PREFAB architecture

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Going Tall and Slim

It has always been the trend for supermodels to sport extremely slim and tall features. The trend seems to have hit buildings too, looking at the new developments in the Newton area. And just like the supermodels, these buildings please the eye to a great degree.

The whole concept of going slender and high probably came about in Singapore due to land constraints but somehow this concept has developed into a bohemian look for the new developments. Take for example the Great Eastern Life Condominium (left). It has been described by its architects as a "slender box with a series of wall planes". The slenderness of the structure has been instrumental in getting over site constraints in the relatively populous district, and prefab construction has come to its aid to do wonders to smoothen the operation.

Another project highlighted in this newsletter, the Lincoln Modern (right), features a highly slender 107 m high block which is 12 m at its widest and only 7 m at the narrow end. Despite being tall and narrow, the units are in no way restricted. The architects have found the means to capitalise on the situation by coming up with spacious units that have that bohemian look that young couples these days want to live in.

Prefabricated construction goes extremely well with the tall and slim concept of the condominiums, and does not in any way restrict the appendages that seem to sprout from these buildings. Sun shading devices, bay windows, ledges, fins and steel staircases are some details that were not just easily tackled with prefab construction, but enhanced to precision by it.

As prefabrication techniques become more advanced, architectural precast concrete can be custom-designed to a variety of shapes, sizes and finishes. The two overseas projects featured in this issue go to great lengths to demonstrate the flexibility of prefabrication, emphasizing its role as a tool that creates unique architecture which cannot be achieved using insitu techniques.

by Punitha Govindasamy

Living in Style

by Gieto Sugianto, Associate Director (design)
Architects 61 Pte Ltd

Precast sunshading ledges and bay windows in elevation

The Great Eastern Life Condominium was conceptualised as a slender box with a series of wall planes during the design process.

With an ideal location in the new bustling district at the perimeter of the CBD area, the Newton residential development is situated on an elongated site that stretches from the north to the south and sandwiched between Newton Road and Lincoln Road. Besides determining the building frontage, the narrowness of the site facing Newton and Lincoln Road presents a form of guidance or reference point in marking out the site planning and floor plan layout of the units.

Among the series of wall planes that run parallel across the site from the north to the south, there were two parallel walls along the south-

Site plan showing narrowness of site

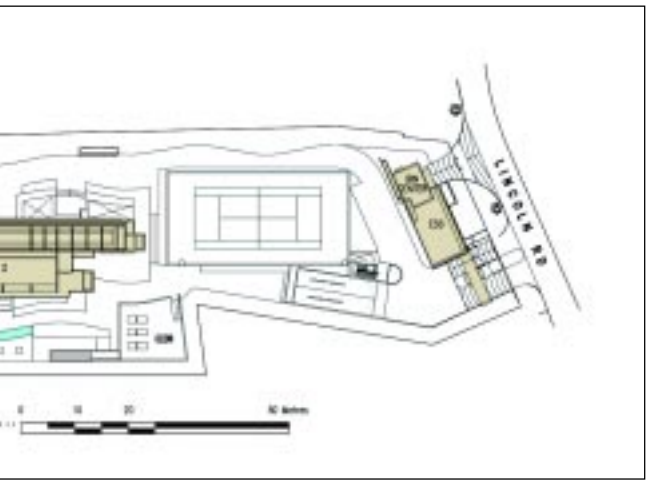
west region of the site that formed the backbone of the tower to support the entire building. Along the northwest region of the site, there were two parallel walls that formed a shorter tower element, as well as the front facade.

The solid attachment walls at the northwest façade was deliberately expressed as a discontinuity by carrying through and engaging the structural columns which was part of the façade from the 21st storey to the roof top. The centre of the building façade was cladded with glass curtain walls to distinguish the function and the location of the living room of the units significantly. The glass cladding in the living room was further expanded and wrapped around and intersected with the structure fin wall in order to create a unique and distinguished dialogue of solidity and transparency.

The essence of the design, however, lies not in the formal play of elements, skilful as it is, but in the delightfully sequenced spaces and the views to be experienced from each unit type.

The environmental deck boasts a lush and green environment, which is interspersed with the water body, water streams and other areas for social activities.

