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TIPS



**CEMENT & CONCRETE** ASSOCIATION OF AUSTRALIA

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# Discarding the Frivolous

## Quinlan House at Margaret River, Western Australia

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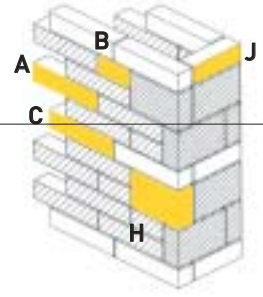
Located on a semi-rural, semi-suburban site in Margaret River, this house was designed for young clients, both inventors. From the outset, the project for a new house, was an opportunity to discard the frivolous and use the everyday in extreme.

The building is set back 100 metres from the street, but its unobtrusive aspect is quickly dissolved by a fortress-like, concrete masonry, parapetted front wall. The private spaces of the house are located behind, strung along the hallway in a linear manner. Despite its solid appearance, the wall, which was the last part of the house to be constructed, is non-loadbearing cavity construction with reinforced cores. It has four expansion joints at 8-m intervals, which are purposefully covered by large down pipes. The modular spacing dictates the pattern of fenestration, which is centred between each stretch.

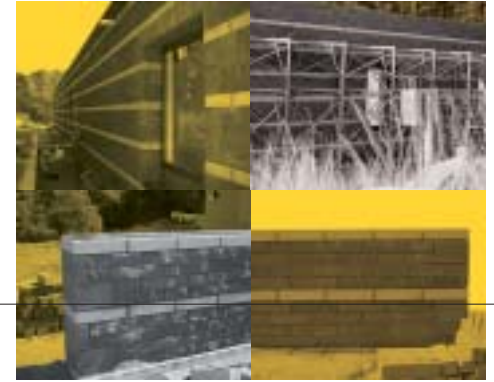
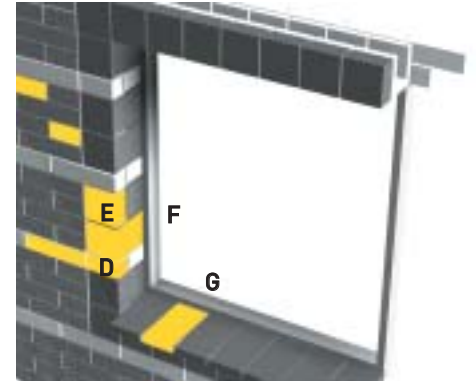
The use of concrete masonry contrasts with the rendered clay maxi-brick houses nearby and is emphasised by scale, texture, pattern and colour. This was achieved using a range of solid and hollowcore blocks, selected from standard proprietary ranges in the 100-mm, 150-mm and 200-mm series.

Nine different sizes were used in all and careful selection of the units allowed a 450 mm-thick wall to be designed and constructed in a lego-like manner. To assist the construction process, rendered axonometric drawings were supplied to the builder, numbering the different block

**A** 390x90x90 SPLITFACE CARBON **B** 190x90x90 SPLITFACE CARBON **C** 390x90x90 SMOOTH LIGHT-GREY  
**D** 190x90x90 SMOOTH LIGHT-GREY **E** 190x190x90 SMOOTH CARBON **F** 290x190x190 SMOOTH CARBON  
**G** 390x40x190 SMOOTH CARBON **H** 290x190x90 SMOOTH CARBON **J** 290x90x90 SMOOTH LIGHT-GREY [mm]



lia



sizes, colours and face textures. On-site progress was relayed back to the Perth office by digital construction shots sent via email.

The majority of the wall is constructed of 390 x 90 x 90 mm-thick units across a 220-mm cavity to achieve the desired effect of blowing up the scale of the wall by approximately 200%.

Split-faced carbon-coloured blocks were laid in a stretcher bond pattern for three courses, to suggest the appearance of an exaggerated, tumbled clay brick. Mortar was colour-matched to the dark grey of the blocks to unify the masonry as a single 600 mm-high band. The rusticated treatment was further emphasised using smooth-faced, light-grey 100 mm-high blockwork with struck jointing, to separate the bands like an over-scaled bed joint.

The modular dimensions of the blocks also offered flexibility with the construction. For example, the standard 40 mm-thick sill blocks were rotated 90 degrees and used as capping

blocks to span the over-sized wall cavity.

