use of the inbuilt advantages of precast concrete construction.

Such upgrading projects involve complicated timetabling to minimise track closure. Hence, any construction system which can measurably reduce on-site work and minimise possible inclement-weather effects must be considered.

At Concord West station, platform rejuvenation features the use of customised box culvert units, laid on a prepared sand bed. After partial backfilling with sand, the culvert units doubled as services ducts accessed via removable covers, whilst providing the platform structure.

Repetition of unit size and shape is well recognised as offering economic advantage for precasting insofar that the greater the number of castings which can be made from a mould, the more effective is the cost amortisation of the mould.

What is apparently less well recognised is that repetition of unit and process, very significantly speeds up the on-site component of the work. In the Concord West project, the ability to complete over 100 linear metres of platform over a long weekend emphasises the superiority of precast construction.

OVERALL VIEW OF APPLICATION – UNITS LAID ON SAND BED, THEN PARTIALLY BACKFILLED. NOTE CURVED PLATFORM.

MEMBER PROFILE

NINE-STOREY STRUCTURAL PRECAST FRAMED BUILDING WITH 33 000 m^2 OF HOLLOW CORE FLOORING – BY AUSCORE

Auscore Concrete Pty Ltd is a Melbourne-based precaster, having its manufacturing plant at Tyabb on the Mornington Peninsula, some 53 km south east of the Melbourne CBD.

Auscore is a privately-owned diverse product manufacturer, formed in the late 1980s, initially to produce the versatile and economically recognised hollow core plank for use in walling and flooring.

At that time, hollow core planks, whilst widely accepted in the construction markets of other State capitals, had virtually no impact on the Melbourne scene.

Through marketing and manufacturing research, and a new 'built from scratch' plant, Auscore was able to provide a very efficient production and customer service operation, winning its first supply contract at the beginning of December 1989.

The onset of the recession quickly convinced the company's Directors that it needed to diversify its manufacturing base to provide a much broader product range.

With its extensive prestressing capability, Auscore was soon producing prestressed beams for significant buildings, and quickly expanded to include a full building system of columns, beams, flooring, wall panels, lift and stair shafts, stair flights, etc.

Auscore's Managing Director, Mr Bob Attwater, believes that the company's contribution to the building industry in such difficult times was to offer a complete and total precast building system to suit the customer's specific requirements, and to be able to do it cheaper and quicker than the more traditional alternative 'insitu' systems.

Auscore provided complete or partial building re-design where necessary, and sought out potential projects still in their development stages that were suited to a precast system.

YESTERDAY'S HOLLOW CORE PANEL CASTING BEING LIFTED FROM THE BED AFTER SAWING INTO THE REQUIRED PANEL LENGTHS

One of the most significant benefits of a total precast building is the minimal time required on site to erect the structure to a stage where the builder can commence with his finishing trades, and hence to an early completion of the building.

However, this does not mean that the builder can delay in making important decisions on sub-contracts, structural and architectural details, and expect that time wasted in the early stages can be made up by the precaster. Early decisions result in the necessary lead time to achieve a more effective and efficient structural design that is integrated with services and other requirements of the project.

Nothing is more frustrating for the precaster than to be chasing the builder around a construction site and watching site excavation and other preliminaries occurring without a commitment to detail that will give the necessary lead time. Many excellent opportunities for the builder and developer to reap the benefits of a precast system are lost because of their preoccupation with digging a hole rather than ensuring that early decisions are made on a system, and that good documentation is prepared.

Auscore Concrete has successfully manufactured and erected total precast structural systems ranging from single offices or factories to multi-storey offices in excess of 35 000 m^2 of floor area with a precast value of several million dollars.

One such large total precast structure is the Australian Taxation Office in Box Hill, east of Melbourne. This structure, which has three levels below ground and six above ground, used over 35 000 m^2 of hollow core floor planking, 200 three-storey columns, 600 beams, 120 stair flights, and over 600 wall panels, all of which were precast in Auscore's production facilities at Tyabb.

Once manufactured, precast can be competitively transported. Having assisted in the development of an economical multi-storey car park system, Auscore was able to supply the precast for these systems into Canberra and Sydney, as well as their local Melbourne market.

In addition to building systems and components, Auscore has captured a significant amount of civil works, with the largest such contract being the supply of precast tunnel liner blocks for the North Western Trunk Sewer under Melbourne. This 3.85-m-diameter pipe is assembled in a bored underground tunnel in 1.2-m-long rings, with five precast segments in each ring. 41 100 segments were made for this project, and Auscore demonstrated its ability for mass production of precast by producing 96 separate segments each day, six days per week.

This production was achieved in addition to the company's commitments to its building systems and hollow core production, and maintained Auscore as the leading consumer of cement for a single batching site in Melbourne!