Furthermore, all traffic activities are located



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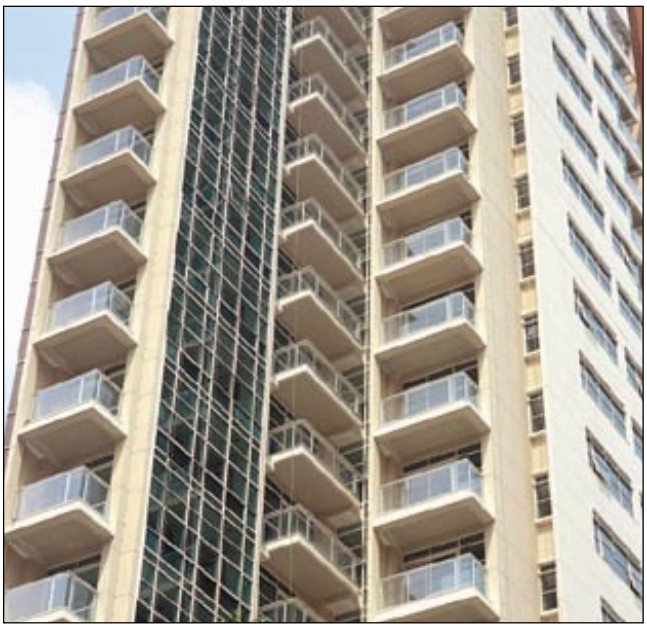
Slender elevation of the tower viewed from Newton Road

Layering effects of the precast components, curtain wall and glass sunscreen

below ground level to restrict noise levels and traffic to that level.

The densely populated area surrounding the site coupled with the hotel next door posed a great challenge to the design team. The precast method was adopted to meet the stringent buildability requirements and construction time, as well as overcome the site constraints.

The designs of floor plates were limited to two typical plates whereby a re-adjustment of the non load-bearing wall could create a combination of 4 unit types. This allowed the flexibility to create sufficient modules and critical mass to construct the building using a precast system without changing the basic structure and modulation.



Creating a display of layering effect

Installation in progress - precast facade, plank and household shelter

The possibilities of designing with a precast system in residential developments are endless. In order to implement a successful precast system, good co-ordination, construction method and site management from the early design stage proved essential.

The planning and coordination include early confirmation of unit types and providing sufficient number of each unit type in relation to the overall unit numbers.

The modular system chosen enabled the efficient coordination of the building elements with the M&E works which were subsequently interphased with interior works. As for the external façade, the vertical and horizontal precast components also had to be coordinated in advance. Architectural features such as the sun shading device, bay windows and ledges which enhance the character of the building were precast to achieve higher construction quality. Precasting also ensured the elements were extruded precisely to the designer's desire.

Enclosing the towers to allow internal dry trades to proceed early

Achieving flatness of the wall through precast wall system

PROJECTTEAM

Client : Great Eastern Life Assurance Pte Ltd
Architect : Architects 61 Pte Ltd
Structural Engineer : Meinhardt (Singapore) Pte Ltd
M&E Engineer: Squire Mech (Pte) Ltd
Project Manager : Davis Langdon & Seah Singapore (PM) Pte Ltd
Main Contractor : Shimizu Corporation
Precaster : Fermold Pte Ltd
Landscape Architect : Sitetectonix Pte Ltd
Interior Design : ID 61 Pte Ltd

An overall view of the 30-storey building

Stainless steel feature wall at the main

THE LINCOLN

by SCDA Architects

Inspired by the great Le Corbusier's two-storey prototype dwelling from the Immeubles-Villas project of 1922, the Lincoln Modern located at Lincoln Road is a 30-storey condominium in the form of 56, split-level, apartments, studios and penthouses.

The 1922 project which was subsequently displayed in the *Esprit Nouveau* Pavilion at the Paris 1925 exhibition[i] showed drawings of the dwelling in its possible contexts, both as a stacked unit and as a detached suburban villa. The interior of Le Corbusier's pavilion developed the idea of spatial overlaps, with the upper floor as a gallery overlooking the main living space.

Several of SCDA's individual house projects have adopted a similar plan and section. As for the Lincoln Modern, these ideas are applied to a high-rise residential project in the same manner that Le Corbusier used a double-height living room with a single-height bedroom zone in the Unité d'Habitation in Marseilles which was completed in 1952.[ii]

Unlike the Unité, where the interlocking apartments run across the building, in the Lincoln Modern, the section is rotated through 90 degrees so that it is evident behind the

entry

MODERN

fixed glass curtain walling and becomes part of the façade expression. A three-storey module is repeated on both the east facing and west facing elevations. This strategy allows for maximum efficiency as it reduces the amount of corridor and lobby area.