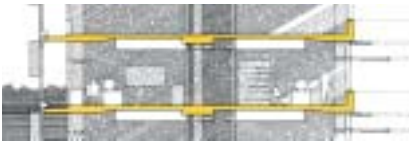
The major construction cost related to the design of details to reinforce the wall's thickness. For example, doors and windows were pushed to the inside face of the wall, allowing the coloured banding to wrap around the full depth of each opening. Reveals were further ornamented by varying the unit size and shape. Similarly, the ends of the wall, which use an arrangement of rectangular quoining, are highlighted by the use of smooth-textured blocks. Double-width lintel beams were specially fabricated and reinforced to flash off the openings and span the extra width.

Within the context of the clients' brief, concrete masonry is cost effective, provides essential insulating, thermal and fire resisting properties and is a durable choice for a rural setting exposed to strong southerly winds and cool nights.

In addition, they give this modest home the appearance of something else.

**ARCHITECT:** Kelly Rattigan  
**Architectural Services**  
**COMPLETION:** 2003  
**STRUCTURAL CONSULTANT:**  
 Burdett & Associates  
**BUILDER:** Gerrard Waddell  
**BLOCKLAYER:** Shawn Scales  
**BLOCK SUPPLIER:** Boral Besser  
 by Midland Brick [08 9273 5124]  
**ARTICLE:** Kelly Rattigan  
**PHOTOGRAPHY:** Rene Van Meeuwen





1 *Oblique end elevation*

# GPN3 St Lucia Campus, University of Queensland

## Pixellated Precast Brise Soleil



2 *View of the Forgan Smith Building from GPN3*



3 *GPN3 elevations to the western aspects*

The General Purpose North 3 Building (GPN3), designed by Peddle Thorp and Harvey Pty Ltd in association with Donovan Hill Architects, is an innovative tribute to the University of Queensland's built heritage.

The original campus masterplan was laid out by the prominent Sydney architect Jack Francis Hennessy and dates from 1936. Originally a clear example of American collegiate planning principles introduced by Thomas Jefferson, subsequent building additions to the campus, have diminished its formal geometry and axial properties.

The design of GPN3 was intended to reinforce these historical themes and enhance sight lines to the Forgan Smith Building, the Great Court and Circular Drive.

The commission resulted from a short-listed design competition held by the University in 1999. The brief included a suite of seminar rooms, computer laboratories, academic offices, a computer centre, and a cooling tower to service the immediate precinct. The key objective of the competition was to design an energy efficient building that related to the aesthetic context presented by Hennessy's sandstone buildings about the Great Court. These buildings are within walking distance of the GPN3 site and are built with beautiful sandstone quarried from the Helidon region in south-east Queensland. The stone varies from rich purples, to creams and browns.

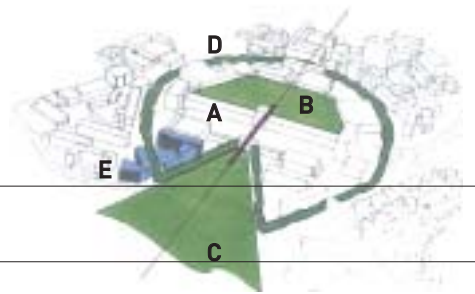
GPN3 addressed both aspects of the competition brief through the design of concrete precast brise soleil.

The plan form of the building is trapezoidal with formal elevations presented to the western aspects. Various entries to the building are located within an internal courtyard, which also acts as a more informal area typical to campus environments. Access to the upper levels is by lifts and a main stairwell situated within the western apex of the building.

The concrete structure, which is four floors high, has a partial lower ground level and a rooftop structure which houses plant machinery minimising noise transmission. Initially, the design team considered various structural options with a prestressed beam and partially-prestressed slab assembly selected to increase spans, optimise column spacings and offer serviceability and flexibility in future floor layouts. Fixed connections were nominated at beam/column interfaces to minimise slab thickness and deflection. The ends of prestressing units are cleverly hidden behind the precast solar shading panels, whilst the



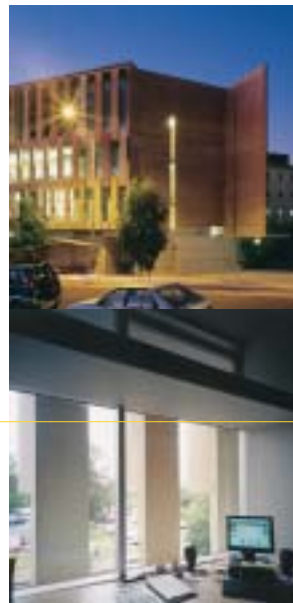
Original campus masterplan



A. Forgan Smith Building  
B. Great Court  
C. Forecourt  
D. Circular Drive  
E. GPN3



4 Random colouring



5 Transparency



6 Precast awning components



7 Pixellation

upstand profile of edge beams improves the transparency of external walls.

