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NATIONAL PRECAST CONCRETE ASSOCIATION AUSTRALIA WEB ADDRESS: www.npcaa.com.au EMAIL: info@npcaa.com.au

President's Message

The past year has been a very exciting and progressive time for our Association. A number of significant changes have been made, including a modernised image and an enhancement of the content of *National Precaster,* a completely revamped and more user friendly website, a new Constitution, and the appointment of our new Executive Officer, Sarah Moore.

Sarah replaces our retiring Executive Director, Brian Mallon. Brian has been with the Association for almost six years. During this time he has worked tirelessly to protect the interests of the precast industry and raise the awareness and use of precast within the construction industry generally.

On behalf of the Board of Directors and Members of the NPCAA, I would like to express my thanks to Brian, for the excellent work he has done during his tenure and wish him a happy retirement.

Sarah's background in both construction and associations, makes her perfect for the role of Executive Officer. We are excited to have Sarah come on board, with a set of skills and experiences which we believe will benefit the direction the Association is taking.

Our AGM and Conference was held in Perth in November 2003. This was the NPCAA's 13th Conference and included a number of outstanding local speakers, presenting subjects associated with the use of precast in the construction industry.

Looking forward to the coming year, the prospects for the precast industry throughout Australia is very encouraging indeed. In fact, with the increase in construction activity throughout Australia, and the acceptance of precast as a preferred construction system, the use of precast has increased to a level seldom seen in recent years. The main growth area is the use of precast as a structural element, primarily in medium to high density multi-storey residential buildings.

A great deal of credit for this development goes to the efforts of all Members of the NPCAA, designers, engineers, builders and contractors in the construction industry who have recognised the advantages in building with precast concrete.

The objectives of the Association are to continue to maintain a high standard of technical publications, to actively promote the expertise, service and product range of its Members, and to continue to provide educational material for consultants and academic institutions.

Matt Perrella
President

LIBERTY TOWERS reaches new precast heights in SA

By floor area, Liberty Towers is the largest single building site in South Australia.

As the first almost totally precast concrete building development in Adelaide, Liberty Towers is breaking new ground in the South Australian construction industry.

Located on the foreshore at Glenelg, the development consists of 258 residential apartments in the twelve above-ground stories over a four-storey basement. With a gross floor area of more than 43,000m2, Liberty Towers is the largest single building in South Australia by floor area.

Architecturally, the development is strikingly different from surrounding buildings. Eighty five percent of its façade is glazed, and stark white external exposed precast blade walls and columns give the building a Mediterranean feel.

According to Niko Tsoukalas, Engineering Project Leader from Connell Mott MacDonald, numerous construction techniques were investigated together with Baulderstone Hornibrook. The decision to use the 'top down and up' technique was driven from a project finance perspective, as was the decision to use precast concrete extensively.

"Considerable time was saved by simultaneously constructing in two directions, where upward construction occurred while excavating and constructing the basement. The added time-saving benefits of using precast, together with its advantage of minimal propping and earlier fitout commencement, have resulted in considerable cost minimisation", says Niko.

"The superstructure is a unique design from a structural perspective as it utilises a significant amount of precast for the upper floor levels, compared to conventional local industry construction techniques".

The grid of the building is an 8.4m internal grid, which is split into a 4.2m external grid for architectural reasons. Precast wall/blade columns around the external 4.2m grid, and in-situ concrete columns on the internal 8.4m grid until Level 1, resist the vertical loads. Large precast concrete columns then support the building from Level 1 down.

Continued Page 5

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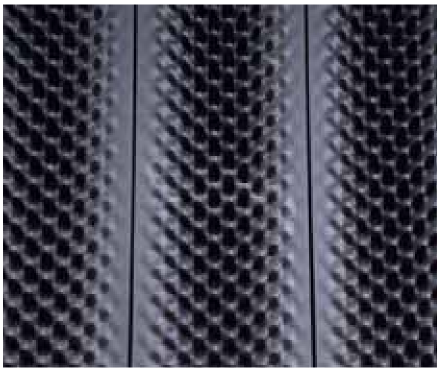
SELF-SHADING PRECAST
North and South
By Dr Edward L Harkness FRAIA FIEAust CPEng



An unlimited number of patterns can be created with shade–inducing precast concrete.