Also, while Le Corbusier adopted a language of reinforced board-marked concrete (*béton brut*) for the Marseilles project, SCDA's language emphasises transparency with the use of curtain walling. For climatic control purposes double glazing is used with low-E glass and vertical, aluminium *brise soleil* attached to the floor slabs, which in turn project 1.6 m in front of the glass façade.

Slender block

Due to the site configuration and setback requirements, the design of the 30-storey building resulted in a highly slender 107 m high block which is 12 m at its widest and only 7 m at the narrow end. In keeping with the architectural expression of planes, the structural design of the building features reinforced concrete shear walls in both the long and short direction of the building and the use of flat plate for floors.

Shear walls in the longitudinal axis painted grey, while shear walls in the lateral axis are highlighted in white and orange

Curtain wall

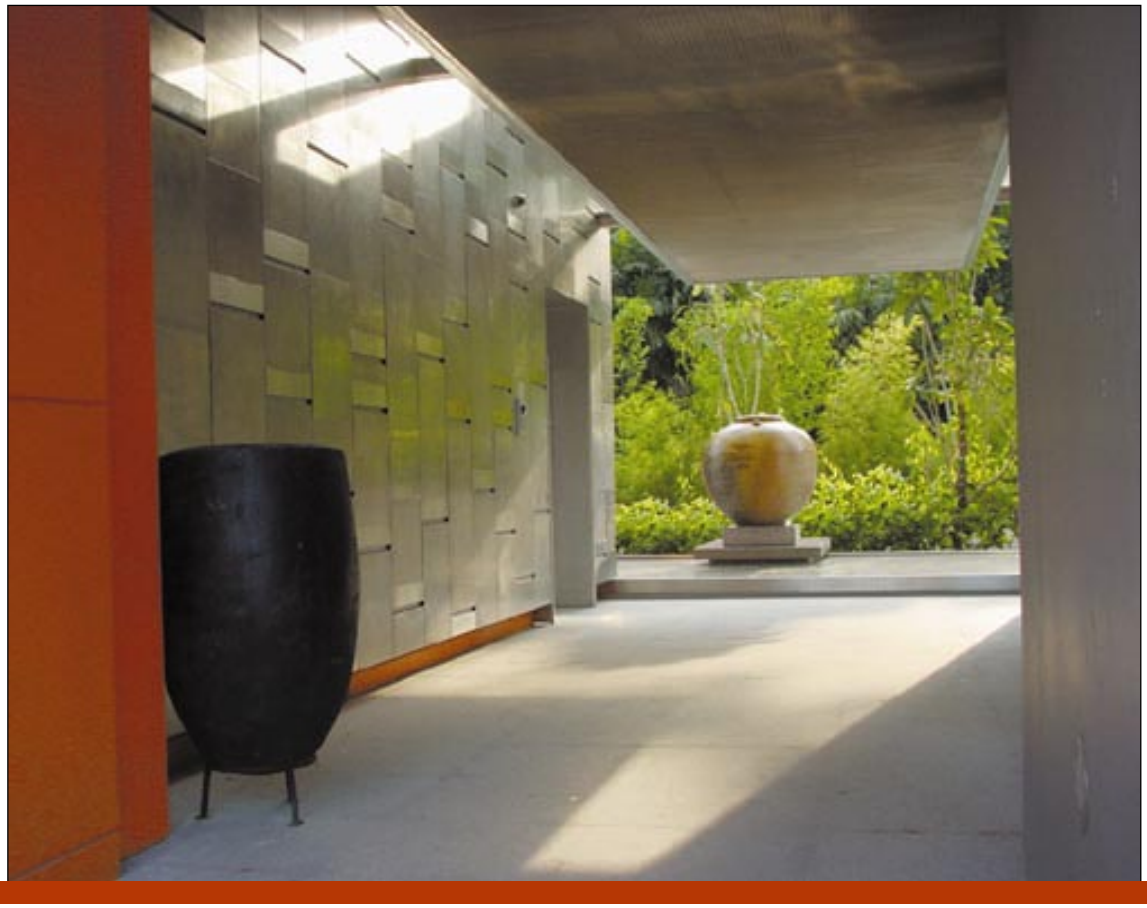
As the building predominantly faced the east and west, a system of vertical and horizontal sun-shading fins and ledges were incorporated into the curtain wall design to reduce the heat load on the building. These fins and ledges were strategically placed to enhance the volumes of the interlocking apartments. Deep ledges demarcate the 3-storey layer that make up the tower block while shallow fins and ledges articulate the interlocking of the units within the 3-storey layer.

