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NATIONAL PRECAST CONCRETE ASSOCIATION AUSTRALIA

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VODAPHONE Gives Precast a Call

International telecommunications service provider, Vodaphone has chosen precast concrete construction for their new state-of-the art customer care centre at Kingston, Tasmania.

Vodaphone's decision for one of Tasmania's leading building companies, Bells Constructions and Technologies Pty Ltd to design their building primarily in precast, resulted in this $12m project being completed under programmed time in ninety six working days.

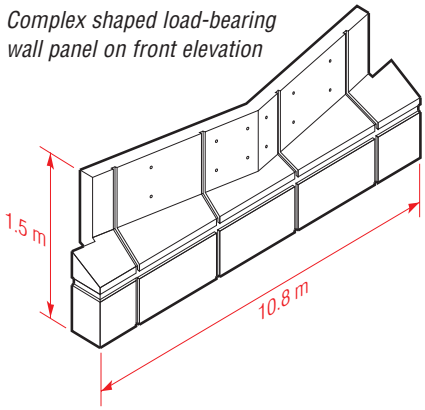
Features of the project:

- **Project cost** $12m
- **Floor area** 6400 sq m
- **Building description** Single level suspended slab and slab on fill. Supported by subfloor basement/ retaining precast walls. Precast concrete facade supporting structural steel roof framing with metal clad roofing.
- **Precast content** Manufacture, supply and delivery of architectural facade panels, structural header beams and retaining wall panels.
  No. components 140
  Largest panel weight 17 tonnes
  Total tonnage 800
  Concrete grade 40 Mpa
  Finish Class 2
  Features Dummy joints, panel returns, window rebates, structural interface.

The key reason for the speedy construction cycle of this project was clearly choosing off-site precast manufacture. Duggans Pty Ltd, a third-generation Tasmanian company formed over 65 years ago have their under-cover casting facility only 40 km from the project site; this facility offered the benefits of a large storage area for stockpiling components, tilting steel casting tables providing edge lift capability thus allowing minimum 1 day casting turnaround of moulds. The builder, Bells Constructions and Technologies Pty Ltd made the optimum use of this rapid manufacture cycle by erecting each of the panel elevations every 2 days, and in some cases achieving 15 minute installation time per panel. ■

Front elevation of painted precast wall panels in Vodaphone Building

Complex shaped load-bearing wall panel on front elevation



Erection of 6.3 m x 4 m window panels on Vodaphone Building

ACN 051 987 181

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Fire-rated polyurethane joint sealing in the seating platts of Stadium Australia, Sydney

JOINT SEALANTS A Grass Roots Look

Joint design and detailing in precast concrete cannot be overemphasised. Joints between cladding units are of various types – open-drained, gasket, face-sealed, and compression seal. This article focusses primarily on the performance of face-sealed joints.

GENERAL

Thin concrete panels can undergo dimensional changes in more than one plane and both the joint size and the selected joint sealant must be able to accommodate the movement.

The sealant industry has come a long way from the days of relying only on butyl or oil based mastics and pitch or bitumen hot applied joint fillers. Sealants today have become an integral part of the structure, reaching beyond just weather and water-proofing, they must now be mechanically and structurally supportive, fire and acoustically rated and provide high adhesion strength qualities. There is no one 'do it all wonder drug' sealant that can be utilised to cater for all the joint sealing contingencies we encounter in the industry.

The sealant's role, first and foremost, is to be a sealant. The 'add on' benefits of being fire, acoustic, chemical resistant, potable or immersible certified are the next step priorities.

Some sealants have displayed excellent 'add on' properties but often failed in the fundamental 'in service' requirements of being a good, long term durable sealant.

Specification authorities, engineers, architects, developers and construction contractors are advised to consult with the various sealant suppliers to ensure they are specifying the correct sealant for their specific need. They should obtain independent evaluations if and when necessary to confirm their selection.

Prior to specification or selection of any sealant the specifier should establish if any past case histories are available on applications similar to the one now under consideration. If possible, establish if there are any current projects in the local vicinity that can be inspected to see how the sealant to be considered is performing.

Technical and product information bulletins and test certification should be sourced from the manufacturer to evaluate the sealants properties in relation to the 'in service' parameters to which the sealant will be subjected.