Introduction

The immense versatility of precast concrete can achieve significant energy savings by the use of relatively minor surface patterning. Reductions in incident solar radiation for various self-shading patterns are quantified for north and south façades in this article. Energy savings will be quantified in a future article.

Three dimensional patterns and figures have been formed on the surfaces of buildings by architects throughout history for decoration and making long term records. Australian architects have used off-the-form rope textures, unpainted ribbed patterns in off-white cement, and extraordinary three-dimensional surface patterns in projects such the National Museum in Canberra.

Simple horizontal and vertical profiles have been used in this article for the purpose of illustrating a method of calculating reductions in incident radiation.

Architects may use their creative flair to develop appealing patterns; keeping in mind that the effectiveness of a pattern would be dependent upon orientation.

Getting started

To get started, the architect needs to know the latitude and orientation of the façade, the intensities of direct and diffuse solar radiation at the required times of day and the thermal time lag of the precast panel.

In the case studies presented here, the latitude is 32.5 degrees South, the orientations are north and south and the thermal time lag of the nominally 170 mm thick precast panel is approximately 5 hours. Radiation intensities are for clear sky conditions.

A review of some simple options for self-shading patterns for a north-facing panel will be presented first, and then a review of a pattern for a south-facing panel will be made, in which the same pattern will be appraised in two arrays: one vertical and the other horizontal.

Vertical shadow angles (VSAs) and horizontal shadow angles (HSAs) of the sun were taken from a solar chart in R. O. Phillips' book *Sunshine and Shade in Australasia.*

Self-shading patterns for North

Figure 1 shows four options for the surface of a north-facing precast panel: a plain smooth surface, and three horizontal patterns annotated: Profile Type One, Profile Type Two and Profile Type Three.

The months selected for this study were November and January because the sun's vertical shadow angle in these warm months is lower than in December. Being lower, there is a greater challenge in achieving shade.

The hours at which the study was carried out were 10 am and 2 pm (being geometrically symmetrical) and 12 Noon. Note that the vertical shadow angle at 12 Noon for a north-facing panel is lower than at 10 am and 2 pm in November and January.

Whilst all of the calculations have been shown for each of the case studies, only those for Profile Type One will be discussed in detail in the text.

Given a thermal time lag of 5 hours, in order to calculate the heat gains internally that result from external conditions, the radiation effects and external air temperatures that prevail 5 hours earlier have to be taken into account. Thus to calculate conducted heat gains through the precast panels to size a/c plant as at 3 pm external conditions at 10 am would need to be known.

At the top left of Figure 1 is shown the plain face of a precast panel beneath which is presented the solar radiation data for clear sky conditions at a normal to the wall.

At 10 am in November and January the *Direct* component of solar radiation at a normal to the panel face Dp is 130 watts/sqm; and the *diffuse* component of solar radiation dp is 125watts/sqm.

The total solar radiation on that vertical face at 10am in November and January is 255 watts/sqm.

Of the three profile types studied the most effective was that shown at the top right in Fig. 1.

The calculations to be discussed below are those for the lower portion of the section detail Profile Type One annotated at the right by "10 AM".

Calculations for North

Because the face of the panel has been angled to face upwards by 31 degrees in order to provide shade under the projection above, this face is directed towards the solar beam and will be subjected to a higher intensity of radiation compared to a vertical plain panel. This higher intensity of radiation has been calculated using trigonometry in the blue triangle at the bottom right of the diagram under consideration. The angle of the face is arrayed to be 31 degrees closer to the solar beam. The corrected direct radiation is now 130 / cos 31 = 151 watts/sqm.

The area exposed to the direct component of solar radiation is shown by projecting the vertical shadow angle of the sun (83 degrees VSA) from the outer extremity of the shading projection above, onto the inclined face of the panel below.

The depth of this exposed surface on each of the 20 elements is 0.0099m. The total area of these exposed surfaces may be calculated by multiplying 0.0099m by the width of the panel (1.0m) and by the number of elements (20).

This area will also be exposed to the diffuse component of solar radiation, which is 125 watts/sqm. The radiation incident on the exposed area is the sum of the direct and diffuse radiation multiplied by the exposed area.