The heavy cantilevered horizontal ledges could be fixed to either the curtain wall system or to the floor slab. The latter option was taken as it would not require the increase in mullion size to carry the weight of the sun-shades. The connection to the slab was through the spandrel panel located at the slab line.

For early enclosure, the curtain wall panels were installed concurrently as the main building structure works progressed to allow savings in time so that interior finishing works could begin once the curtain wall was installed.

Detail of sunshading vertical fins and deep horizontal ledges to demarcate each 3 - storey layer

Although the façade design appears to be highly articulated, each section of the curtain-wall and sun-shading device was assembled from a library of standardised components. As a result, a modified curtain wall sys-



The main entry lift lobby with stainless steel feature wall

tem was adopted. Each panel of the curtain wall could be pre-glazed and preassembled off–site. These pre-assembled panels were brought to site and hoisted onto the floors and slotted between top and bottom channels which were fixed to every floor slab. The sun-shading ledges and vertical fins were installed only towards the end of construction to minimise damage.

Steel Staircase

The external steel staircases in addition to serving as the fire escape staircases also double as architectural features of the building. The main staircase is wrapped with an aluminium screen and resembles a lantern when lit at night, drawing one's view of the skyline to the building.

The steel staircase and screen spans the entire 30 storeys and is thus very repetitive in nature. The major components that make up the entire feature are the steel structure, the railing system, the aluminium louvre system and the lighting system.

The steel structure was designed as a 'Vierendeel' truss system that is cantilevered and supported only by the structure wall. With careful planning, the staircase was broken up into modules that could easily be assembled on site. The size of the modules was also determined by the size of the galvanising tanks and the maximum size for transportation by trailer.

Shop drawings and a series of off-site mockups were required to ensure that on-site assembly of the railings, lights and screen progressed smoothly. Special attention was paid to the details of the connection between the modules for a seamless look.

The prefabricated modules were transported to site on trailers and hoisted into place by the tower crane. The frames were bolted to the wall from the bottom up. The installation of the railings and lights followed started once the stair structure reached the 15th storey. To avoid damage from falling debris, the aluminium louvres were also installed only when the structure was completed.

Similar to the curtain wall system, prefabrication minimised the amount of on-site work required for the staircase. It also reduced the need to store material on site and this allowed for external works to progress sooner without interference.

Expression of planes at roof level and wrapping of main staircase in aluminium screen

References

i Arts Council of Great Britain, Le Corbusier: Architect of the Century, Exhibition Catalogue, Hayward Gallery, London, 1987.

ii Lim, Vincent, "Corbusien Precedence: The Lincoln Modern", SPACE 2001/01, Singapore, Feb/Mar 2001. (48-54 pp)

PROJECTTEAM

Client : Tabosca Pte Ltd
Architect : SCDA Architects
Structural Engineer : Web Structures
M & E Engineer : Bescon Consulting Engineers Pte Ltd
Quantity Surveyor : Davis Langdon & Seah Singapore Pte Ltd
Main Contractor : Multiplex Constructions Pte Ltd
Landscape Designer : Tierra Design
Interior Designer : SCDA Architects

Computer-patterned concrete mould used for the façade panels on the National Museum, Canberra
Images courtesy of : Photocall Australia

Canberra's *beautiful* Museum

One of the most innovative buildings in Australia is the Acton Peninsula Alliance project constructed on the Acton Peninsula in Canberra. It consists of two new facilities - The National Museum of Australia and the Australian Institute of Aboriginal and Torres Strait Islander Studies.

This prominent development on the Acton Peninsula is a highly attractive addition to Canberra's landscape and cultural life and a long awaited national cultural institution. It has garnered many prestigious awards for its distinctive architecture and landscape concepts through the use of concrete.

The creative application of precast concrete as a form, structure and display of artwork was momentous both structurally and architecturally. As the buildings are complex, the precast components were challenging for the precast manufacturer to draw and to produce. The project architect, Howard Raggart, commented on the construction technology philosophy as "something to dream about - surfaces, structures and services in one seamless file, emailed for manufacture to arrive in easy to assemble components. Complex surfaces are unfolded, transforming facade construction into a kind of giant dressmaking."