With the current upsurge in Melbourne of expenditure in civil works, principally freeways and significant projects such as the Grand Prix circuit at Albert Park, Auscore is proudly taking on its share of Melbourne's progression from the most depressed capital city and state, to matching it with the best of them.

As builders and developers recognise more and more the enormous benefits of minimising 'on-site' work – and maximising off-site work by placing their confidence in precast, where better quality and cost controls can be achieved – the role of precast in continuing to develop this nation will grow.

However, not being one to be complacent with the achievement of his company to date, Auscore's Managing Director, Bob Attwater, sees great opportunities for continuing improvements to building systems and project management by developers recognising the potential contribution available from the precaster. By being invited to join the team at a very early stage, and well before the project is ready for the appointment of a builder, the precaster can use his considerable experience to the benefit of the developer.

Unfortunately, the greatest barrier to achieving such co-operation and efficiency in Australia is the obsessive mistrust between all parties in this industry, and the adversarial approach to 'screw the subbie' or he may dare to contemplate a profit.

Auscore Concrete, like all precasters, is here for the business, but also believes that it has a product and a system that has benefits even beyond those currently being exploited.

We welcome your approach, even before we approach you.

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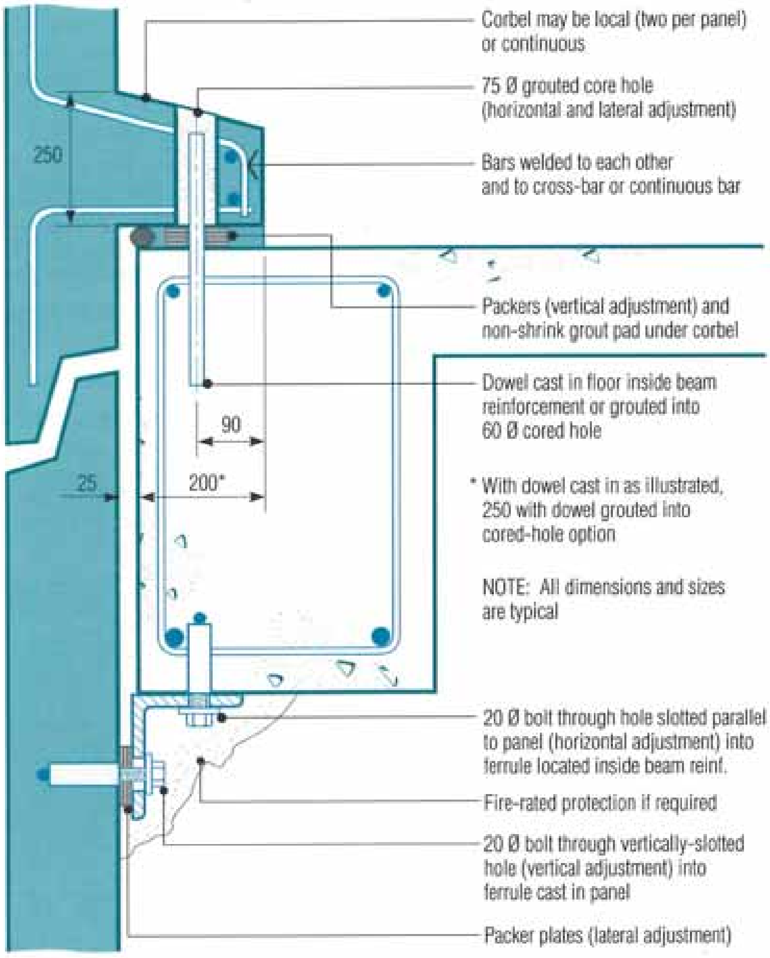
Quality Assurance Policy Statement

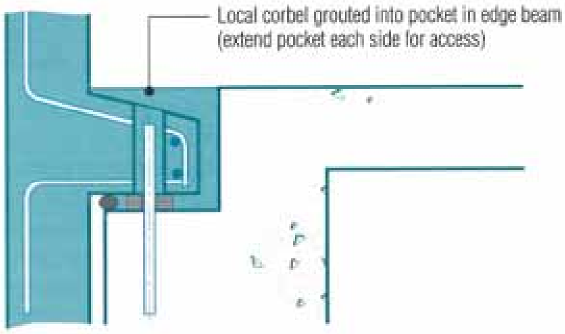
The Association supports, encourages and advises members in their efforts to achieve and satisfy clients' quality and quality assurance requirements. This Association and its members are committed to providing real quality and quality assurance to users of precast components in accordance with the specification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

TYPICAL DETAIL

CONCRETE HAUNCH OR CORBEL WITH ANGLE CLEAT TIE-BACK

- *Preferred fixing for economy, speed of erection and for fire rating*
- *May not be the optimum solution if units are made face-up and haunch location varies considerably or there are only a few units in the job*
- *See AS 3600 Section 12 for design rules*





ALTERNATIVE DETAIL FOR MAXIMUM RENTABLE SPACE

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