Specification authorities and their clients are asked to understand the nature of the possible 'in service' conditions the sealant will be subjected to, and, in conjunction with the preferred sealant supplier establish a reasonable and sensible evaluation of a life expectancy in any given application. Once the specifying authority has established the criteria requirements of the sealant, the selection of the correct sealant can be made.

SEALANT TYPES

There are two categories of sealants available on the Australian market:

1 High performance sealants

Polysulphide (PS), Polyurethane (PU), and Silicone (SR).

Polysulphide was the general joint sealant market leader for many years in masonry applications both above and below water. Due to their availability only in two part, not fire rated, requiring a primer in all applications, high initial cost and slower application time, polysulphide sealants have taken a reduced position in the market.

Polyurethane now leads the way in all masonry and construction building materials joint sealing applications other than glazing. Available in both one and two parts, fast and standard cure with fire rating, acoustic, potable water and sewage certifications, polyurethane is the first choice of most specification authorities.

Silicones with their unparalleled UV light resistance will always be irreplaceable in structural glass curtain wall and glazing applications. Silicone based sealants are generally not considered suitable for masonry applications due to their poor history of surface staining and questionable long term adhesion capabilities to porous substrates.

2 Plastic or plastoelastic sealants

Acrylic sealants being water based and deemed more 'user friendly' will always be in demand wherever possible but their poor long term movement characteristics combined with curing shrinkage, limits their applications to internal low movement joints.

Butyl sealants in both gun and preformed extruded grades are used mainly in bedding or compression seal applications.

Dry jointing systems such as the open-drained type using rubber or PVC baffles are still very popular with some precast facade jointing. These joints require good tolerance factors for panel manufacture and placement and the requirement of a rear internal air seal..

JOINT DESIGN

To ensure a joint sealant selected can perform to the optimum level, correct joint design, preparation and application technique is vital. When designing joints and presenting them for sealant application it is often assumed that they will be installed in ideal weather conditions, the substrates will be in perfect condition, and joint design configuration will be exactly as presented in the final drawings. This very rarely happens, however, by adhering as closely as possible to the '**Golden Rules**' one can hopefully achieve the best possible sealant installation which will prolong the life of the joint.

There are four '**Golden Rules**' of good joint sealing:

1 Correct joint preparation

Substrate clean and dry, surface temperature above 5°, if masonry, fully cured and correct primer applied if necessary. Early introduction of sealants onto 'green' concrete can result in severe bubbling, and adhesion loss.

2 Correct sealant backing systems

All sealants to perform to their optimum movement parameters must adhere to only the joint sides and never adhere to the base. Foam backing rods or bond breaking tapes should be used to ensure two-sided adhesion only.

3 Correct joint geometry

Correct sealant geometry is another critical path area to ensure longevity of the selected sealant.The depth of sealant should never be less half the width, and never greater than the width. (This may vary in narrow (10 mm) or wide (40 mm) joint applications).

4 Correct joint into service time

This relates to the time sealant takes to cure through their depth and width. These factors are very important especially in relation to early traffic introduction or when a sealant is to be fully or partially immersed in service. Standard curing polyurethanes will cure at a rate of 2/3 mm of depth a day in temperatures over 5°; fast curing versions and two part systems will be fractionally faster dependant on their curing mechanism. Acrylics and silicones will surface skin relatively quickly but will then have a slower cure through depth time resulting in a slower into service period.

FIRE AND ACOUSTIC RATED SEALANTS

Fire-rated sealants

The requirement for fire-rated sealants arose with the banning of mineral fibre wool products from the Australian building sites in the mid to late 1980's.

Initially the water based acrylic products were the only available option utilising technology primarily from the UK Although these products provided the necessary fire rating conformity it was quickly acknowledged that they had many shortcomings. They suffered severe shrinkage on curing,which often produced splitting and cracking with the resulting loss of joint geometry and therefore compromised fire rating minimum depth/ width ratios. The other major problem was their inability to accept high joint movement which was heightened as they aged.

It was with these shortcomings the sealant industry recognised the need for advanced technology in fire-rated sealants. This prompted manufactures to formulate elastomeric sealants with fire rating capabilities. Initially silicone led the change, but polyurethane with its overall advantages higher fire rating conformity, cost effectiveness and ease of application soon established itself as the market leader.Acrylics are still quite acceptable in areas of low movement and away form direct or constant UV light attack. As it does not require priming, polyurethane is still the first choice in all areas of external and internal fire-rated movement jointing.