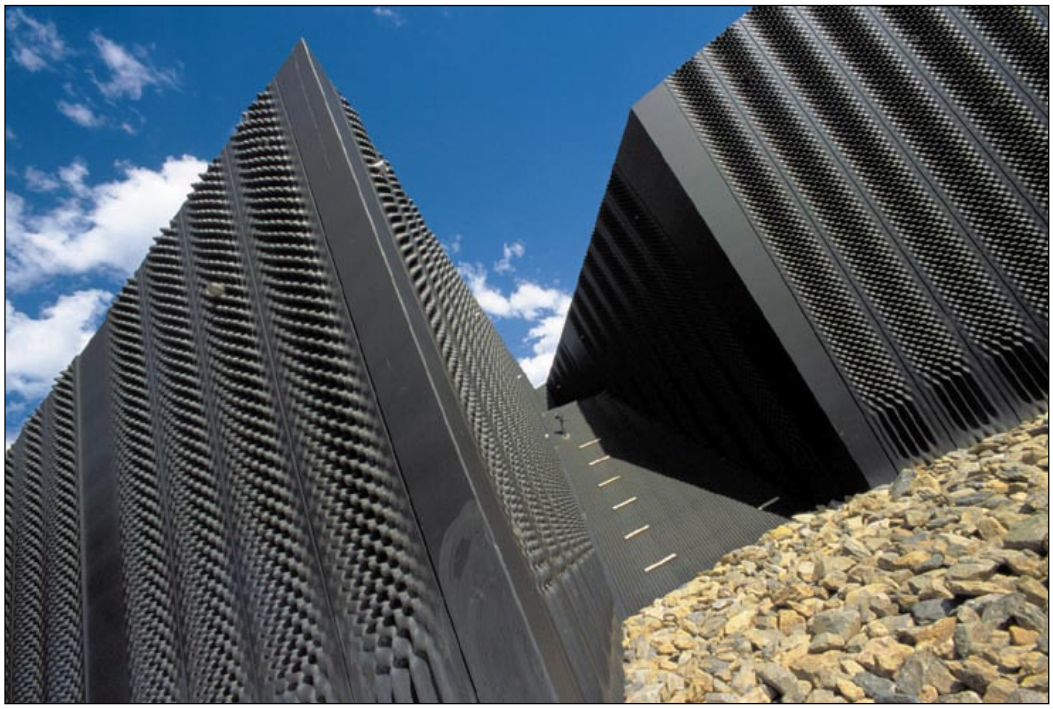
The stunning facade comprises 260 wall panels with a profiled surface designed in three dimensional graphics by the architect. The 1200 mm wide panels were up to 13 m in height and varied in weight from 1 to over 10 tonnes. The geometry was complicated in some instances by the panels leaning outwards as well as tilting sideways. The facade profile was transferred to the moulds for precast production directly from the architect's CAD CAM generated files and shop drawings.

The precast panels were cast face-down in concrete and steel moulds and left off-form for painting on site. Prestressed hollowcore panels were used to clad part of the Gallery of Aboriginal Australia section of the Museum. These panels were left smooth for painting on site.

Deep profiled pattern on the exposed face of precast wall
Images courtesy of : Photocall Australia

The key people involved with the design and con-

The National Museum of Australia on the shores of Lake Burley Griffin in Canberra
Photo : George Serras, NMA