As shown beneath the second diagram from the left at the top of Figure 1 this is expressed as

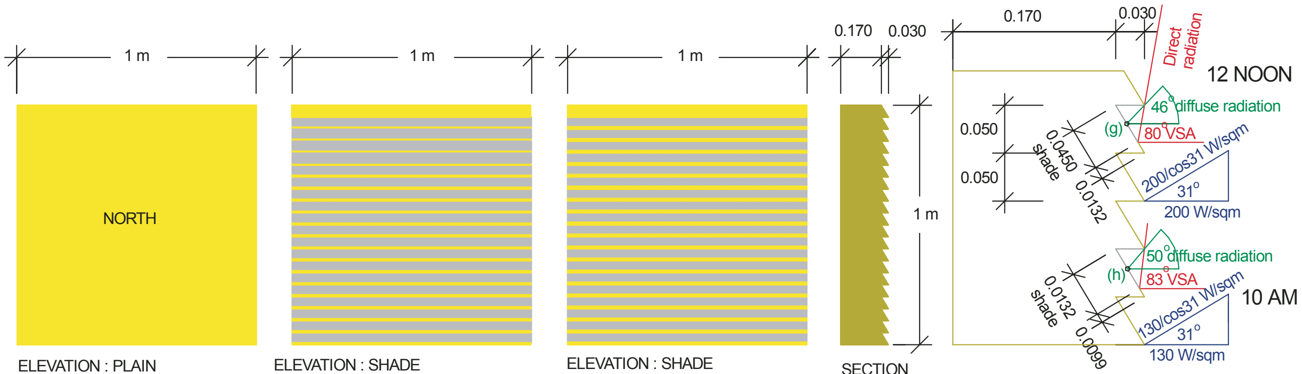
(Dp/cos31 + dp) x unshaded or exposed area
= (130/0.8571 + 125) x 0.0099 x 1 x 20
= 54.6 W/sqm

Note: The full figure of 125 watts/sqm has been added above because the shading of this area against the diffuse component is proportionally small.

Within the shaded area, which has a depth of 0.0132 m, some diffuse radiation will be incident.

From an average point or centroid (h) on that shaded surface an estimate was made of the quantity of diffuse radiation it would receive from the sky which is 50 / 90 x the diffuse radiation intensity (dp) x the area of shade = 50/90 x 125 x 0.0132 x 1 x 20 = 18.3 W/sqm.

The total incident radiation 54.6 + 18.3 = 72.9 watts/sqm is 71% less than on a plain faced panel.



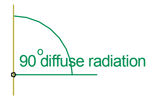
ELEVATION : PLAIN
NOV & JAN : 10 am & 2 pm
Clear sky radiation intensities
normal to the vertical plane
Direct D_p = 130 W/sqm
diffuse d_p = 125 W/sqm
Total = 255 W/sqm
NOV & JAN : 12 Noon
Clear sky radiation intensities
normal to the vertical plane
Direct D_p = 200 W/sqm
diffuse d_p = 140 W/sqm
Total = 340 W/sqm

ELEVATION : SHADE
NOV & JAN : 10 am & 2 pm
Radiation incident on unshaded area
= (D_p/cos31+d_p) x unshaded area
= (130/0.8571+125)x 0.0099 x 1 x 20
= 54.6 W/sqm
Radiation incident on shaded area
= % of sky seen from (h) x d_p x area
= 50/90 x 125 x 0.0132 x 1 x 20
= 18.3 W/sqm
Total = 72.9 W/sqm
71% reduction in incident radiation