Acoustic sealants

The requirement for sealants to provide acoustic sound transmission class (STC) rating values has increased dramatically with the higher emphasis on noise and sound transmission reduction in residential, hospitality and commercial properties.

The ability of a sealant to provide an STC acoustic rating evolves primarily from the specific density it achieves in the cured state. Acrylic achieve on average 1.6, Polyurethane approximately 1.5 and Silicones 0.97.

It is generally accepted that the higher the sealant density, the better the STC rating.

As with fire-rated sealants the initial choice was acrylics but the critical factor in maintaining acoustic integrity was often being compromised when sealant adhesive or co-adhesive failure was experienced.

One part fire-rated polyurethane is now the first choice by the acoustic industry in Australia for acoustic joint sealing in a multitude of substrates.

This achieves two goals, it assures fire-rated capability without compromising the long term adhesion and flexibility required in jointing to maintain STC integrity.

SUMMARY

It is the responsibility of sealant manufacturers to ensure their technical data is correct, truthful, up to date and the products promoted are 'fit for purpose'.

There is also an equal obligation on the specification authority to design the correct joint configurations aligned to movement expectations. This will ensure the sealant selected has a greater chance of performing to its formulation characteristics.

Choosing the right sealant for the right application the first time will save considerable cost, labour intensity and client frustration when repair or replacement contingencies must be employed due to a poor initial sealant selection. ■

JOINT SEALANT PROFILES

Correct Joint Design		Incorrect Joint Design	
	Good joint width/depth profile ■ Concave sealant surface ■ Depth/width ratio correct		Joint too deep ■ No bond breaker or back up ■ Poor geometry for movement
	■ Bond breaking tape eliminates adhesion of the sealant to the base of the joint		■ No bond breaker ■ Sealant adheres to base of joint, thus creating a cohesive tear when movement occurs
	■ Backing rod has now increased width at the base of sealant allowing sealant greater ability to compensate		■ Cohesive tear sealant can only compensate for movement at the narrowest point. Tear may develop if movement exceeds sealants limits at the neck of the joint

City Condos, 24 level condominium block being constructed in St Kilda Rd, Melbourne

PRECAST – the Answer for Multi-level Units

With the social changes of Australians wishing to live closer to both the city and workplace, there has been a huge upsurge in apartment construction. Developers and builders have responded to this change, whether it be low-rise or high-rise structures, by utilising the advantages of precast construction for speed of construction and design flexibility.

The surge in use of precast construction in residential apartments commenced in the early 90's, starting off with one of Melbourne's leading developers substituting the cladding on a project initially designed in masonry block with load bearing precast wall panels. Precast was not acceptable originally because of condensate problems which were overcome with external walls by supplying an air gap and furring channels with no direct adherence of the plasterboard on to the concrete.

A particularly innovative feature of multi-storey construction in Victoria has been the use of loadbearing panels for external and division walls providing frame action to serve both a cladding function and a structural function. Moreover, columns and beams are eliminated and the structural integrity of the building is preserved by using post-tensioned flat soffitt slabs. With all precast walls being vertical load bearing structural elements, economy is gained by keeping the vertical load path down to the ground as straight as possible. ie walls are designed on top of walls all the way down to the ground.

This style of construction achieves staggering reductions in floor turnaround cycles from 10 days to 5 or 6 days for most high rise projects; planned coordination with the precaster can ensure that wall panels, covering a floor area of up to 2000 square metres, can be erected in one day.

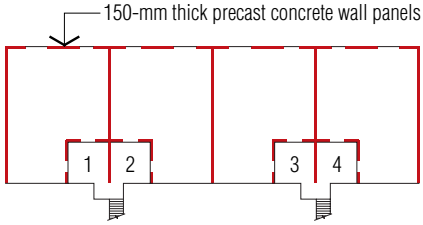
Speed of construction is one thing, but additional economy is obtained with eliminating beams by reducing floor heights to 2.65 m, thus providing additional floors for the same building height.

This combination of smart engineering, practical architecture and competent precast manufacturing techniques realises huge savings in construction time, scaffolding and reduced site labour. Precast construction improves potential savings if designers take into account the following principles:

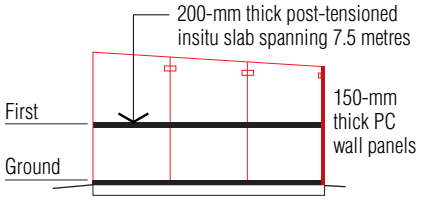
- Keep the construction as simple as possible.
- Maintain repetition to reduce mould cost and allow familiarity of handling, erection and fixing techniques.
- Maximise lead time available to work on design, with consideration to efficient manufacture and erection techniques which can then be coordinated with other trades, also making their job easier.