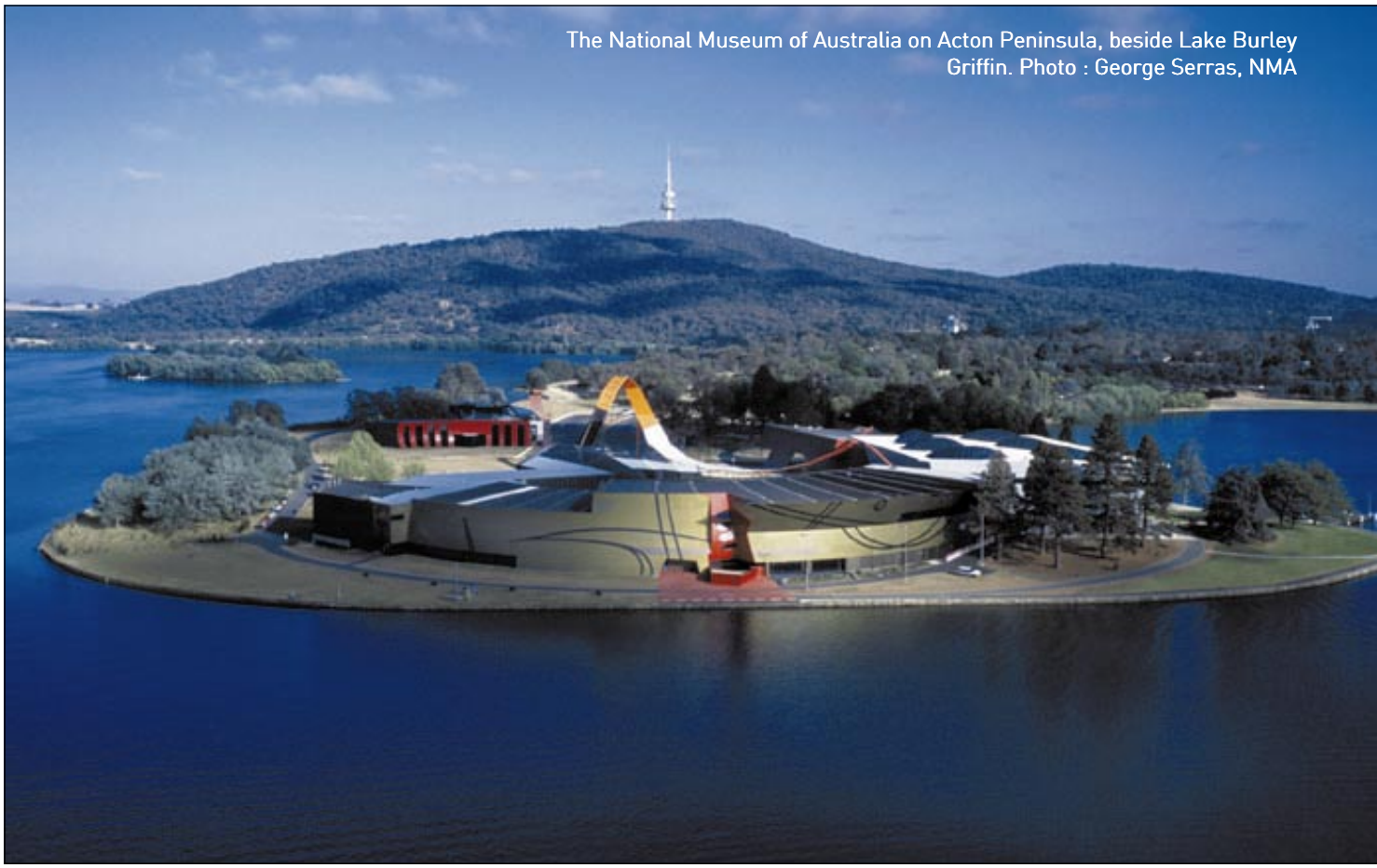


PROJECTTEAM

Client : Department of Communication Information Technology and the Arts
Architect : Ashton Raggatt McDougall – Robert Peck von Hartel Trethowan
Design and Build Team : Action Peninsula Alliance
Precast Manufacturer : Rescrete Industries Pty Ltd
Acknowledgements : National Museum of Australia, National Precast Concrete Association Australia, Bovis Lend Lease Pty Ltd, Photocall Australia

Typical precast facade of the Museum
Images courtesy of : Photocall Australia

struction of this landmark project were delighted with the role that precast had played. The techniques used to draw and manufacture the facade panels on this project open up a whole new area of architectural expression. The computer generated 3-D profiles and computer controlled cutting technology used enable the translation of architectural ideas into reality to a far greater extent than ever.



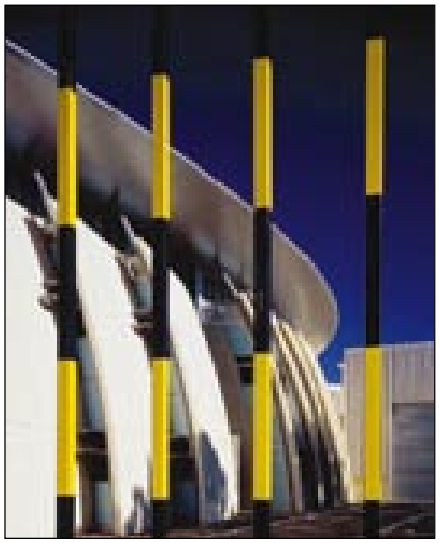
The National Museum of Australia on Acton Peninsula, beside Lake Burley Griffin. Photo : George Serras, NMA