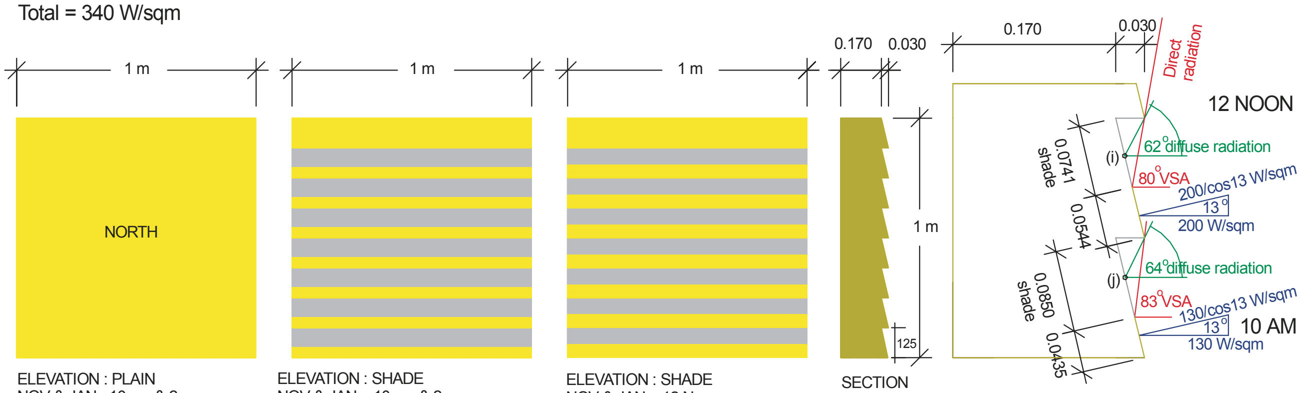
ELEVATION : SHADE
NOV & JAN : 12 Noon
Radiation incident on unshaded area
= (D_p/cos31+d_p) x unshaded area
= (200/cos31+140) x 0.0132 x 1 x 20
= 98.5 W/sqm
Radiation incident on shaded area
= % of sky seen from (g) x d_p x area
= 46/90 x 140 x 0.045 x 1 x 20
= 64.4 W/sqm
Total = 162.9 W/sqm
52% reduction in incident radiation

SECTION PROFILE 1

SECTION DETAIL PROFILE TYPE ONE



On a plain unpatterned vertical surface incident diffuse radiation intensity is 90/90xd_p



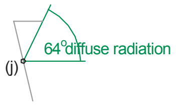
ELEVATION : PLAIN
NOV & JAN : 10 am & 2 pm
Clear sky radiation intensities
normal to the vertical plane
Direct D_p = 130 W/sqm
diffuse d_p = 125 W/sqm
Total = 255 W/sqm
NOV & JAN : 12 Noon
Clear sky radiation intensities
normal to the vertical plane
Direct D_p = 200 W/sqm
diffuse d_p = 140 W/sqm
Total = 340 W/sqm

ELEVATION : SHADE
NOV & JAN : 10 am & 2 pm
Radiation incident on unshaded area
= (D_p/cos13+d_p) x unshaded area
= (130/0.9743+125) x 0.0435 x 1 x 8
= 89.7 W/sqm
Radiation incident on shaded area
= % of sky seen from (j)* x d_p x area
= 64/90 x 125 x 0.0850 x 1 x 8
= 60.4 W/sqm
Total = 150.1 W/sqm
41% reduction in incident radiation

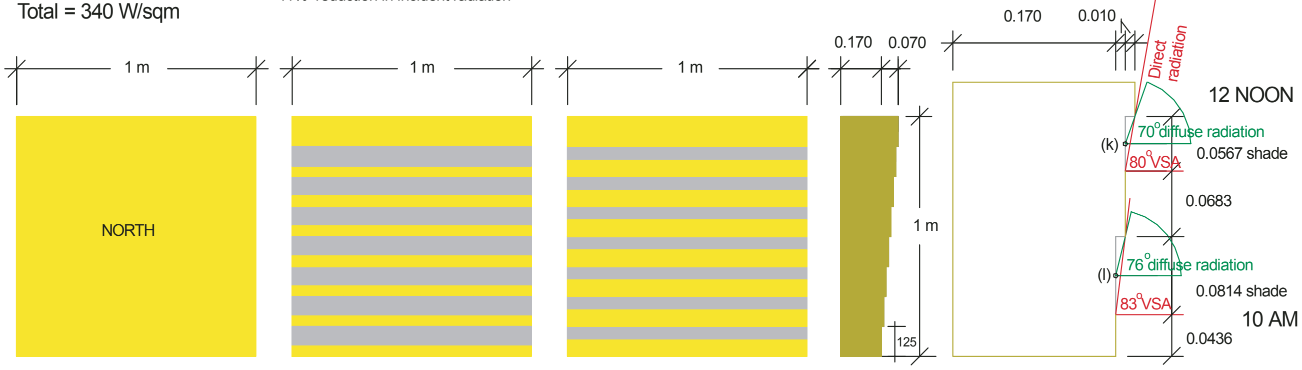
ELEVATION : SHADE
NOV & JAN : 12 Noon
Radiation incident on unshaded area
= (D_p/cos13+d_p) x unshaded area
= (200/cos13+140) x 0.0544 x 1x 8
= 150.1 W/sqm
Radiation incident on shaded area
= % of sky seen from (i) x d_p x area
= 62/90 x 140 x 0.0741 x 1x 8
= 57.1 W/sqm
Total = 207.2 W/sqm
39% reduction in incident radiation