The cladding assembly comprises floor to floor precast panels which are typically 600 mm wide, 150 mm thick with a Class 2 off-form finish. The repetition of this component provides vertical stress to the facade. But importantly, the pixellation that is achieved through a seemingly random variation in the colour of the individual panels, serves to reinforce a visual relationship between GPN3 and the original sandstone buildings. Integral colouring was achieved using a 3-4% oxide addition, colour-matched by *Concrete Colour Systems* in Brisbane.

Off-white cement was used for both precast and insitu off-form elements, such as external columns and loadbearing walls, in order to optimise colour consistency between the two. Off-white cement and grey oxide were even used to ensure Class 2 colour consistency of elements intended to feature as plain grey

concrete. Colour variation was assessed against pre-agreed tonal ranges in full-size test panels cast in discrete locations within the structure.

The profile, depth and alignment of the precast components was confirmed through numerous design iterations to optimise the building's solar protection, whilst maximising views to the outside. A specialised connection and tolerance adjustment system, which was developed by the project team, allowed for the installation of the precast components to be taken off the critical path of the building programme.

The precast concrete elements that envelop GPN3, provide an economical skin which delivers a high-level energy efficient structure. Their thoughtful resolution has resulted in a building, which reinforces its place as a confident and dignified member of the existing campus community, whilst strengthening some aspects of its heritage fabric.

ARCHITECTS: Peddle Thorp & Harvey Pty Ltd in association with Donovan Hill Architects  
COMPLETION: 2003  
STRUCTURAL CONSULTANT: McWilliam Consulting Engineers (now Qantec McWilliam)  
BUILDING CONTRACTOR: Walter Constructions  
CONCRETE CONTRACTOR: Boral Concrete  
SPECIALIST CONSULTANTS: Precast Concrete [07 32712766] Concrete Colour Systems [07 32876444]  
PHOTOGRAPHY: Jon Linkins: images 1,2,5  
Chris Stacey: images 3,4,6,7  
ACKNOWLEDGEMENTS: Brian Donovan, Timothy Hill, Frank Way, Peter Melloy, Diana Lilley, Colin Ginger  
ARTICLE: John Tuxworth



# Specifying Concrete Masonry

## Introduction

With concrete masonry, the structure and finish is installed in a single step. A significant benefit of designing with concrete masonry is its versatility of finished appearance, which can be varied with the unit size, shape, texture and colour, bonding pattern, mortar colour and joint type. This specification guide focuses on ways to optimise the design of durable masonry for domestic use.

## Selection of Masonry Units

Most walls are subject to lateral forces such as wind, induced shear forces caused by minor settlement of foundations, and in some instances, more-severe forces resulting from earthquakes.

The main types of masonry walls are single leaf, veneer and cavity walls and the structural assembly required, will inform the selection of the concrete unit. For example, load bearing capacity is increased by grout-filling, whereas vertical and horizontal reinforcement increases resistance to shear forces generated by large horizontal loadings or bending stresses over openings.



## FURTHER REFERENCES

Masonry units are manufactured and tested in accordance with *AS4455 Masonry Units & Segmental Pavers* and *AS4456 Methods of Test*.

Compliance with *AS3700 Masonry Structures* requires specification of the masonry unit, bond pattern, mortar, jointing, wall ties, reinforcement and grout strength. Specify mortars in accordance with Table 10.1.

## Concrete Blocks and Bricks

Concrete blocks and bricks are formed in steel moulds with modular dimensions controlled within small tolerances. Recent developments have led to increased water absorption resistance by the concrete units, through the incorporation of pre-sealing additives and efflorescence inhibitors, which reduce lime-leaching and discolouration.

Architectural concrete units can be integrally coloured by adding mineral oxide pigments. A wide range of proprietary colours and face types are available, and customised finishes are possible depending on the quantity required. The colour and texture of units varies between manufacturers, and if consistency of appearance is required, units should be purchased from the same source at the one time.

The thermal insulation of concrete is primarily derived from the minute air voids in the matrix and masonry units of lower density concrete, will have higher thermal resistance because of the greater voids content. Lightweight or coarse-textured blocks will improve sound absorption for reverberation control. The resistance to salt-attack by the masonry unit will be determined by the prevailing weather conditions and the nature of the environment.

## Mortar Bond Strength

Whereas clay masonry units tend to expand, concrete masonry units shrink, and if used with a mortar with high shrinkage, cracking may result. The bond strength between the mortar and masonry unit is a priority in masonry construction, and is critical in unreinforced masonry subject to lateral loads. Although manufacturers test and report the compressive strength of the concrete unit, this property has no bearing on its bonding properties, which is determined by surface characteristics, pore structure and suction properties.