Curved coloured precast facade

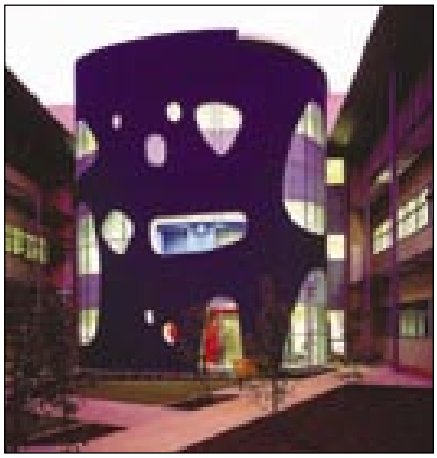
The design for the Science and Health Building, Joondalup Campus at the Edith Cowan University (ECU) by Jones Coulter Young of Perth, was the result of an intensive value management assessment undertaken during the design process.

The results included the selection of external concrete precast panels with a limestone-coloured concrete skin as the external finish requiring no painting or ongoing maintenance. The limestone colour was consistent with other off-form concrete elements such as beams and columns of the existing surrounding campus buildings. All panels were lightly sandblasted to remove sheen off the face giving a slightly matt effect. They were then sealed with an anti-graffiti and waterproofing agent in the precast yard.

The concrete mix incorporated a blend of naturally occurring granite (as quarried) and cream coloured cement. No additional oxides for colouring were used. The mix was plasticised to improve workability, surface finish and curing time demands. Colour consistency was a high priority, especially due to the panels being fabricated over a seven-month period from mid-summer (dry and hot) to late winter (wet and cold).



Curved coloured precast concrete facade



The three-storey, concrete-framed building with precast concrete plank floor system has elements throughout selected for their cost effectiveness and speed of construction. All the curved precast panels (except for two 40 tonne panels) were designed to weigh a maximum of ten-tonnes for ease of transporting to the site. Assembling the modular system was a relatively straightforward exercise, as the building was designed as a kit of

PROJECTTEAM

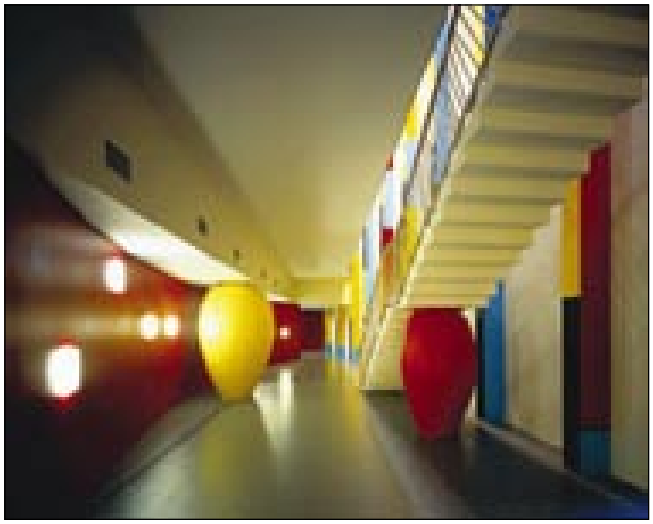
Client: Edith Cowan University, Western Australia
Architect : Jones Coulter Young
Structural Consultant : Ove Arup & Partners
Builder : Cooper & Oxley
Precaster : John Holland Pre-cast
Acknowledgements : Cement and Concrete Association (C&CAA), Elisabetta Guj, Paul Jones, Jones Coulter Yong, John Holland Pre-cast.
This article first appeared in C&CAA Journal, Mix Volume 9 Dec 2001

The Science and Health Building, Edith Cowan University, Western Australia

parts with all precast and self-coloured elements manufactured and sealed off-site.

The north and south facing blocks incorporate concrete sunshades or brise soleil to assist in passive thermal control, while the western wings have a series of amorphous and shell-like precast panels which give oblique and unusual vision into a generally tame and conventional campus context. The richness of the forms are in the fresh assembly of shapes and openings, which are moulded Plasticine-like in an overall engaging composition. It was indeed proof that the use of precast concrete panels has few limitations when it comes to creative expression.

Interior view of the building



Fresh assembly of shapes and openings in precast concrete wall

Total design concept and integrated building system

E-Centre @ Redhill features a predominantly precast structure, walls and other components.

Chao Tse Ann & Partners Pte Ltd provides architectural services from design to contract implementation and construction supervision. The projects undertaken by the company includes hotels, residential and commercial developments, as well as industrial and institutional/religious buildings.