SECTION PROFILE 2

SECTION DETAIL PROFILE TYPE TWO



*At 10 am the pattern reduces incident diffuse radiation intensity to 64/90xd_p



ELEVATION : PLAIN
NOV & JAN : 10 am & 2 pm
Clear sky radiation intensities
normal to the vertical plane
Direct D_p = 130 W/sqm
diffuse d_p = 125 W/sqm
Total = 255 W/sqm
NOV & JAN : 12 Noon
Clear sky radiation intensities
normal to the vertical plane
Direct D_p = 200 W/sqm
diffuse d_p = 140 W/sqm
Total = 340 W/sqm

ELEVATION : SHADE
NOV & JAN : 10 am & 2 pm
Radiation incident on unshaded area
= (D_p+d_p) x unshaded area
= (130+125) x 0.0436 x 1 x 8
= 88.9 W/sqm
Radiation incident on shaded area
= % of sky seen from (l) x d_p x area
= 76/90 x 125 x 0.0814 x 1 x 8
= 68.7 W/sqm
Total = 157.6 W/sqm
38% reduction in incident radiation

ELEVATION : SHADE
NOV & JAN : 12 Noon
Radiation incident on unshaded area
= (Dp+dp) x unshaded area
= (200+140) x 0.0683 x 1 x 8
= 185.7 W/sqm
Radiation incident on shaded area
= % of sky seen from (k) d_p x area
= 70/90 x140 x 0.0567 x 1 x 8
= 49.4 W/sqm
Total = 235.1 W/sqm
30% reduction in incident radiation

SECTION PROFILE 3

SECTION DETAIL PROFILE TYPE THREE

Note: Although the gray areas on the facades show shade against the direct component of solar radiation, those shaded areas receive some diffuse radiation as shown in the calculations.
In making the calculations it has been assumed that the panels are modules and that the top shading elements will also be shaded. There are 20 shading elements in Profile Type One and 8 shading elements in each of Profile Types Two and Three.

Fig. 1. Four facade options are shown for a north facing wall: a plain face, vertical faces offset one above the other, a weatherboard type angular offset and a saw tooth pattern in section. The saw tooth section provided the most shade for this northern orientation.