The compressive strength of mortar should be less than the masonry unit, but must attain sufficient bond strength with the units to accommodate their thermal expansion and contraction. This action helps to minimise water penetration, as well as provide unreinforced masonry with resistance to lateral loads.

## Specifying Mortar

The best mortar mixes for concrete masonry have consistently been shown to use clean, sharp, well-graded sand with no clay content and incorporate a water thickener. The following serves as a guide:

1. The type of mortar should match the masonry unit and its bonding characteristics;

2. Mortar strength should be less than the strength of the masonry unit;
3. Mortar must possess sufficient durability in aggressive environments such as marine areas or in external walls below the damp proof course;
4. Additives should not replace lime, since lime makes the mortar creamier, easier to use, improves bond strength and minimises cracking;
5. Chemical admixtures must be used carefully as overdosing reduces bond strength and masonry performance;
6. Materials should be measured accurately by volume and not by the shovelful;
7. "Brickies loam," fatty or dirty sands should not be used, as they contain clay particles which make the mortar more workable, but cause high shrinkage and reduce bond strength;
8. Mortar should be thoroughly mixed in a mechanical mixer, hand-mixing is not sufficient;
9. Mortars should be used promptly within half an hour of mixing. Adding water to restore reworkability, reduces the mortar's quality and masonry performance;
10. Mortars benefit significantly from being properly cured. Covering the wall with a plastic sheet after laying will improve bond strength, reduce micro-cracking and increase water-tightness.

## Laying Masonry

Lay units in the specified bonding pattern as follows:

1. Solid and cored units are laid on full bedding with the perpend joints completely filled with mortar;
2. Hollow blocks are laid with face shell bedding and no mortar is laid on the web i.e. two strips of mortar are laid over the face shells and continue up the perpend;
3. Mortar bed thickness for normal masonry is generally 10 mm;
4. Mortar joints should be tooled to give a dense, water-shedding surface;
5. Hollow unit ungrouted masonry must not have raked joints;
6. Solid bricks are well suited for designed joints, and/or if raking is required;
7. Non-standard joint profiles and bonding patterns require careful consideration in order to achieve good bonding and flexibility in the masonry;
8. Mortar bed thickness for special masonry using a thin joint, for example, autoclaved aerated concrete masonry, should be between 2 and 4 mm and to manufacturer's proprietary recommendations.

ACKNOWLEDGEMENTS: Alan Pearson, Adele Brooks

Further C&CAA references include: *Datasheet: Masonry Bond Strength*, July 2003 and *Housing Concrete Handbook*, June 2000. Also refer to the *Design of Concrete Masonry Buildings*, a joint publication between CMAA and Standards Australia in 1999.

# Concrete Tracery

## Holes in the Masonry Tradition



GRIFFIN 1919

WRIGHT 1926

SUMMERHAYES 1958

HOWLETT 1969

NOUVEL 2003

In traditional masonry construction, the building structure serves as an unornamented finished surface.

For instance, nineteenth century polychromy produced taut brick skins, bustling with the energy of diaper work and pixellation, as if stretched like a textile over the pilasters, buttresses and blind arcades. Textile block technology, developed in the late teens and 1920s, translated this strobing optical quality into a more modular arrangement, as for instance demonstrated by the articulated structures produced by the Griffins, Perret and Wright. In the post-War period, perforated concrete technologies literally embedded this geometry as a series of crystalline holes within the fabric of the wall.

Known variously as concrete tracery, sun grilles, stock-pierced, hit-and-miss and honeycomb walls, concrete masonry blocks and precast grilles, were instantly in the mix, offering cost savings and speed of erection.

In Australia, the range of available products skyrocketed from 1954, with the manufacture of high quality concrete masonry by Jayworth Besser Ltd in Adelaide. The consumer-driven demand for ribbed, split-faced and patterned screen blocks spread to Victoria where, by 1959, the high speed production plant at Dandenong was chugging out in the order of 50,000 units a day.<sup>1</sup> By December 1962, the use of brise soleil was *Touché le cliché!*<sup>2</sup>

The popularity of concrete blocks and grilles during this period is understandable. At a time when "tectonic flush" was kept to a minimum, the technology provided a formal strategy to unlock the building mass as a series of planes and animate the blind planar ends which were typical of the 1950s enclosed box form. Any survey of club buildings or industrial offices will confirm this; as will a study of

housing in the smaller tropical dominions, where concrete was the mass material of construction.<sup>3</sup>

Some projects were to suffer from the architect's insistence to use as many products as possible, and all at once. Elevations were self-conscious, overworked, jam-packed with a surfeit of ideas. In others, perspective and depth of field were once again an issue in the work.