In summary, major property developers like Central Equity Limited choose precast construction for these reasons:

- For efficient building program times.
- Enables off-site productivity to continue in wet weather.
- Value which flows through to a more affordable quality product for unit owners.
- The superior aesthetic appeal from polished and sandblasted finishes. ■



FLOOR PLAN



CROSS SECTION

Typical elevation and cross section for residential precast concrete construction

24 Level apartment block, Southbank Condos under construction in Melbourne's Southbank

GRC New Release of Recommended Practice

GRC is increasing it's usage in Australia as designers, specifiers and contractors become more familiar with it's properties and characteristics.

GRC is a composite material, consisting of a mortar of hydraulic cement and fine aggregate reinforced with alkali resistant glass fibres. The product may contain additional filler materials, pozzolanic materials and admixtures to assist workability and improve curing conditions. GRC is a material that combines the high compressive properties of a cementitious mortar with significantly increased impact, flexural and tensile strengths imparted by the glass fibres.

GRC is normally a relatively thin, cross-section material giving elements manufactured from it a low component weight, which provides advantages when transporting, lifting and installing the product. Nonetheless, its density is in the order of 2000 kg/m^3. The product rates well in terms of durability, chemical and fire resistance.

The most recognised application of GRC in Australia is in wall cladding; generally the composite (chopped fibre and matrix) is sprayed onto a mould with the resulting panel then being attached to a steel stud frame for structural support and attachment.

Spraying of this fine-aggregate matrix allows for the capture of surface detail capable of replicating the most complex of surfaces. Additionally, a range of surfaces finishes and textures together with integral colour are available. Additionally, the lightweight nature of GRC, makes it ideal for use in the overcladding of existing facades in refurbishment and repair programs.

Ceiling panels and noise barriers both able to be decoratively moulded to give visual interest and expression are further applications. At the other end of the spectrum, drainage and electrical accessories such as pits and ducts are produced by the technique of vibration casting.

The GRC Group of NPCAA has published a manual entitled ***Recommended Practice for the Design, Manufacture and Installation of Glass Reinforced Concrete***, which is available from the NPCAA for $70.

This comprehensive manual covers design, manufacturing and installation aspects relevant to the GRC industry and is based upon overseas and local technical information together with manufacturing procedures current in Australia. The main aim of the Recommended Practice is to set down all requirements fundamental to the design and manufacture of GRC necessary to obtain acceptable levels of safety, serviceability and durability.

The Recommended Practice examines and discusses in its 15 chapters a wide range of aspects including: Materials for GRC, GRC manufacture, Curing, Physical Properties, Design requirements and Procedures, Establishment and Quality Control, Contract Considerations, Handling, Erection/Installation, Surface Finishes and Vibration – Cast GRC.

GRC REACHES NEW HEIGHTS

Most Australian cities have many examples of the use of GRC as an exciting cladding facade material. One of the recent additions to the Sydney skyline is the 'Excelsior Apartments' project which is presently under construction close to Sydney's Central Railway Station. This is an example of the visually pleasing appearance and cost-effective construction offered by GRC facade cladding.

The 164 apartment project features some 14 accommodation levels, a shopping centre at ground level and 4 sub-ground levels of carparking and services. The GRC panels on this project created a facade 3 metres in front of the walls of the residential units. The balcony space in between the two forms an outdoor entertainment area.

Loading one of the twelve 25 m length, 65 tonne precast columns for the Roxby Downs site

CARING for Copper Concentrate

WMC, developer of the giant $1.9 billion Olympic Dam Expansion Project, chose a precast concrete option last year when deciding on the design of an 1000 tonne elevated copper concentrate bin for its copper processing facility. The bin stores copper concentrate prior to feeding into the flash furnace within the new smelter which was constructed as part of the expansion project.

Features of the precast construction included:

- 12 no. 25 m length 1.2 m x 1.2 m width columns, weighing 65 tonnes each.
- Each heavily reinforced (Y 32 bars) column fitted with 'wings' at 3/5 height to facilitate connection to adjacent columns and provide bracing for structure.
- One column cast every 3 days from timber moulds.