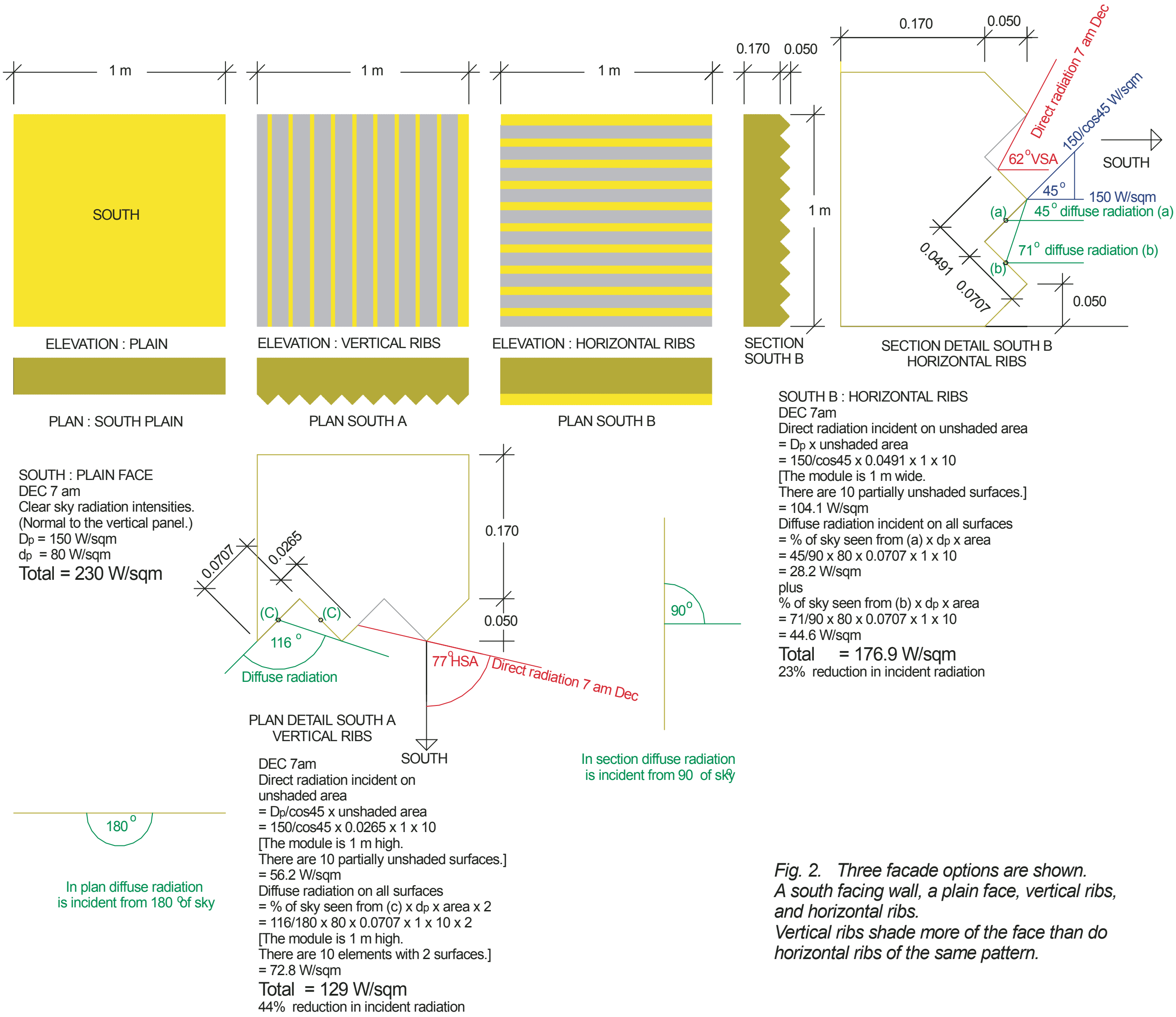


Fig. 2. Three facade options are shown.
A south facing wall, a plain face, vertical ribs, and horizontal ribs.
Vertical ribs shade more of the face than do horizontal ribs of the same pattern.

Self-shading pattern for South

Figure 2 summarises calculations for South at 7 am in December, which is the most critical month geometrically for this orientation.

Allowing for the 5 hour thermal time lag of the precast panel, the shading effects at 7 am would be required when calculating the envelope loads on the air-conditioning plant for 12 noon.

A profile pattern different from those used for north was assessed for a south-facing panel. This panel was assessed in two arrays: one horizontal and the other vertical.

On this occasion the area exposed to the direct component of solar radiation was only multiplied by the corrected direct component.

For the vertical southern array, the diffuse component was calculated by finding an average point on the surfaces (c) and assessing how much of the diffuse radiation from the sky would be incident on that average point. This is 116 degrees divided by 180 degrees. Both surfaces are so exposed.

For the horizontal southern array, the diffuse component was calculated for both surfaces at average positions (a) and (b) at which the vertical inclusive angles were 45 and 71 respectively. These were expressed as fractions of 90 degrees and multiplied by the intensity of diffuse radiation and the areas of those surfaces.

On this south-facing panel, the vertical array was almost twice as effective as the horizontal array in producing shade.

Summary

Three-dimensional patterns cast into the exterior faces of precast concrete wall panels could achieve significant energy savings.

A pattern may be more effectively self-shading for a particular orientation.