In the hands of some architects however, the blocks and grilles provided grist to investigate the transparency and enclosure of the courtyard house. At its best, the thermal mass, insulation and shape of the concrete was determined by the particularities of local climate to address fundamental concerns such as cross-ventilation, light filtration, and the subdivision of views. The results were construction-oriented, economically-based, spatially-cohesive, and had a hint of empiricism which was no doubt inspired by the CSIRO's *Notes on The Science of Building*, which were widely read at the time.

In Western Australia, a series of beautiful, mainly flat-roofed, solar-planned courtyard block houses were developed by architects such as Cameron Chisholm & Nicol, Iwam Iwanoff, Howlett & Bailey and Geoffrey Summerhayes. In Queensland and NSW, the technology was equally safe in the hands of Peter Heathwood, John Dalton and Peter Muller, whose integrated response to material, technology and craft, is a key measure of their skill.

These architects showed a new sensitivity to pavilion planning and openness: 'If you couldn't bring the outside in you'd put some outdoors in the middle by having an internal court'.<sup>4</sup> Concrete offered a constructional vocabulary to link exterior and interior as part of the same composition. New synergies began to develop in details such as breezeways, internal partitions and loggia walls, which were more

than regularly patterned dabs of light. Mute pavilions could be cemented shut in stack-bond, or opened-up by extended running-bond which slipped past glazing, or went on to adopt a numerical or chequerboard pattern in the manner of a string course.

Recent projects by Jean Nouvel in Barcelona and Steven Holl in Boston may well represent a resurgence of these ideas, where the structure and skin are recombined, albeit at a colossal scale.

<sup>1</sup> *Cross Section*. University of Melbourne. Issue No.80 June 1 1959.

<sup>2</sup> See *Cross Section's* account of the 1962 RAIA Queensland Chapter Awards in Issue No.122 December 1 1962.

<sup>3</sup> See *New Buildings in the Commonwealth*, edited by J.M.Richards. The Architectural Press. London. 1961.

<sup>4</sup> *Modern Houses: Architect Designed Houses in Western Australia from 1950-1965*. UWA. 1997. p.31.

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## Re-useable Precast Panels

S d i l

A new ambulance station located in Bairnsdale which is 285 kilometres east of Melbourne, features re-usable concrete walls. The building is rectangular in plan form, with precast concrete panels to the north, west and south walls, and girt and metal deck wall cladding to the east. Contributing to the selection of the concrete system, was the requirement for an economical extension of the building at a future stage, in which case the north and south panels are capable of being removed and re-used with no waste.

The panels are in the order of 13 m long by 2.5 m high allowing for the installation of a single panel to enclose the full width of the building. Weighing-in at approximately 14 tonnes each, the panels are self-supporting, bolted back to the steel frame for stability. The panel thickness was increased to 200 mm to eliminate condensation and increase the building's thermal mass. The external finish of the precast panels is embedded terracotta tiles, achieved using the US Scott System Inc Brick Snaps™. The tiles are integral to the concrete, eliminating the need for weepholes or lintels associated with conventional masonry. High-strength 40-MPa concrete was used to provide a high quality concrete finish, which was left exposed internally and finished with a clear sealant.

Brick snaps are plastic templates arranged in standard brick configurations. In this instance, 295 x 92 x 15 mm-thick tiles are arranged in a vertical stack bond pattern and the overall dimensions of the panels worked to whole tile modules. Despite this, some wastage was encountered due to the difference between the manufacturing tolerance of the clay tile to that of the templates which meant that all over-size tiles were not able to be used. While only two tiles in the entire project were damaged through installation, these were replaced using traditional tiling techniques.

The use of precast concrete at RAV Bairnsdale offered cost savings associated with speed of construction and ease of installation. In addition, the cladding and finish was installed in a single step, with long-life cost benefits.

ARCHITECT: Field Consultants in association with Tim Hall & Associates  
COMPLETION: 2003

STRUCTURAL ENGINEER: Tim Hall and Associates

BUILDER: Southon Builders Pty Ltd

PRECAST CONTRACTOR: HL & BJ Venables Pty Ltd

BRICKSNAP SYSTEM/TERRACOTTA TILES: Daniel Robertson

ARTICLE: Peter Brew, Tim Hall



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