Such massive precast elements required special attention in freighting from Adelaide to the site with the use of extendable trailers.

Erection of this structure provided another set of challenges that were met successfully as a result of close liaison between the installer and the precaster.

The erection sequence was arranged in three phases with a trio of columns stood up in a purpose-designed triangular lifting frame, thus allowing the wing sections of the columns to be readily spliced to brace the structure.

Installation and precast manufacture was carried out by prominent Australian civil contractor, Thiess Contractors Pty Ltd and NPCAA Member, Constress Pty Ltd respectively. ■

The 1000 tonne copper concentrate bin after installation

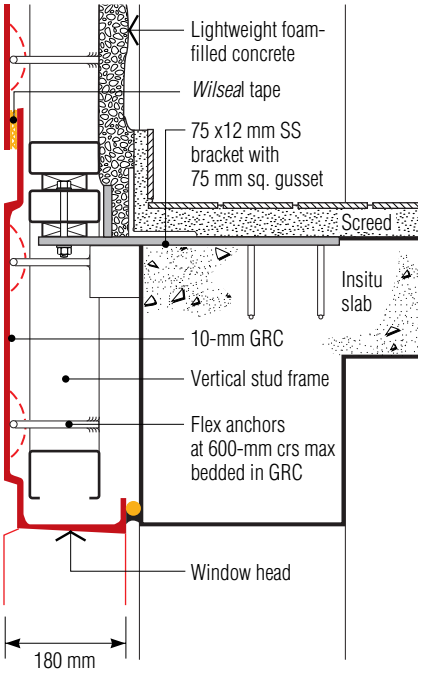


Figure 1 *Vertical section – junction of GRC panel with slab edge beam*

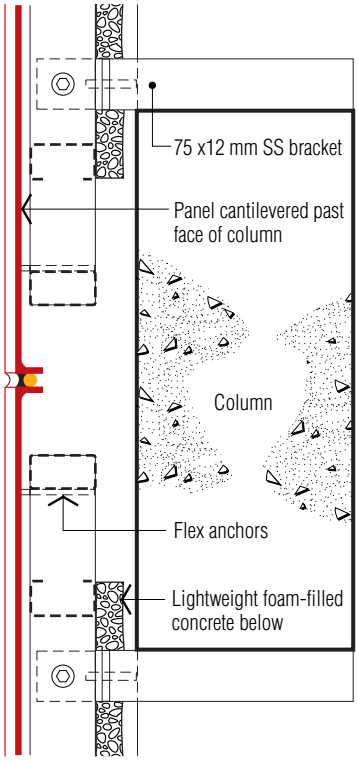


Figure 2 *Plan view – junction of panel with edge beam*

Because panels were visible on both sides, the back also had a GRC skin. Panel construction consisted of a 12 mm outer skin attached to a steel frame with vertical C150 studs at 600 mm centres. The core of the panels was filled with a lightweight mix of styrene pieces and cement. A GRC rear skin was poured on top of this to give a total panel thickness of 180 mm.

Some statistics on the project:

Building height 50 m
Floor area per storey 1150 m^2
Face area of GRC panels 4600 m^2
No. facade panels spanning floor to ceiling 356 off
Largest facade panel 7 m long X 3 m high
False columns 1 m long x 3 m high, 154 off
Balustrade 11 m long x 1.5 m high, 24 off
Weight facade panels 91 kg/m^2
GRC mix design:

Matrix ratio (cement:sand) 1:0.66
Water/cement ratio – 0.26
Polymer addition – 2 litres per 100 kg of total matrix
Cem-FIL AR glass fibre – 4.6% of total matrix

Panels were finished smooth faced and prior to dispatch were given one coat of Grano Impact with a stippled finish followed by a spray applied second coat of Grano Impact. A final, roller applied coat was applied on site.

Figures 1 and 2 indicate the fixing and support system for the panels using a stainless steel corbel arrangement. ■

Excelsior Apartments under construction. Builder – Multiplex, GRC supplier – Asurco Contracting Pty Ltd, Adelaide.

NPCAA

National Precast Concrete Association Australia

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NEW MEMBERS

The President, Directors and Members of NPCAA welcome the forthcoming support of these new members in further consolidating the status of the precast concrete industry.

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Reinforced Earth Pty Ltd Supplier of retaining wall systems and precast arch structures.

ASSOCIATE MEMBER

Erico Products Australia Pty Ltd National supplier of reinforcement splicing systems.

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