Self-shading patterns should be designed to be optimally effective for specific orientations.

Concrete façades are an ideal medium in which to create the patterns described here. Consequent energy savings can be realised without sacrificing any of the structural, architectural, fire or acoustic properties of precast concrete.

Acknowledgements

Appreciation is expressed to the following who made helpful comments on this article: Steve Hennessy, AHA Management Pty Ltd; Bruce Forwood, University of Sydney; and John Burke, Rescrete Industries.

Liberty Towers - Continued from Page 1

The floor systems consists of 1200mm wide by up to 8500mm long and 370mm deep precast-prestressed band beams. These are supported on 200mm thick precast blades or 400mm by 800mm insitu columns, which inturn support over 17,000m2 of 150mm thick precast pre-stressed hollowcore floor panels and 100mm thick precast concrete balcony panels. The system is tied together by a 70mm concrete topping over the hollowcore and 120mm topping over the precast cantilever balcony areas. Due to the extremely fast pour cycle, supporting the precast band beams via an innovative system of raking props to the main column lines, eliminates the problem of multi-storey propping. This supports each floor by floor, as the building is constructed, whilst the topping reaches full design strength.

Balcony units are made from off-form grey precast concrete, varying in size and shape, from a simple rectangular shape in plan, to a more complex curved layout, with the largest units being approximately 9000mm long and 1700mm wide. An in-situ concrete topping, profiled appropriately for drainage purposes, is cast on the top of the units, locking them into the structure. The underside of the precast balcony units forms the soffit for the balcony below.

The overall construction sequence involved firstly constructing diaphragm walls, then excavating barrette piles, carrying ultimate loads in the order of 8,500kN up to 25,000kN (note: barrette piles are rectangular piles, constructed in the same manner as a diaphragm wall). Precast concrete columns which are capable of supporting the full load of the building were then inserted, and barrettes were filled with concrete up to the underside of the lowest basement level (approx 11.25m below existing surface level). The remainder of the piles were then filled with low strength (1MPa) cement-stabilised sand mix. Having excavated down to the first basement level and poured slabs, upward construction on the precast concrete columns could then begin. Once strength was achieved in the transfer ground floor slab, the top down construction process commenced.

With all floors having been erected in only 8 months, Liberty Towers is a perfect example of the time-saving benefit of precast concrete, while minimising cost and maximising quality.

Design & Construct Contractors
Baulderstone Hornibrook.
Project Manager: Stephen Blewett
Total Engineering Consultants:
Connell Mott MacDonald.
Engineering Project Leader: Niko Tsoukalas
Architect: Woodhead International Architects.
Precast Supply: SA Precast P/L, Delta Corporation Ltd, Bianco Walling P/L, Marble & Cement P/L

HOBART waterfront on the move

The redevelopment of the old Dockside site on the Hobart waterfront is testament to on-going investment and interest by developers, and is evidenced by the establishment of Zero Davey and several other projects adjacent to the near-completed site.

A seven-level commercial/apartment development, the Zero Davey site rests directly opposite the once controversial, now widely accepted Federation Concert Hall. It boasts a unique location for people to enjoy everything the Hobart waterfront has to offer.

The building structure utilises precast concrete extensively, from column sections, lift and stair cores and external structural cladding to internal apartment party walls.

The project has become somewhat of a design-and-construct project for the builder, Fairbrother Pty Ltd, a firm noted for its extensive experience in the use of precast concrete throughout Hobart CBD projects.

External loadbearing wall panels cover almost the entire façade of the building, with the exception of the ground floor commercial business level which consists mainly of precast columns and glazing. The external 175mm thick panels were produced with an off form architectural finish, enhanced by the use of off-white cement. External panels contain a double layer of reinforcement, tied back to the insitu post-tensioned floor slabs with starter bars. These panels are connected to one another at panel joints both vertically and horizontally mid-height between floors,forming a safety balustrade on the third, fourth and fifth floors during construction, resulting in cost savings and increased safety. Other connection details include a typical dowel bar/grout tube arrangement and also the use of bolt fixed mild steel corner plates between panels. North and south elevations will see such panels clad with natural sandstone, blending the new with the old existing structures which are typical of the Hobart waterfront.