Prestigious five-star hotel projects include Shangri-la, Mandarin and Sedona Hotels. It has also been involved in overseas projects in Malaysia, Indonesia, Thailand, Myanmar, Vietnam, Hong Kong, China and Turkey. The firm has also designed several projects using precast systems for condominiums and hi-tech industrial buildings.

It has adopted the precast system not just to replace the cast-in-situ method, but as a total concept in design and an integrated building system. It gives equal priorities to aesthetics and buildability. From the inception of planning and design, the team always coordinates with other consultants such as civil and structural or mechanical and electrical engineers, main contractor and specialist precasters.

Architectural layouts are fine-tuned to suit functional aspects and various precast components. Odd corners due to columns and beams will be eliminated as far as possible to create a neat and clean-cut design as well as a user-friendly space. All precast components are carefully examined in consideration of all factors including logistics, on-site and off-site precast yard and transportation.

Park Green at Sengkang is one of the projects which has adopted the total design concept and integrated building system. It was one of the two projects Mr Mah Bow Tan, the Minister for National Development visited to review the progress of the government's efforts to promote better buildability and precast in the building industry.

Park Green at Sengkang (above and below) features dual objectives - a contemporary clean-cut design as well as high buildability (below)

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Innovative precast solutions

Precast Technology Pte Ltd, formed in June 1999, believes in taking more than a traditional precaster's approach to succeed in an increasingly competitive market, which explains the company's strategy to introduce new innovative products and technologies at competitive prices.

Its innovation includes pre-finished architectural concrete. It has the production techniques and quality control measures to ensure a high level of consistency in its products. It can offer a wide range of surface finishes which include polished, honed, acid etched, sand blasted and textured surfaces in a variety of colours. Its gray concrete products include custom made structural and non-structural components commonly used in Singapore's construction industry.

Precast Technology's production plant, certified to ISO 9000, occupies seventeen hectares of land at Tanjong Pinang, Indonesia. Six hectares have been developed with the necessary facilities and administrative support such as casting bed, storage space and worker's dormitory. As it is located along the coastal line, it is easy to ship precast components to Singapore.

As Tanjong Pinang itself has a reliable source of different aggregates, clean water and inexpensive workers, Precast Technology can be highly cost competitive in Singapore.

With its main office located in Singapore and having highly competent technical and marketing teams in association with external advisers, Precast Technology provides high standard of services.

Its projects include Wintech Centre at Ubi Road 1, E-Centre at Bukit Merah, basement car-park extension for UWC and Casablanca Condominium (under construction).

E-Centre, a recently completed building, was constructed using precast structural components, as well as pre-finished polished precast façades.

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MEINHARDT ... the forerunner in Precast Technology

42-Storey Millenia Tower, 37-Storey Centennial Tower & 32-Storey Conrad International, Singapore

STMicroelectronics Wafer Fab, Singapore

Sengkang HDB (1550 unit apartments), Singapore

17-Storey Casablanca Condominium, Singapore

Leading international consulting company Meinhardt, principally provides multi-disciplinary integrated engineering services delivered seamlessly under one roof in the areas of civil, structural, façade, mechanical, electrical, hydraulics, transportation, marine, infrastructure and related engineering disciplines. Specialist in-house units in precast technology, geotechnical and façade engineering support its core engineering services. The result is an integrated approach empowered to improve the building process. The Group also provides principal consultancy, project management and planning services related to engineering.

Precast Technology, a specialist division within Meinhardt (Singapore) Pte Ltd is set up to meet the demand of the construction industry today. Meinhardt is a fore-runner in the field of precast technology and is one of the few companies in the region which has extensive track record and expertise in precast design. Its in-house engineers are trained in all aspects of precast design.

Meinhardt has designed some BCA award winning projects using precast technology, such as the Centennial Tower, Millenia Tower, Conrad International, Gurkha Camp and STMicroelectronics Wafer Fab, to name but a few. The successful use of a precast structural system in Centennial Tower has achieved a record four day floor cycle time in high-rise construction.

30-storey GE Life Condominium

67-storey Gilarmi Tower, Manila

The full range of precast engineering services provided by Meinhardt include precast system feasibility study, evaluation of components and cranage, design of steel moulds and hoisting system, detailed design and integration of the whole precast system, architecture façade design, detailing of joint and connection details, and production of shop-drawings.

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