Of particular structural interest are some larger internal 175mm thick, 12 tonne stair shaft wall panels at the northern end of the building, forming cantilevers of around six metres to the northern exterior façade panels from level three through level six. These panels are connected to internal corridor wall panels using large 16mm cast in plates.

The project contains altogether some 400 walling and column components in lower ground retail space, 50 units/apartments, 6 sub-penthouses and 3 penthouses.

The commencement of a further two projects which are similar in size, confirms that the overall

Constructed extensively from precast concrete, Zero Davey enjoys everything the Hobart waterfront has to offer right on its door step.

interest in the Hobart waterfront and the surrounding Wapping area is far from waning. Although a rather sensitive area development wise, the mere fact that groups such as the Wapping Implementation Working Group are warming to redevelopment proposals put before them is extremely encouraging to all concerned within the industry.

Since the completion of the Old Woolstore Project, Federation Concert Hall and Silos Redevelopment around 1999/2000, new additions will include Zero Davey, Evans Street Redevelopment (26 apartments-250 precast components) and One Collins Street. Situated on the old Transport Authority site, One Collins Street was recently demolished to make way for a three-stage apartment development (approx. 70 units), containing upwards of 500 precast components.

Complementing such projects is an array of various smaller scale precast accommodation projects, to be built both on new sites and as interesting redevelopments of the old. This trend supports the growing understanding developers and builders are gaining relating to quality and the speed of construction gained from the precast product; a fact long known in several larger capital cities.

NPCAA member Duggans Pty Ltd has undertaken casting of precast components used in all of these projects. Most recently, production of the Zero Davey precast was manufactured concurrently with a student accommodation project. This project, which was undertaken by the builders Hinman Wright and Manser for the University of Tasmania, contained around 700 precast wall panels. This past year has been one of the more active in recent history for precast suppliers, with the horizon for 2004/05 offering varying projects, including the construction of a new prison on Hobart's Eastern Shore.

MEMBER PROFILE
Hicrete Precast

Since its inception in July 1986, Hicrete Precast (SA) Pty Ltd has established a reputation for the manufacture of precast concrete products and wall panels of the highest quality using innovative construction methods.

Façades are cast in Hicrete's modern Wingfield, SA facility

As a leader in the field of large scale precast wall panels the company has a commitment to continuing to maintain its quality standards using management methods which are both effective and cost efficient. Being quality assured to AS 3902, Hicrete manufactures and erects only those products which fully conform to the customer's requirements.

Through its ability to manufacture panels in its factory as well on site, Hicrete is ably suited to the rapid realisation of a wide range of buildings for industrial, commercial, residential and community use.

Façades are able to be cast in the factory, whilst plainer walls especially on the boundary can be site-cast with the subsequent cost saving. The combination gives the client the best of both worlds.

Hicrete Precast operates from a purpose built modern factory of $1,600m^2$ on $15,000m^2$ of land at Wingfield, South Australia.

Hicrete has a creative team capable of designing to your requirements and following right through to the completed project.

Depending on the project and the client's requirements, Hicrete offers either part of, or the whole completed project… even ownership with lease back facilities if you so desire.

A full free advisory service is available for feasibilities and budgets.

Services Available

- Precast Walling Systems
- On-site Walling Systems
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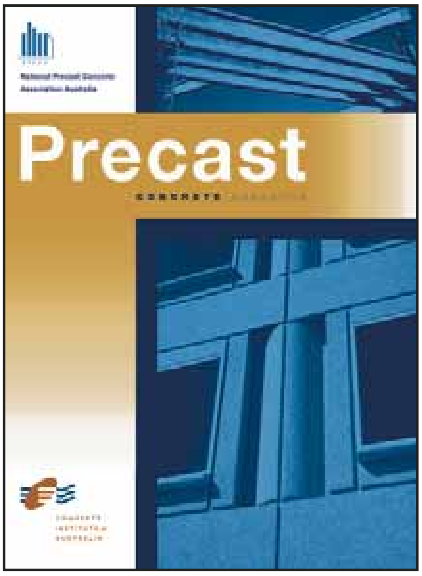

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National Precast Concrete Association Australia

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PRECAST NEW ZEALAND INC.

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